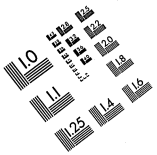

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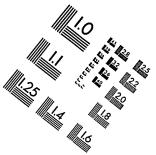

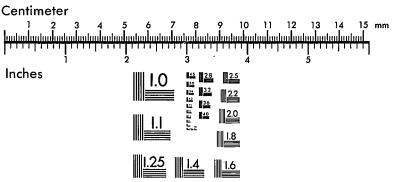

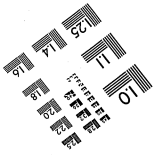

Thomas A. Edison Papers

A SELECTIVE MICROFILM EDITION

PART I
(1850–1878)

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Menlo Park Scrapbook, Cat. 1015

No. 11E. "Electric Light"

This is the fifth of nine scrapbooks containing clippings about electric lighting. All are for 1880. There are 142 numbered pages.

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Electric Light 1015
Scientific
Mem Dapper account
No 11 ft

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surprise, and we are glad to remember that it was not an Englishman, nor even a Scotchman, who showed such supreme incapacity for seeing the absurdity of his language. He to Englishmen, however, we are now briefly addressing ourselves, and they cannot claim any immunity from sharp criticism so long as they despise the ordinary aids to lucid and dignified explanation which the long-suffering student has a right to demand of them.

Electrician June 19 1880

CORRESPONDENCE.

CARBONS AND DIFFUSION APPARATUS FOR THE ELECTRIC LIGHT.

(CONTINUED.)

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Very few words will be sufficient to describe the improvements which have been made since 1846, when the first patent for the manufacture of carbon rods for electric lighting was taken out by Messrs. Greener and Staite, as raw material carbon of gas retorts, foundry coke, lampblack, and charcoal have been used, and as agglomerating mediums, sugar, gummes, molasses, starch, glues, &c., in fact, any kind of agglutinating materials have been all patented over and over again, but with no improvement in the ultimate product. Within the last eighteen months or two powerful potents were taken out by different persons, but there is absolutely nothing new in them except the names of the patentees, who (or some of them, at all events) appear to have rushed into the manufacture of carbon rods as soon as they heard that possibly the electric light was coming on, trusting that some day the public might be dazzled into subscribing capital towards the formation of a company of some sort to work their so-called patents. Some patentees have introduced wires of copper or of iron into the interior of the carbon rods, with what result it is needless to inquire, as a knowledge of the first rudiments of chemistry on the one hand, and of the laws of expansion on the other, easily disposes of the value of the introduction. Some others, like Mr. E. Hedges, advocate the introduction of certain oxydes likely to impart to the light a certain colour to hide the natural colour of the electric arc until the public get accustomed to its brilliant whiteness, or, in other words, Mr. Hedges, and those who follow the same principle, propose simply to obliterate the electric light: but of real, genuine improvements, beyond those introduced by Mr. Gaudais, and attempted by Mr. Jaquelin, there have been none. It may be the quantity of these carbon rods actually required, and probably to be required for some years to come, is too small to warrant any large outlay of money with a view to amply secure the manufacture of the best article for the future. Probably in time to come, however, the best carbons will be manufactured on a process based on that of Mr. Jaquelin. As I said in my last, Mr. Jaquelin based his manufacture of carbon on a sound theory. Not being able to obtain carbon in a fused or dissolved state, he took the only course open to him to arrive at a perfect conglomeration of the molecules of carbon just at the time this material is disengaged from some of the gaseous compounds it forms with hydrogen. The plan followed by Mr. Jaquelin unfortunately necessitates the mechanical cutting of the rods from the block of carbon he produces, and this entails no small expense, and constitutes no little drawback. A modification of his process or plan is, however, possible, and by a very simple arrangement the carbon rods, after having been moulded, dried, and baked once, can be completed by following part of Mr. Jaquelin's valuable discovery. Moreover, Mr. Jaquelin manufactured the hydrocarbides he required direct from the coal, and having eliminated from them the carbon they can part with, used them no more; I use them again, and make them take up again as much carbon as they left behind in the rod they had to pass through; by such means a carbon rod of perfect compactness and homogeneity is obtained at less cost and labour than by the ordinary processes.

DIFFUSION.—The peculiarity of the electric light is that it is entirely composed of sharp, well-defined rays, and hence the necessity of diffusing that fast spending light, or, to better perhaps, express my meaning, of fusing together all the rays into a compact luminous focus, something similar to what is naturally produced in the flame of gas, or petroleum oil. It seems to me that all the different contrivances hitherto termed "diffusers" (permit me to use the term) are wrongly named;

MR. EDISON'S LIGHT.

What Two Scientific Men Who Have Seen Only Electric Lights Say.

Although many of the visitors to Menlo Park are unacquainted with what has been heretofore accomplished in electric lighting, by far the greatest number are well informed on the subject, and it is interesting to hear them compare Mr. Edison's lights with the Gramme, Siemens and Wallace lights. Said one last evening: "In the Avenue de l'Opera, in Paris, recently, I saw ten electric lights on one circuit. They were on the voltaic arc principle, and the fact that ten lights could be generated by one dynamo machine was considered a marvel. The Jablochkoff candle was then in vogue, and I saw that it was falsified. Parts of the apparatus were brilliantly lighted, while other parts were not in even shade. It was easily seen that for the present, together with the cost of the lamps, this system was impracticable."

Much amusement was created in Menlo Park by an article recently published in a morning paper stating that Mr. Edison's 1,000 candle lights were a failure because none of them was of greater intensity than an ordinary gas jet. Mr. Edison explained, however, that it is easy enough to multiply small units into large ones. The object is to reduce and subdivide the light for practical purposes.

It has been objected by critics that the difference of potential between the wires leading to and returning between points remote would render it in an economy where the wires terminate, and that the loss would be great. Mr. Edison explained, however, the fact that the arc without has a constant pressure of fourteen pounds to the square inch, the Gramme lights have two pounds pressure, the Siemens lights twenty pounds. The difference in pressure between the two points can be varied to any extent necessary. Mr. Edison has succeeded in sinking an insulated wire in the earth without loss of current.

The experiments with a polished platinum bar the Electric Light stock had dropped to $1,500 a share, and the Edison Electric Light stock sold yesterday for as much as $3,000 a share, and the sales were large. The sales of the Edison stock at auction yesterday were at the rate of 3,000 shares per day.

LONDON, Jan. 5.—The Paris correspondent of the Standard telegraphs: "The power of Edison's discovery in electric lighting has produced great excitement in scientific circles here. An eminent French authority on electric science, writes to the Temps, saying that Edison's lamp is not new, and asserts that until the contrary is proved he considers the Edison discovery a myth."

1495. "Electric lamps." A. V. Newton. (A communication from F. Tommasi.) Dated October 30, '80. (In communicating a pedestal lamp a carbon block, used, carried by central rod for a series of carbon electrodes to burn together. These carbon electrodes, about in mercury trough, which, being brought upwards a common centre.)

fait connaître la forme primitive[1] et qui s'est présentée au public parisien il y a un mois, au moment des expériences d'éclairage électrique du foyer de l'Opéra, sous une forme nouvelle qui constitue, à notre point de vue, un réel progrès.

La lampe Werdermann, par son principe, participe à la fois de l'éclairage par incandescence et de l'éclairage par l'arc voltaïque; elle constitue donc un système intermédiaire qui doit remplir des conditions spéciales. Dans le modèle représenté ci-dessous (fig. 1) l'inventeur s'est attaché à régler la pression du contact latéral sur la tige de charbon

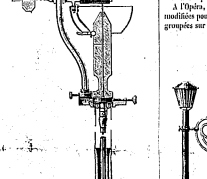


Fig. 1. — Nouvelle lampe électrique de M. Werdermann.

d'après la pression que cette tige exerce sur le disque supérieur.

Pour cela le disque de charbon supérieur est placé sur un fléau dont on règle l'équilibre par un poids à vis.

Ce fléau porte un petit levier, placé à l'intérieur du globe, et qui vient exercer sur le contact latéral mobile du charbon une pression d'autant plus grande que la pression de ce charbon fixe[2] est elle-même plus grande; cette pression s'oppose au mouvement ascensionnel de la tige de charbon.

Il y a donc là une sorte de frein dont l'équilibre dépend du réglage primitif à l'aide de contrepoids. A mesure que le charbon s'use, la pression sur le disque diminue, le contact latéral se desserre un peu et permet le mouvement ascendant de la tige de charbon. Cette disposition qui permet de *très légers* contacts entre le disque et la tige, fait qu'il n'y a jamais rupture de la pointe, mais usure régulière, et par suite une grande fixité de la lumière, ce que tout le monde a pu constater à l'Opéra.

Comme plusieurs lampes sont montées en tension sur le même circuit, il faut que, si l'une d'elle s'éteint, elle soit aussitôt mise en dehors du circuit pour ne pas éteindre les autres.

Ce résultat est obtenu par le levier coudé qui sert à presser sur le contact latéral. Quand la tige ne vient plus appuyer contre le disque, ce disque descend et le levier vient buter contre un arrêt métallique qui établit une communication directe et met la lampe hors du circuit.

A l'Opéra, les 42 lampes Werdermann ont pu modifiées pour le cas spécial par M. Napoli étaient groupées sur quatre lustres. Elles étaient alimentées

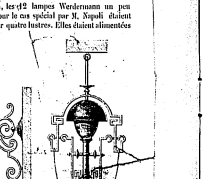


Fig. 2 et 3. — Appliqué et suspension de M. Werdermann pour l'éclairage électrique.

par 2 machines Gramme, chacune de ces machines ayant dans son circuit six lampes montées en tension. A défaut de mesures photométriques, il nous est absolument impossible de nous prononcer sur la valeur économique du système Werdermann, regrettant malheureusement trop fréquent à une époque où toute invention se ramène à une question de francs et de centimes. M. Werdermann se propose d'appliquer ses appareils à l'éclairage domestique. Nous représentons, figure 3, une suspension et figure 2 une appliqué qui montrent que ces appareils se prêtent à un effet décoratif, bien que ces modèles laissent un peu à désirer au point de vue artistique.

Le Propriétaire-Gérant : G. TISSANDIER.

16 886. — Typographie A. Lahure, rue de Fleurus, 9, à Paris.

[1] Voy. n° 297 du 30 novembre 1878, p. 417.

A NEW ELECTRIC LAMP.—An electric lamp for use in workshops, railway stations, mines, collieries, and the like, the invention of Mr. C. W. Harrison, of Queen Victoria Street, London, is being brought out by the Sun Electric Light Company, at their experimental works, No. 80, Grey's-inn-road, London. In this lamp carbon rods 3/8 in. in diameter, and placed vertically, are used, the positive being the top carbon and the negative the bottom one. The adjustment is stated to be automatic and not to consist of weights, springs, or any similar clockwork arrangement whatever. What this adjustment does consist of, however, is known only to the inventor at present, particulars being withheld from the public in consequence of the foreign patents not having been quite completed. The light is a good, strong, and steady one, and on the light being extinguished through any accident, contact is instantly renewed. The light is about to be employed at collieries near Manchester and in South Yorkshire. The inventor claims to have solved the questions of divisibility of the current and modification of the light, and he proposes, after the foreign patents shall have been secured, to exhibit a number of lamps suitable for public and private purposes. Drawings were shown illustrating the principles of the proposed method of street illumination. This consists in the point of light being placed in the base of the lamp standard and directed up the interior of the lamp post, on the top of which is placed a circular reflector, by means of which the light will be reflected around. There were other modifications shown which will be best described when the principles of the invention are made known. The company are manufacturing their own carbons, which are understood to be made by a special process to insure uniformity in composition and as to conduce to steadiness of the light.

OBSTACLES TO THE SUCCESS OF EDISON'S SYSTEM.

CLEVELAND, OHIO, Feb. 3.—A well-known electrician of this city, who recently returned from a visit to Edison's laboratory at Menlo Park, has been indulging in some severe criticisms on the inventor and his work with regard to electric lighting. As these comments are in great measure based on statements of alleged facts, they are falsely and fatally inspired into. As a result of his inquiries, which were very thorough, he asserts that Edison has simply converted a lot of scientific humbug with the design of dazzling the public, which has forgotten the experiments of Sir Humphrey Davy and other that attracted so much attention thirty years ago. Taking up seriatim the claims of the inventor, or put forward in his behalf, said he, there comes first the assertion that the carbon horseshoe would last indefinitely without there being any indication of its differing from the horseshoe carbon employed before. It was well known before incandescent carbon, even in superficial vacuum, if heated sufficiently to be of any value as a light-producing agent, could last but a short time, owing to a peculiar disintegration of the material, the cause of which has never been satisfactorily determined. It seems that Edison, in order to make his carbon last somewhat less a reasonable length of time, heated them to a comparatively low temperature only, thus sacrificing most of their light-producing power in order to add to their durability, which was thereby still limited. In this one point of want of durability, which has wrecked all previous experimenters during the past 24 years, he appears to have made no advance whatever. It has been assumed by Edison and the public that this lamp would give a decrease in the way of durability the problem of economical electric lighting by the incandescent plan would be solved. This is far from being the case. Success would be as hopelessly far off as ever. A question of economy would at once arise, and here the real difficulty will begin. Edison has carefully ignored or avoided this point, undoubtedly understanding fully where its discussion would land him. He called his lights 10 candle-power each. Even if they were of this size, no one would think of accepting one in place of a 16-candle gas-burner. But the fact is, they were by no means of 10 candle-power each, as any experienced observer could see at a glance, and as photometric measurements appear to have been made in the laboratory. Moreover, the light differs greatly at different aspects. For instance, when the edge of the horseshoe is presented, the light evolved is vastly less than when the side is viewed. Even granting 10 candles for the side of the horseshoe, the light from the edge is noticeably very much less. Mr. Edison claimed to produce four or five lights with a consumption of one horse-power in driving his generators, but promised to so improve his apparatus as to get 8 or 10 lights per horse-power. Even assuming those latter figures to have been attained, the hopelessness of the affair in an economic sense is apparent to any thinking person. But, in point of fact, he has failed if he can get more than two, or possibly three, of these small lights per horse-power under the best management.

It was perfectly apparent to this gentleman that, from the size of the belts carrying the power, from the rapidity of the revolution of the machines, and from the heating of the armatures and field magnets, each machine was absorbing from five to seven horse-power; and as he has never had to exceed 50 lights burning at one time it is evident that he is not now getting with his present apparatus more than three or, at the outside, four lights per horse-power.

The absurdity of the claims made for the so-called Edison governor, with which the electric current for Edison's lights has been produced, has been discussed and made sufficiently apparent by many scientific writers during the past few months. A critical investigation of this governor reveals the fact that it is a rather poor form of the well-known Siemens machine without any novel or additional feature.

Much has been said in connection with Edison's lamp about the great convenience of the well-known Sprengel air-pump (which he uses to exhaust the air from his lamp bulbs), by reason of which the time required to effect the exhaustion was reduced from 40 odd hours to 25 minutes, and through which the extraordinarily perfect vacuum of a millionth atmosphere was attained. In *Beerbauer's Philosophy*—1873, page 198—Dr. Sprengel, the inventor of the Sprengel pump, says:—"From 20 to 25 minutes are required to exhaust a receiver of the capacity of half a litre." This is a much larger receiver than the Edison lamp bulb. Again: "By this instrument air has been reduced to one thirteen hundred thousandth atmospheric density, and this average exhaustion attainable by its use is about one millionth." It is easy to see where Edison borrowed his air-pump thunder.

The author of the article goes on to discuss in great detail the cost of lighting New York on Edison's system, and concludes that the cost of each light would, by this estimate, be 21 dollars a year. It would not be equal to the light furnished by a four-foot burner. At 1 dollar per 1,000 for gas, the average annual cost of a single burner to the consumer is 2 dollars or 2 dollars 50 cents at 2 dollars per 1,000. If gas were sold at 10 per cent. profit, it could be delivered in the laboratory for 40 cents per 1,000. The actual cost to the gas companies is less than 30 cents. Granting all his claims, Edison's electric light would entail an expense equal to that of a gaslight of greater brilliancy at 2 dollars 50 cents per 1,000, while the gas companies would make more money than the Electric Light Company, and sell it for 40 cents per 1,000.

Another point that does not seem to have been made clear by Mr. Edison, or at least about which he has said little, is the necessity for some automatic means of regulating the current delivered by his generators, so that sudden and great changes in the number of lamps being used at any time shall not affect the uniform working of his system. For instance, in lighting a large hotel, it would be necessary to have a sufficient amount of the current provided to maintain, say 1 thousand lamps at one time, at 7 o'clock in the evening. Two or three hours later, perhaps, only half this number of lamps would be burning, and after midnight possibly not one-tenth. It will be at once evident that for the proper operation of the Edison system in such places, an automatic regulator of the quantity of current must be provided which will follow accurately, and with the utmost certainty, these changes in the number of lamps burning, so that when all are burning each one will give full light, and when one-tenth only are burning each one will give only its normal light. So far as the public knows, no arrangement whatever has been provided to meet this imperative necessity in such a system. In the recent article in *Scribner's Monthly*, written by one of Mr. Edison's employés, and accompanied by lithographic sketches, this vital point is not even mentioned. To those conversant with the subject, it does not seem possible to provide practically for this difficulty. At present, at Mr. Edison's, a young man is stationed in the vicinity of the apparatus with his eye on the Thomson galvanometer, prepared to throw into the circuit more or less artificial resistance to provide for any changes of current caused by the increase or diminution in the number of lamps burning.—*New York Times*, Feb. 7.

CHRONIQUE

La lumière électrique et les végétaux. — L'institution de la *Royal Society d'Angleterre* vient d'ins appelle sur une découverte assez singulière, qui sera sans doute utilisée pour l'horticulture. Il s'agit de l'influence de la lumière électrique sur les végétaux. A la suite d'expériences faites pendant plusieurs mois par le docteur Siemens aux environs de Londres, il a été reconnu que les plantes et les fleurs exposées pendant la nuit à la lumière électrique poussaient et prospéraient beaucoup mieux que celles qu'on laisse simplement exposées à la lumière du jour et qui restent la nuit dans l'obscurité. Pour montrer combien l'influence de la lumière électrique se fait sentir rapidement sur les fleurs, le docteur Siemens a placé sur une table, dans la salle de conférences de la *Royal Society*, un pot de tulipes en bouton; ces tulipes

ont été soumises aux rayons d'une lampe électrique. Au bout de quarante minutes, elles étaient complétement épanouies.

ANDRÉ'S ELECTRIC LIGHT FOR MANSIONS.

While the attention of the public is directed to the numerous laboratory of Menlo Park for the advent of the coming electric light which is to astonish the world, and eclipse alike the spirits of gas-shareholders and the dividends which yields them their fat dividends, and while it is directed there, then far at least in vain, a great deal of quiet, successful work is being done and progress made in practical electric lighting, both in England and the Continent. Although we are not in a fortunate circumstance for our inventors that they are not subjected in this country to the blustery of the Press, and do not, like Mr. Edison, lose the sweet inspiration of secret working which flatters success and revolution alone can give. They are not also forced to count their chickens before they are hatched, and trumpet forth what they mean to do before they can be sure of doing it. The true development of an invention is seclusion, secrecy, and alone can still be followed out. If it is successful, a rush reward is earned; while if it fails, the worker does not incur any opprobrium for announcing results which could not be achieved.

The electric lamp of Professor André has not been often brought before the notice of the public. It is a lamp on which the inventor has spent a vast deal of labour and ingenuity, and one which promises to take a high place in the electric lighting of the immediate future. It is a small lamp designed for lighting private dwellings, shops, and factories, and is in this respect unlike the ordinary lamps of Siemens, Rapieff, and Jablochkoff, now in vogue, for it can also be made to give a very intense light. We recently described his first form of the lamp in *The Electrician*, page 174, Vol. III., but its efficiency has been much improved of late by several minor improvements. It may be remembered that it is based on the incandescent principle, and consists of several pencils of carbon enclosed in an air-tight glass cylinder, which forms the globe of the lamp. The pencils are placed vertically, and their points rest on a copper electrode in the bottom of the lamp. When the current is let on there is electrified points glow with great brilliance. The light lasts for many hours, because the carbons are very slowly consumed one after another in the carbonic acid gas which the air within the vessel is converted into after a short burning. Generally speaking, M. André's lamp comes between the incandescent electric lamps of Lodigrin and Swyne-Mann, which consist of a solid rod of carbon wholly heated by the passage of a current in a glass vessel filled with nitrogen, and the incandescent lamps of Regnier and Werdermann, which consist of incandescent carbon points burning free in air. The multiple points, the solid copper electrode for all the carbons to burn from, the electro-magnetic regulator, in short, the whole arrangements of the lamp are peculiar to M. André, and it must be confessed that the idea of placing the incandescent points in an atmosphere of carbonic acid, which is mostly formed by the action of the lamp itself, and, at the same time, is so essential to protect the fine carbons from unnecessary waste, is a happy and important one, though not altogether new.

The proof of an invention lies, however, in its practice, and M. André's lamp has now earned a fair title to public consideration. An exhibition of his system of electric lighting for mansions and dwelling houses came off at Stafford House on the evening of January 26, in the presence of the Prince of Wales, the Duke and Duchess of Sutherland, Sir Frederick Leighton, and several other gentlemen. The first experiment was made with six lamps of 75 candle-power each, in circuit with 1,000 yards of cable, and fed by one small Gramme machine; the second was made with 14 lamps of 70 candle-power each, in the same circuit; the third, of 70 lamps of 50 candles each, in a circuit of 2,500 yards, fed by the same machine; and lastly 30 lamps of 25 candles each, in the same circuit of 2,500 yards, and fed by the same machine. The power absorbed was from 1-3 to 1-6 horse-power per lamp.

The lantern ceiling of the grand staircase was lighted up brilliantly, clearly showing from below with very fine effect the splendid decorations overhead at a height of from 60 to 80 feet.

The dining rooms, drawing rooms, and boudoir were also lighted up with lamps, harmonising in general with white, pink, and yellow tissue paper, which produced a most agreeable, soft, and steady light, and when it was required to illuminate the pictures on the walls these tissues were removed so as to throw the unclouded effulgence of the lamps upon them. His Royal Highness the Prince of Wales was, we believe, greatly pleased with the light, and told Professor André that it was the best display of electric lighting he had yet seen. The apartments used at Stafford House has now been removed to the country mansion of Mr. Edward Easton, C.E., who is associated with M. André in the extensive development of the lamp, and will there be permanently installed as the model, to be shown the public, of André's system of domestic electric lighting. It is, we think, to be regretted that M. André should have chosen so inconvenient a place to exhibit his system, but probably he will also arrange to show it in operation in the metropolis itself."

The new lamp is not, of course, to be confined to dwellinghouses, or fiery mines, but is also especially adapted to mills, manufactories, and other large works. The North Shore Corporation, near Liverpool, have also been lighted by them, and the Mills, near Liverpool, have also been lighted by them, and the Liverpool Corporation, who have purchased an Act of Parliament to light the borough of Liverpool by means of electricity, mean to light the borough of Liverpool by means of electricity, are at present considering its advantages for the purpose of lighting streets.

[The above article was crowded out of our last issue, and since then we have seen an improvement which, to our mind, renders this lamp the best that has, as yet, been invented. This improvement has been made and carried out by the Hon R. Brougham, and will be described and illustrated next week.—Ed. E.]

SWAN'S ELECTRIC LAMP.

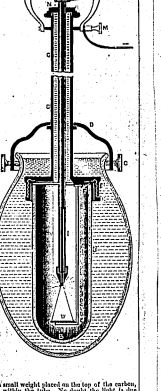
Swan's Electric Lamp.—Soon, the archipelago of Edison's carbonated lamp, has had his researches interrupted for a time by a disastrous fire. His engine and magneto-electric machines escaped, though most of his lamps and other appliances suffered. He is now aiming at the production of a permanent lamp on the incandescent principle.

THE ANDRÉ-BROUGHAM ELECTRIC LAMP.

The accompanying engraving is a perspective view, partly in section, of the lamp as it will be exhibited at Wells some other electric-light lamps have been. Investing lamps on paper Prof. André has been quietly pursuing his way, and now, with the assistance of the Hon. R. F. D. Brougham, he has evolved a lamp which by common consent is considered the best that has yet been. We take the following description from the *Engineer*:—

The value of the improvements which we have to note when we state that it reduces the carbon consumption to about 1000th per hour, whilst a similar carbon burns in the lamp then in the electric lamps burns about 6in. per hour, the cost in carbons being reduced from 1-20th of what it would be in an ordinary lamp. This is, probably, a maximum reduction, but the carbons in ordinary incandescent lamps use of a large glass vessel, fitted with the André-Brougham lamp being only 5cm. diameter.

The improvement consists in surrounding the lamp, or a portion of it, with a separate vessel of glass containing water or some other suitable liquid. In the accompanying diagram B B D is the glass globe of the lamp, and A A the vessel containing round containing the liquid. The shape or these vessels is immaterial. It may, perhaps, conduce to simplicity if the lamp is first described. Two concentric tubes (G G, I I) arrangented by a non-conductor, such as plaster of Paris. These tubes are connected to the two terminals of the circuit by the wires N and M. The tube G G forms a kind of electrical contact with the platinum stopped piece of metal W. The lower tube, I, contains the carbon rod, which rests upon the metallic wedge and falls down by its own weight, and that



of a small weight placed on the top of the carbon, but within the tube. No doubt the light is due partially to incandescence of the carbon, and partially to the formation of an arc. The cap, on the top of the tube O O, through which the carbon passes, is made of some non-conducting material. Through the top of the lamp globe B B B is a metal cylinder to be screwed into the corresponding cylindrical P P. The ring E E has a sharp edge at its top, whilst F F F has a corresponding recess. Between the two is an india-rubber washer F F, so that on screwing E E the chamber is pressed into the recess in F F F,

and a good watertight joint made. The lamp is filled with a cap, D D, to which, by means of binding screws G G and clamps, the vessel A A is fixed. This vessel is partially filled with water or other liquid, and the cap D D screwed down. The liquid rises above the top of the lamp globe, and the possession of air into the lamp an impossibility. So long as the lamp B B is heated to nearly 212 atmospheric air can enter the lamp globe B, a tight joint is obtained, and at the same time the heat from the lamp is carried off or dispersed, and the light more or less diffused.

THE WERDERMANN ELECTRIC LIGHT.

At the time when new systems of electric lighting were being introduced to the public in some what more rapid succession than they are at present, and which was about eighteen months since, we described, amongst others, the Werdermann light.* As we stated at the time, this light, although then not quite perfected as regards details, was one of considerable promise, and the period intervening between our previous notice and the present one has been advantageously occupied in working out its details to a very successful issue. Several modifications and improvements have been introduced in the system, which have rendered it in many respects a much more practical means of illumination than it previously was. Having recently been afforded the opportunity of inspecting the Werdermann Light in its improved condition, we propose placing particulars before our readers. We may premise that the demonstration was carried out at the London and wharf of Messrs. Rownson, Drew and Co., Upper Ground Street, Blackfriars Bridge, where one of these lights have been in successful use for somelittle time past. The demonstration took place in the presence of a number of scientific gentlemen and others interested in the question. It was conducted by Mr. Henry F. Joel, C.E., on behalf of the Signal Engineering Company, of 171, Queen Victoria Street, London, and was in every way a success.

In order to render clear to our readers the improvements that have been made in the system it will be best for us to describe it briefly as it existed at the date of our previous notice. It will doubtless be remembered that as originally constructed, the lamp consisted of a carbon pencil placed vertically point upwards and impinging upon the underside of a disc of carbon placed horizontally, and forming the negative electrode of the lamp. The disc was about 2 inches in diameter and 1 inch in thickness, the carbon pencil being rather more than one-eighth of an inch in diameter and of any convenient length, about 18 inches being the normal length adopted. The pencil was fed vertically under the disc in a guide, its lower end being fitted in a small holder in which a piece of fine cords were attached. These cords were led up over pulleys and down again to a counterbalance weight, and as the carbon rod was free to move in its guide in point was always held up against the underside of the disc with a gentle pressure. By this means the consumption of the carbon rod was uniformly and easily followed up. The same general principles and arrangements are preserved in the improved form of Werdermann light, its details only having been modified. The carbon pencil, instead of being a still divided, and is conducted to the lamps through a main cable, but without the branches leading to each lamp which were formerly adopted. There is, too, still the power of extinguishing any one or more lamps of the series without affecting the rest. The first point of departure is the substitution of a disc of copper for that of carbon, which was formerly used, and which answers its intended purpose equally as well as the carbon electrode. It is of the same diameter as was the carbon disc; but, unlike its predecessor, it is not consumed, while it produces an equally effective light. The carbon pencil impinges upon its underside as it did on the under side of the carbon disc. It will be seen that by this arrangement Mr. Werdermann has been the first to depart from the usual track in that his electrodes are always in close contact. He has discarded the electric arc space, not deeming it essential that a certain definite

interval should exist between the carbons, and he thereby produces what to all intents and purposes is a light of incandescence.

The next important feature is a new automatic arrangement, by means of which the carbon, in rising, regulates the contact pressure on itself. To this end, the copper disc is made movable, and capable of being pressed upwards by the carbon beneath it. The copper disc is hinged or pivoted so as to slightly overbalance at the front, where it impinges upon the carbon pencil. Attached to the rear of the disc is a flat spring which is pressed against one side of the copper nipples, through which the carbon pencil passes, by the upward pressure of the pencil acting upon the disc, the side of the nipple against which the spring presses being hinged. This constitutes an automatic adjustment and re-adjustment of the pressure on the carbon pencil, so that if by any chance the carbon should stick fast—as formerly it occasionally did—the pencil is consumed at the top, and the copper electrode follows it down, thus releasing the spring, relieving the pressure on the nipples, and freeing the carbon pencil.

The result of this modification is that the light can now be burned in series with an intensity current, whereas, formerly, the sticking of the carbon pencil prevented the lights being joined up in one circuit. Hence the conductor is now made continuous, instead of having branches, as formerly. A quantity current then had to be used, which, as is well known, requires a greater power to generate than an intensity current. Altogether, these improvements have, as we have already observed, made the Werdermann system much more practicable

* See Iron, vol. xii., p. 555.]

than it formerly was, while a much steadier light is now obtained. In its improved form this system has been successfully applied to lighting a factory in Manchester, as well as at Messrs. Rownson and Drew's works. In the demonstration which was given at the latter establishment eight lamps of various designs were placed on a circuit, each giving an estimated light of about 200 candles, the current being supplied from a Gramme continuous machine, which was driven from the surplus power of the 8-horse engine used for driving punching and other machines on the works. This engine also drives the machine for producing the current for the electric light ordinarily used in the works. The results of the demonstration went to show that the light is well adapted for use in warehouses, workshops, and other large interiors. We understand that Major Festing, R.E., having tried the Werdermann light in the old library of the South Kensington Museum, purposes recommending its adoption in the new one which is now in course of construction. On the whole we may congratulate M. Werdermann upon having succeeded in dividing the electric current in an effectual manner, and in producing a practical and steady white light of moderate power.

The Electric Light for Light-Houses.—The last report of the United States Light-House Board contains some useful facts relating to the electric light, and the modes and appliances employed in generating and adapting it for various uses that are of interest. The report in question discusses (1) the modes of producing electric illumination, (2) the instruments for producing electric currents, and (3) the results of measurements of luminous intensity.

Eng. & Mining Jour. March 27 1880

On the first point the report makes note of three modes of producing electric illumination—(*a*) by the electric arc, (*b*) by ignited (incandescent?) conductors, and (*c*) by incandescent gases. The report notes that the use of the electric arc is attended with several objections—its unsteadiness, and the wearing away and combustion of the carbon poles; and that, while very ingenious regulators to correct these troubles have been devised, they can not control the minute accidental variations in the structure of the carbons during their consumption. The poles wear away unequally, the arc shifts its position, and the consequence is, that frequent and great variations in the intensity of the light occur. Mention is made of variations occurring within a few minutes from 400 to 2000 candle-power. Nevertheless, asserts the report, "since the great improvements recently made in the homogeneity of the carbon poles, and in the regulating machinery, and since the introduction of reflectors, the electric arc is no longer too unsteady for practical purposes."

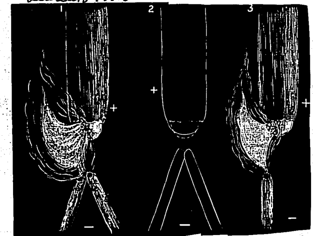
The production of the electric light from ignited (incandescent?) conductors introduces the grave objections of great wastefulness of energy (and consequent costliness) and the rapid destruction of the conductors by disintegration. A current, for example, that would furnish an electric arc of 1000 to 2000 candle-power, would not generate a light of more than 50 to 100, with platinum wires, and the platinum soon became brittle, and broke up. Better results were obtained with carbon rods placed in exhausted glass tubes; but the rods soon vaporized and disintegrated (it is noteworthy here that these experiments antedate Mr. Edison's latest announcements). The report is unfavorable to lamps of this class, and gives a list of inventions of this class for reference. Among others, the following instructive example of the great loss of energy resulting from a division of the current is given: When concentrated on a single lamp, a given current gave a light of 65 burners; when divided between two lamps, it was reduced to $7\frac{1}{2}$ each; among three, to $1\frac{1}{8}$ burners each; among four, to $\frac{3}{4}$ each; and among five, to $\frac{1}{2}$ each.

The report describes and explains the action of 17 magneto-electric machines, and gives the results of a number of comparative tests of the economy and illuminating power of some of the best-known of these machines and lamps, from which it appears that the Brush and Weston machines make the best showing.

CURIOUS VOLTAIC ARC EXPERIMENT.

We lately had the pleasure of witnessing a curious experiment, made by Mr. J. Rapieff, with the electric-light arc in one of his three carbon lamps. The voltaic arc being started, the end of the upper, or +, carbon was touched with a piece of iron wire, which immediately melted, the molten portion clinging to the end of the carbon by capillary attraction. After a short time the carbon became cup-shaped at the bottom, the molten iron resting in the cup. On drawing out the arc, a curious phenomenon manifested itself, a cluster of small circles, or spots, presented themselves on the surface of the glistening metal, and flames radiated from them, which eventually lost themselves in the general flame. The drawings illustrate the effect in profile and nearly front view. The centre of the

March 15 1880



flame was of a yellowish tinge, merging into a beautiful purple near the edges. On disconnecting the circuit and allowing the carbons to cool, the iron commenced a pulsatory movement up and down, as indicated by dotted line of figure 2, and eventually fell to the ground.

ELECTRIC LIGHTING.

SOME important additional experiments have been carried out in connection with the electric lighting by Mr. Hedges Eyre Johnson-Jablochkoff system of electric lighting at Chatham Dockyard, "They were conducted at the Victoria Station of the London, Chatham and Dover Railway, where the offices of the Metropolitan District Railway, where the Jablochkoff system of electric lighting was introduced about two years." About that period towards the close of last year, Mr. Berly had the two rails of the up-line connected together by a "copper wire (insulated), both ends of Charing Cross and at Victoria Stations. He also had the two rails of the down-line connected in the same manner. He tried experimentally: (1) to maintain five lights on the up-circuit, using the up-line as return wire; (2) to maintain five lights on the down-circuit, using the down-line as a return conductor, and successful. Subsequently he carried out the lighting of the station with one main wire only to each circuit, and the rail as the return wire to each circuit. In the third place, Mr. Berly tried to maintain five lights on the up-platform circuit, using the up-line as return at Charing Cross, and the down-line as return at Victoria; and in the fourth place to maintain five lights on the down-platform circuit, using in a similar way the down and up lines as return. Both succeeded separately. He then lighted the station with both circuits connected as in the first, and in the third and fourth experiments, which was done successfully. Later on, namely, on the 2nd and 4th inst., he joined, experimentally, the two wires of Victoria Station into one, making, therefore, a total circuit of about seven miles of wire. He maintained, in the middle of that distance, lights 3½ miles from the Gramme machine, five lights burning, and by the side of which he kept burning another five lights mounted on a circuit of about 250 yards of wire. He reports that both circuits worked admirably with the same brilliancy, and the candles on the short circuit burned very little quicker than those on the long one."

With regard to the progress of the Jablochkoff lights on the Continent, we understand that the Paris Municipal Council has renewed for one year its lighting on March, 1881) the contract for lighting the Avenue de l'Opera, the Place de l'Opera, and the Place du Théâtre Français, with the Société Générale d'Electricité. The Sous Secrétaire d'Etat at the Ministère des Beaux Arts has just given the necessary authorisations to the Société for re-lighting the Salon at Paris in the Industrie in June next. The Hippodrome, which has been lighted for the last two years, and with sixty Jablochkoff lights and twenty Serrin regulators, will be lighted with a battery of 125 Jablochkoff lights, the twenty Serrin regulators being replaced by sixty-eight Jablochkoff lights. The number of the applications of the system has extended to a number of industrial establishments in France and elsewhere since the commencement of the present year, and including the celebrated Creusot Works.

THE DENNARD-ELECTRIC WORKS.—On Friday evening lecture was given by Dr. Siemens on the various applications of the dynamo-electric machine. The commenced with a reference to Faraday's great discovery of the magneto-electric induced current first brought under the notice of members of the Royal Institution in 1831. Prior to that time Faraday had been engaged in testing unsuccessfully if electric currents exist, but with the apparatus then at his command he could not detect them. The utilisation of the induced current was a work of much time and thought on the part of those who followed in the track of the discovery. Stoehrer, in 1841, made the first attempts to utilise it in telegraphy, but the currents were found insufficient to move the recording instrument with certainty. Dr. Werner Siemens, in 1856, arranged a magneto-electric machine with electro-magnets. The first machine on the dynamo-electric principle invented by the lecturer was exhibited by him to the Royal Society in 1867. This machine differed from magneto-electric arrangements in the substitution of electro magnets for permanent steel magnets. The electro magnets were excited by the current produced by the revolution of the machine itself. Electric light is produced by steam, hand or water power, as the power was available by wire at a distance of twenty or thirty miles.

resistance increases in the inverse ratio of the area (or of the square of the diameter) and as the length; but by considering the conducting current and the resistance, these remains are lost to us, while, by considering the resistance, these remains are lost in a mathematical myth. Now, if we take such a drawn-out liquid conductor and put it to the test of experiment, we find that there is not the smallest trace of difference between it and a solid conductor of equal conducting capacity and area; that is to say, the only difference among all classes of conductors is a *difference of specific conductivity*. Liquids have less conducting power than metallic solids, and more than many other solids. But, *given the same conductivity, there is no other difference whatever*. Such a liquid wire may be stretched in a straight line, or it may be coiled up as a helix; it will then have precisely the same powers of producing static induction, precisely the same magnetic actions as a solid wire.

Have we not, then, the right to conclude that in the solid wire there are actions occurring analogous to those occurring in the liquid wire?

We know even that we can extend our liquid wire for thousands of miles, for what is the return earth circuit but such a wire? Mathematicians are, indeed, fond of giving us another explanation, and talking about the earth being an infinite reservoir. But common sense shows that the analogy I have drawn is perfect, and, as a matter of fact, if the two earth plates differ, if one is zinc and the other copper, the intervening earth acts precisely as do the liquids of a common battery, and will set up a current through the wire exactly corresponding to that produced by a common battery.

THREE MONTHS' EXPERIENCE OF ELECTRIC LIGHTING AT BLACKPOOL.*

Electrician April 10 1880

Under this heading I propose to place before you some particulars of the working of the electric light, together with the working expenses of the electric light plant erected last year in our town, feeling sure that it will be of interest not only to yourselves, but to the gas world generally, inasmuch as it is the only town in which electricity has been tried to the best advantage, and on a practical working scale.

In the beginning of May last year our town council unanimously agreed to light up the central portion of their extensive promenade, which has a length of three miles, by means of the electric light, in a manner surpassing anything that had ever been attempted in the way of lighting to be employed every season during the autumn months, and on days of festivity. The opening day was to be the 19th of September, and I may here say that they have accomplished their object of having created a sensational light.

The committee appointed, together with my father, their gas engineer, they proceeded at once to inspect all the best-known systems, viewing, amongst others, the well-known Thames Embankment lights; but so thoroughly satisfied were they that in all these they were lacking but what some large gas lamps would supercede, that they resolved to strike out the rather bold experiment of using the electric light, and employing four naked lights of 6,000 candle-power from the shore. The whole are placed in plain glass lanterns 60 feet above the level of the roadway. This is necessary with naked lights, so as to prevent any strong penetrating power from the eye when approaching the lamps, as well as to better distribute the light between them.

Having thus briefly stated the object desired to be accomplished, I cannot do better than explain the mode of procedure adopted to produce the effect. Arrangements having been come to with Messrs. Siemens, of Charlton, near Woolwich, for the supply of the necessary electric machinery, and with Mr. Bailey and Co., of Lincoln, for the engines, and the whole of the plant being under the control of the Gas Department, it became part of my duty to superintend its erection, and to see to its working after the contractors had completed.

The site selected as being convenient for the machinery was the Corporation Depôt, situated 400 yards from one end of the Promenade, and 250 yards inland. Here was put up a substantial timber building, 50 feet by 25 feet, and inside, on the ground, was laid a framing, which formed the foundations for the machinery, the interspaces between the timbers being filled in flush with concrete, and then boarded over to prevent rising. Upon this were fixed, as they arrived, two portals, 16 horse-power engines and boilers, and at the opposite end were the electric machines, of which there were seven, all being driven from a counter-shaft placed between them and the engines. From each of the six machines a distinct wire is led to its own lamp, and one common return wire, so to speak, answers for the whole. You will, no doubt, wonder what the odd machine was for. Well, at first, the whole of the six machines had to perform the duty of producing their own electricity, but that duty is now taken from them by specially devoting a dynamo-electric machine to that purpose solely, and this was found to be better for the lights.

The first difficulty we had to contend with was the laying of the wires inside the 2-in. and 3-in. cast-iron pipes, it having been decided to place them underground, hidden from view. This proved no easy matter, inasmuch as the wire was in 500-yard lengths, and it was desirable to have as few joints as possible. It, therefore, cost as much to put the wires through as it did to make the trenches, so careful had we to be in order not to damage the insulation, and to keep off the water. The weather happened unfortunately to be unfavourable for us, as, a day or two after commencing, a series of high winds set in, with their usual effect at Blackpool of forcing the water over the Promenade, to the amusement of visitors, but to the detriment of our work; for, at every tide, it filled the trenches and pipes with sea water. However, as there was no time to stop, we proceeded, and completed the 1,500 yards in the week allowed us, and were ready for the preliminary trial to take place on Saturday, the 18th; but, alas! all our efforts were unavailing, for the insulation of the wires had yielded to the water, and it was quite spoiled for the purpose, so there remained no alternative but to withdraw them. This we commenced on the Friday evening, and drew out the whole and laid them on the arms of the lamp-posts. By the Saturday night we had temporarily connected the wires, and had two of the most commanding lights at work with good effect. By the following Monday morning we had collected together the most suitable poles in the town, and immediately set to work and placed them up telegraph fashion, and secured the wires therein with iron staples, there being no time to get insulators fixed. During the time the wires were being completed, experiments and trials were going on in the engine-room, and by Thursday, September 18, all was finally ready, and the lights were lit at dusk with remarkable steadiness, considering the drawbacks we had to encounter for want of time.

I may tell you that it was with no small degree of pleasure I beheld, from an elevated position, the lights shedding down their bright white beams on the crowded forms of at least 20,000 persons who had come to Blackpool to witness the grand spectacle—to see the poor gas once for all annihilated. Well, I must say the gas cut a sorry figure when burning in the lamps when the electric lights were lit, of which a good many of you present were eye-witnesses. The gas was very much reduced in brilliancy darker, and one of the new illuminants was suddenly extinguished, for it would have been unsafe to the public to have left all in darkness, which might have occurred at any moment. As we got more accustomed to the mechanism and freaks of each lamp, not every now and then, we gained confidence because we found out how to apply the remedy. In nine cases out of ten the cause was the rack holding the carbons getting fast, and a man was usually on the look-out to shake it with the line to the lamp. So frequently did this happen that ultimately the passing public and police served us the friendly turn by merely pulling the line as they went by. Sometimes, however, more serious mishaps would occur, owing to the crossed position of the lights, and to the strong gales of wind and rain. The defective working parts were affected by corrosion and damp, and in such cases there was no alternative but to take the lamp in for readjustment; so it had to remain extinguished for the night, or if it was a very bad light, it was better policy to shut it off. One would naturally say, why not take out the spare lamp and substitute it for the other? This seems very well until explained. The reason is this, that owing to all the circuits being of different lengths, and having different resistances, each lamp had to be accurately adjusted, and tried in the test-room, with the current flowing all through the wire. Thus, supposing No. 1 lamp went out, and could not be got to work again; it is 1,400 yards away, and it would be necessary to send two men to lower it, couple the two wires together, bring the lamp back, and act to work adjusting the spare lamp to the circuit, which would require, say, half an hour; then to send it back and hoist it up, the whole occupying 1½ hour, during which the light would be out, and would need another attendant, who would afterwards have nothing to do, and some of nights would never be wanted, although he must be always at hand.

The mode of working which we have found to be the most

* A Paper read by Mr. W. Chew before the Manchester Institution of Gas Engineers.

iron case similar to a postal pillar-box. The erection of these fire alarm boxes at the corners of the streets excites the usual public curiosity, and it is to be hoped that when the systems are set in working order they will prove as valuable as they ought. It is by no means a creditable fact that the Metropolis should have been left for so long a period without such an essential adjunct to the Fire Brigade force; this disgrace seems now likely to be wiped out, and as soon as full scope is given to the system we may hope to see a very considerable diminution in the large and disastrous fires, both to life and property, which are now of such frequent occurrence.

Use of Electric Lighting.

By Dr. JOHN HOPKINSON, F.R.S., of London.

Experiments (Second Paper.)

Read before the Institution of Mechanical Engineers.

Dynamo-electric Machines.—Since the date of the author's former paper in April, 1879, other observers have published the results of experiments similar to those described by him. These results reduced to a curve, in which the abscissæ represent a current passing through the dynamo-electric machine, and the corresponding ordinates represent the electromotive force of the machine for a certain speed of revolution, when that current is passing through it, show the following results:—It will be found (1) that with varying speed the ordinate, or electromotive force, corresponding to any abscissa or current, is proportional to the speed; (2) that the electromotive force does not increase indefinitely with increasing current, but that the curve approaches an asymptote; (3) that the earlier part of the curve is, roughly speaking, a straight line, until the current attains a certain value, and that at that point the electromotive force has reached about two-thirds of its maximum value. When the current is such that the electromotive force is one-half, about two-thirds of its maximum, a very small change in the resistance with speed of engine constant, or in the speed of the engine with resistance constant, causes a great change in the current. For this reason such a current, which is the same for all speeds of revolution, since the curves for different speeds differ only in the scale of ordinates, may be called the "critical current" of the machine.

In Germany, Auerbach and Meyer (Wiedemann's Annalen, Nov. 1879) have experimented fully on a Gramme machine at various speeds, and with various external resistances. The resistance of the machine was 0·97 ohms. Their results are summarised in a table at the end of their paper, which gives the current passing, with resistances in circuit from 1·75 to 200 Siemens units, and at speeds from 30 to 800 revolutions per minute. This relation between electromotive force and current, as deduced from some of their observations, showed that at a speed

which the intensity of the image formed by the lens is compared with a standard light, by means of an ordinary Bunsen's photometer sliding on a graduated bar.

Mr. Dallmeyer kindly had the lens made for the author; he can therefore rely upon the accuracy of its curvature and thickness; it is plano-convex, the convex side being towards the source of light. The curvature is exactly 1 in. radius and the thickness is 0·04 in.; it is made of Chance's hard crown glass, of which the refractive index for the D line in the spectrum is 1·517. The focal length f is therefore 1·933 inch.

Let v denote the distance of the source of light from the curved surface of the lens, and v the distance of the image of the source from the posterior focal plane. Neglecting for the moment loss by reflection at the surface of the glass, the intensity of the source is reduced by the factor $\left(\frac{v}{v'}\right)^2$. But $\frac{1}{v}+\frac{1}{v'}=\frac{1}{f}$, or $v=\frac{fv'}{v'-f}$; hence the factor of reduction is $\left(\frac{f}{v'-f}\right)^2$. The effect of absorption in so small a thickness of very pure glass may be neglected; but the reflection at the surfaces will cause a loss of 8·3 per cent., which must be allowed for. This percentage is calculated from Fresnel's formulæ, which are certainly accurate for glasses of moderate refrangibility, and for moderate angles of incidence.

Suppose, for example, it is required to measure a light of 8,000 candles; if it be placed at a distance of 40 in. it will be reduced in the ratio 40² to 1, and becomes a conveniently measurable quantity. By transmitting through coloured glasses both the light from an electric lamp and that from the standard, a rough comparison may be made of the red or green in the electric light with the red or green in the standard.

A dispersive photometer, in which a lens is used in a somewhat similar manner, is described in Sylvanus's "Lighthouse Illumination;" but in that case the lens is not used in combination with a Bunsen's photometer, nor with any standard light. Messrs. Ayrton and Perry described a dispersive photometer with a concave lens, at the meeting of the Physical Society, on 13th December, 1879 (Proc. of the Physical Society, vol. iii., p. 184). The concave lens possesses however an obvious advantage in having a real focus, at which a diaphragm to cut off stray light may be placed.

Efficiency of the Electric Arc.—To define the electrical condition of an electric arc, two quantities must be stated—the current passing, and the difference of electric potential at the ends of the two carbons. Instead of either one of these, we may, if we please, state the ratio $\frac{\text{difference of potential}}{\text{current}}$, and call it the resistance of the arc, that is to say the resistance which would replace the arc without changing the current. But such a use of the term electric resistance is unscientific; for Ohm's law, on which the definition of electric resistance rests, is quite untrue of the electric arc; and on the other hand, for a given material of the electrodes, a given distance between them, and a given atmospheric pressure, the difference of potential on the two sides of the arc is approximately constant. The product of the difference of potential and the current is of course equal to the work developed in the arc; and this, divided by the work expended in driving the machine, may be considered as the efficiency of the whole combination. It is a very easy matter to measure these quantities. The difference of potential on the two sides of the arc may be measured by the method given by the author in his previous paper, by an electrometer, or in other ways. The current may be measured by an Ohm's galvanometer, by a suitable electrodynamometer, or best of all, in the author's opinion, by passing the whole current, or in his way to think, through a very small known resistance, which may be regarded as a shunt for a galvanometer of very high resistance, or to the circuit of which a very high resistance has been added.

It appears that with the ordinary carbons and at ordinary atmospheric pressure no arc can exist with a less difference of potential than about 20 volts; and that in ordinary work, with an arc about ½ in. long, the difference of potential is from 30 to 50 volts.

The success of burning more than one regulating lamp in series depends on the use in the regulator of an electro-magnet, excited by a high resistance wire connecting the two opposed carbons. The force of this magnet will depend upon the difference of potential in the arc, instead of depending, as in the ordinary lamp, upon the current passing. Such a shunt magnet has been employed in a variety of ways. The author has arranged it as an attachment to an ordinary regulator: the shunt-magnet actuates a lever, which short-circuits the magnet of the lamp when the carbons are too far parted, and so causes them to close.

In conclusion the author ventures to remind engineers of the following rule for determining the efficiency of any system of electric lighting: in which the electric arc is used, the arc being neither exceptionally long nor exceptionally short. Measure the difference of potential of the arc, and also the current passing through it, in volts and webers respectively; then the product of those quantities, divided by 746, is the horse-power developed in that arc. It is then known that the difference between the horse-power developed in the arc and the horse-power expended to drive the machine must be absolutely wasted, and has been expended in heating either the iron of the machine or the copper conducting wires.

10 12

78 Manufacturing Engineering

Comparative Economy of Gas and Electric Lighting.

Our contemporary, the *Scientific American*, has taken the pains to institute a comparison, based on practical premises, of the cost of gas with electric lighting from the experience gained in one of the largest Eastern factories, (the Riverside Worsted Mills, Providence, R. I.), where the Brush electric lights have been in regular use for almost a year. The result of this comparison, our contemporary thinks, is the demonstration of the fact that in spacious apartments, where large numbers of gas lights are required, the electric method of lighting may now be adopted with considerable economy. This inference holds good if the facts are correctly reported, both with the Brush and the Edison systems, as compared with gas lighting. The facts alleged in the case presented are as follows:

In one portion of the mills aforesaid, 1,000 gas lights were formerly used, each of about 12-candle power, yielding therefrom an aggregate of about 12,000 candle light, at a cost of (at 2s.6d per 1,000 feet) $12.25 per hour, or $^{1}/_{1000}$ of a cent per candle per hour. In place of these 1,000 gas lights, 50 electric lights of the Brush (1) system were introduced, as above noted; each of 2,000 candle power, yielding in the aggregate 100,000 candles, at a cost of 80 cents per hour, or $^{1}/_{125}$ of a cent per candle per hour. This comparison, presuming that the above statement of cost and amount of light yielded are correct, would show that gas lighting at 1,000 candle candle was over one hundred and sixty times more costly than electric lighting, estimated on the basis of an equal quantity of light by both methods.

Our contemporary then proceeds to show how Mr. Edison's system of electric lighting will figure in the above comparison, taking as the basis of comparison Mr. Edison's own statements as to cost and efficiency. Mr. Edison, it will be well to notice here, proposes to furnish small electric lamps, each having about the intensity of an ordinary gas light of 16 candles, burning 3 cubic feet of gas per hour. He affirms that he gets 10 lamps, or 160 candle light, per hour per horse-power of engine, and that each of his electrical machines furnishes 720 candle light per hour with the expenditure of 5 horse-power.

Applying Mr. Edison's statements as to the cost of the Riverside Mills above, we would have the following showing: Number of Edison lamps required=1,000; number of Edison machines required=52; engine power required=190 H. P.; approximate cost of plant =$16,000; approximate cost of running the same, yielding 10,000 candle light per hour (implying a fixed interest on plant), $1.56 per hour=$^{1}/_{1000}$ of a cent per candle per hour. This estimate of expense, it will be observed, does not allow for the item of royalty to the owners of the patent. It shows, however, that the approximate cost of gas light at the Riverside Mills is light for light, 74 times greater than Edison's system; and that Edison in turn is 10 times more costly than the same amount of light by the Brush system. The relative cost of the several plans is shown below:

Kind of Light.	Cost per Candle Light per hour.
Gas light.....	$^{1}/_{1000}$ of a cent.

THE JABLOCHKOFF ELECTRIC LIGHT.

THE Metropolitan Board of Works has recently had under consideration the question of the desirability of continuing the electric lighting on the Victoria Embankment and Waterloo Bridge, by means of the Jablochkoff system, the existing contract for which will expire on the 10th of April next. The result was that the Board has renewed the contract with the Société Générale d'Electricité for another year on modified terms, and the new contract will expire on the 31st of April, 1880. The Jablochkoff system has now been in successful operation for more than fifteen months on the Thames Embankment, and in view of the further the tension of the contract it was interesting if we gather up the history of its application on to the Illuminations of this public thoroughfare. Our readers will doubtless remember that in October, 1878, the Metropolitan Board of Works contracted with the Société Générale for the lighting by means of twenty lights between Westminster and Waterloo Bridges. The inauguration of the lighting of that section took place on the evening of the 13th December, 1878. On the 10th May, 1879, the lighting of the Embankment was extended from Waterloo to Blackfriars Bridge, twenty lights being added to the twenty already burning. A further extension took place on the 10th October, 1879, ten lights being placed on Waterloo Bridge, thus bringing the total number of lights to fifty. Since these various dates—that is to say, for fifteen months for the first series of twenty lights; 10½ months for the second series of twenty; and 5½ months for the last series of ten—the whole of the lamps have been uninterruptedly kept lighted every night, from dusk until four, or six hours, which is the contract time for keeping the lights burning. These facts are worthy of consideration when it is borne in mind that they were originally laid down for twenty lights only. The extension of the electric lighting not having been contemplated at the time of the plant being laid down, no provision was made for such extension. This necessitated the manipulating and altering of the plant each time the last series of lights was done under the circumstances. It is also to be remembered that another ten lights—those at the Victoria Station of the Metropolitan District Railway—were subsequently added to the fifty already burning, thus making sixty altogether. The price paid by the Metropolitan Board of Works was originally 6d. per light per hour. That price was reduced to 5d. per light per hour on the Board increasing the number of lights to forty; then to 3d. on the number of lights being further increased to sixty, and on the contract being renewed for six months. The new contract is to be carried out at 2½d. per light per hour, the duration of the contract having been extended to one year. The Société Générale contemplates extending the number of lights to certain private concerns from the centre at Chiswick Cross.

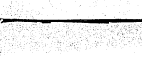
The Jablochkoff system of electric lighting is now in use under almost every possible condition and in every variety of establishment. It is used in streets, on bridges, in railway stations, theatres, circuses, engineering and every variety of industrial works, docks, basins, on board steam-vessels, in hotels and private residences. Crowned and uncrowned heads have also adopted it. King Theebaw, of Burmah, has had sixty lights fitted up in his palace at Mandalay; Shah Nasser ed Deen, of Persia, four in his palace at Teheran; Prince Agrakhan, six in his palace at Bombay; King Don Luis I., of Portugal, six in his royal palace of Cintra, and the Queen Isabella of Spain, six in the conservatory of her beautiful residence in Paris. At the present time there are 565 lights on the Jablochkoff system burning in Paris, 418 in the French provinces and 813 in foreign countries, making a total of 1716 lights, 198 of which are in use in this country. This all denotes progress, and as regards its application in London the Metropolitan Board of Works is to be commended for the spirited way in which they are practically testing the question of electric lighting.

DYNAMO ELECTRIC MACHINES.

Messrs. [illegible] firm of telegraph engineers, late, says *Engineering*, recently published a series of very important researches on the theory of the Gramme machine and other forms of dynamo-electric and magneto-electric generators, in the course of which the services at some extremely interesting results, and clears up a number of points which hitherto have been comparatively obscure in the operation of such machines. Starting from first principles and the simplest experimental data, M. Breguet propounds the successive steps of a logical chain of reasoning to link the grand discovery by Faraday of magneto-electric induction with the applications of the principle in the machines of Gramme and Siemens. He is thus enabled to explain a point hitherto supposed irreconcilable with theory, namely, the retention of electrical energy in setting the "brushes" or collectors of the current in the dynamo-electric machines in an oblique position against the commutator, and unsymmetrical with respect to the field magnets of the instruments. He not only explains this, but points out that it is an absolute necessity of the case, and that upon this position with regard to whether the machine is better suited to be a generator or an electro-motor. He further explains, for the first time, the rôle played by the ring of iron in the armature of the Gramme machine. And lastly, he thus indicates the action of the Siemens machine, and shows that there is at least one method of winding the wires upon its armature superior to that adopted hitherto in practice. It is proposed to treat in the present article of the earlier and more general portions of M. Breguet's research, reserving an account of his work on the Gramme machine and on the Siemens machine for subsequent occasions.

The first principle laid down by M. Breguet is the essential proposition of the Gramme and all other dynamo and magneto-electric machines. Resisted by mechanical means, they supply a current of electricity derived from the energy of a steam engine or other motor. But if you supply them with a current of electricity they will, conversely, rotate and turn the electricity back into mechanical energy. The same thing is true of all electro-magnetic engines or electro-motors, such as those of Hjelmlie, Page, and Froment. They are intended to rotate by electricity, but if you rotate them by mechanical means they will furnish in turn a current of electricity. This principle of reversibility extends even to some unexpected cases. Very early on in the history of magnetism Barlow found he could cause a wheel or disk of copper to rotate between the poles of a magnet by sending a current at the same time perpendicularly through it. He fixed from the axis to the circumference, where it passed into a pool of mercury, a copper wire. The mercury contact with as little friction as possible (Fig. 1). In 1831 Faraday per-

Fig. 1.



formed the converse experiment, and found that by mechanically rotating a copper disk between the poles of a magnet he thereby generated a current in a wire the two ends of which touched the circumference and the axis of the wheel, which were amalgamated over with mercury, so as to insure better contact with the wire (Fig. 2). Here, then, is the

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13

Fig. 2.

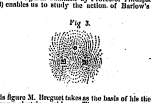
simplest kind of electro-motor and dynamo-electric generator, and it illustrates at the outset the important principle of *reversibility*.

The second matter which claims notice is the mutual interaction of a magnet and a conductor which carries a current. We sometimes speak loosely of the displacement of a current caused by a magnet when we mean that the conductor carrying the current is displaced. Although the term is convenient, it is scarcely accurate, for we must distinguish between mechanical force, or that which tends to move matter, and electro-motive force (as above), which tends only to move electricity in a conductor. This mechanical reaction between magnets and current conductors which turn machines are electrically of the former class. These reactions, therefore, deserve to be studied from a nearer point of view by applying a principle announced by Faraday in startling magnetic attractions, and lately further extended by Professor S. Thompson to the case of the attraction between currents. Faraday first recognized the significance of the so-called lines of magnetic force which are seen crossing in curves through every magnetic field when iron filings are sprinkled over it. Without necessarily attributing to these lines any physical existence, we may conveniently employ them as Faraday did, to investigate and to describe the actions between magnets or magnetic bodies. Faraday laid down the following properties as those possessed by these lines of force: First, the lines of force tend to shorten themselves. Secondly, lines of force lying in the same direction side by side repel one another. To these M. Breguet adds that a line of force, when it passes through iron or other metal capable of magnetic susceptibility, must be regarded as if shorter than one of equal actual length passing through air, so that the "tendency to shorten" may exhibit itself by a tendency to run through a magnetic substance near at hand.

The means of these simple principles Faraday was able to deduce the laws of magnetic attraction and repulsion from the figures formed by the lines of iron filings when sprinkled over the magnetic field whose properties were thus to be investigated. Professor Thompson has applied the same reasoning to the case of the attractions and repulsions exerted between two currents assumed to circulate, and a magnet.

One of the figures introduced by Professor Thompson (see, Fig. 3) enables us to study the action of Barlow's wheel,

Fig. 3.



and this figure M. Breguet takes as the basis of his theory of the dynamo-electric machine. The two magnets are shown as the poles of the magnet, and a point a little way from them is taken as the centre of the conductor perpendicular to the plane of the figure, and the current in a current which passes downward through the paper. Now the current produces a magnetic "field" all round it which, if the magnet were not present, would consist of lines of force forming concentric circular circles. But in presence of the magnet and its system of lines of force there is a mutual reaction, the nature of which can be learned by simply looking at the figure formed by the iron filings. The tendency of the lines to shorten would assuredly urge the conductor toward the poles of the magnet; and in Barlow's wheel, where this goes on continually in the part of the disk lying between the poles and the mercury cup, the simple attraction becomes a movement of rotation.

A current passing in the opposite direction through the wire would obviously be urged in the contrary direction or away from the magnet. Conversely, if the conductor were removed from the magnet further away from the magnet a current circulating in a contrary direction to that which would be generated of opposite direction to that which caused the motion, the electromotive force of the current being proportional to the number of lines cut by the conductor in a second of time.

Following M. Breguet, we next pass to a consideration of the first and simplest of electro-motors, as shown in Fig. 4.

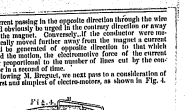


Fig. 4.

This apparatus consists of a metallic conductor bent twice at right angles and balanced on a center at a point X. The vertical branches carry little metallic pointed segments which dip into the halves of a circular mercury cup divided across by a diametrical partition into two portions connected respectively with the poles of a battery; and the whole is placed between the poles P N of a magnet, so placed that the line joining the two poles is at right angles to the diametral line. The conductor rotates upon its center so long as the current passes. We may consider separately the action of the magnet on the two vertical portions, I, I', and on the horizontal portion, H. The action upon the two vertical portions of the conductor is best studied by taking a plan of the apparatus, as shown in Fig. 5, which gives in diagram-

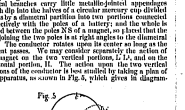


Fig. 5.

matic outline all the working parts. The arrow indicates the direction of the current, which therefore ascends at I, and descends at I'. Connection between the contacts which here exist and those which gave the magnetic figure, Fig. 3, with iron filings, will show a section of lines of force, of which the most characteristic will be the S-shaped curve shown by the dotted lines. Hence the tendency will be to displace I toward the top of the figure and I' toward the bottom, and their positions of equilibrium will be respectively C and C. But if the inertia of movement carry the conductor across past these points and make them touch the opposite mercury cups, the current will be reversed, I being drawn toward C and I' toward C. Hence there will be a continuous rotation, the direction of the current in the conductor being reversed at every half revolution when the moving wire passes through the position of equilibrium at C C'. A little consideration will also show that the action upon the horizontal portion, H, is similar, and adds itself to the forces producing rotation.

Now suppose that, instead of the simple wire bent twice at right angles, a conductor be taken having the vertical branches prolonged into two arcs, and carrying, as in Fig. 6, four little pointed contact pieces. We shall now require

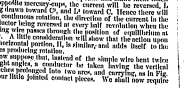


Fig. 6.

the mercurial cups to extend over 90° of arc, *i*, *i*, extending from C only as far as B, and from C only as far as N. Had we taken eight little contact pieces, each mercury cup need only have occupied one-fifth of the circle, or 45° of arc. If the number were indefinitely increased, then the arcs subtended by the mercurial cups might be diminished down to mere points at C C. These considerations hold equally good in the converse case where the instrument is used as a generator of currents.

One further step remains to be considered before we pass on to the application of these motions to the Gramme machine. Instead of the simple wire we may take a wire coiled upon a frame, as in Fig. 7, and having many turns. On each wire of this coil there will be a similar action; hence the total force of rotation will be proportionately greater when an equal current is used. In all the various arrangements hereafter to be described, every single wire may be considered in a similar way to represent a coil, and hence the figures may be made as simple as possible. It will be noticed that the single flat coil of Fig. 7, if wound upon an

Fig. 7.

iron spindle and frame, virtually constitutes an armature of the type introduced by Siemens, and applied by him in the early magneto-electric machines, and also recently employed by M. Marcel Deprez in the excellent little electro-motors which he has constructed.

M. Breguet's application of these ideas to the Gramme machine and to the Siemens machines of modern type will be dealt with in a subsequent article.

The object of this machine is to obtain by improved arrangements and construction of parts a greater intensity of the magnetic field of the revolving armature, and so to generate a greater amount of electricity than can be produced with machines of other forms, and also to provide means for the governing of the current and cooling the magnets.

The construction of the apparatus is shown by figs. 1, 2, 3, 4, and 5, and it is as follows:—As are end standards, A, having bearing, circular surfaces, and serving as stationary discs, these are bolted to a bed plate, B; the standards having central bosses through which passes the central main driving shaft, C. On the inner surface of these bosses, the stationary magnets, D, are radially arranged in a manner to be more fully described later on. The shaft, C, carries a pulley on one end, to which is connected the driving machinery, the other end of the shaft carries the commutator, E, the extremities of the shaft being supported by bearing standards, F, fixed to the bed plate, B. On the main shaft, C, between the standards, A, is mounted a disc, F, upon both sides of which are bolted radial magnets, a number and size required according to the area of the disc; the disc when so fitted constitutes a revolving armature. The magnets of the stationary discs and the revolving armature are constructed as follows:—Two soft iron plates, *d*, *d*, of approximately sector form, are connected by a solid or hollow connecting piece, *c*, of steel or iron of corresponding shape to, but smaller than, the plates; one of the plates, *a*, serves as a flange for bolting the magnets, G and D, respectively, either to the revolving disc, F, or to the stationary disc, A, and the other plate, *b*, acts as the soft iron keeper of the magnet. The connecting piece, *c*, of the plates of the magnets is hollow or solid, and serves as the core upon which the wire is wound. In small machines, the connecting piece or core may be solid; the connecting piece of the stationary magnets, D, is, in all cases, longer than that of the revolving disc magnets, G, so as to receive a longer coil of wire; in fig. 1 the core of the magnet, D, are shown hollow. The magnets are bolted in a circle on to and around the revolving and stationary discs, F and A, respectively, and are relatively opposite to each other, so that the revolving disc will carry and be furnished with a circle of magnets upon each face, so as to revolve in face of corresponding sets of magnets on the stationary discs, A, of the standards.

The centre of the revolving disc is fitted with a bush, H, in which are holes lined with insulating material, through this bush are passed the wires of the coils of the magnets, G; these wires are carried along the shaft to the commutator, E, thence through a perforated bushing, H, fixed on the shaft, C, which works in the boss of the standard, A. The wires are insulated by passing them through small tubes of insulating material, as will be understood by reference to figs. 3 and 5.

The wire upon the opposite stationary magnets is wound and connected in such manner as to give opposite polarity to each magnet facing the other, and so forming pairs between which the armature revolves.

For machines of large construction, and where larger currents are to be developed, the number of the armatures, F, and the stationary magnet

standards, A, may be increased; thus, for a machine having two of the revolving armatures upon the shaft, C, there will be provided three stationary magnet standards, A, and so on.

To keep the hollow magnets cool, the stationary disc is perforated at the back of its magnets, and a blast or current of air from a fan can be directed by tubes, T, into the hollows of the magnets, outlets being also provided for circulation of the air through them.

The governor, which cuts the circuit when the machine ceases working, is shown in figs. 1 and 4.

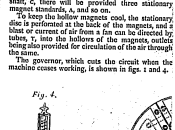


Fig. 4.

In this arrangement, contact will only be made by the saddle-shaped plunger upon the machine attaining the required speed, and so depressing and immersing the extremities of plunger arms one into each cup of mercury. The mercury is covered with glycerine, and ends of the plunger arms which dip into the mercury are platinised to prevent oxidation and to ensure perfect contact. A flexible cover of thin rubber cloth, secured by a ring, keeps out dust and dirt from the cups. In Westcott's machine, even when the speed is very low, the mercury is thrown up in a spiral column, thereby making con-

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

VI.

RELAYS *(continued)*.

A GENERAL view of the *Standard* Relay is shown by fig. 30, the cover being removed and placed by the side of the instrument.

Slowest Relay.

This form of relay is used to a greater extent than any other kind, and its general construction is very generally known. A top view of the instrument is shown by fig. 31. It consists of an ordinary electro-magnet, the poles of which are provided with soft iron shoes, or pole pieces, A, A'. A

THE MAGNETISATION OF INDUCTORS BY ALTERNATING CURRENTS. SUPPRESSION OF THE MACHINE FOR EXCITING DYNAMO-ELECTRIC MACHINES GIVING ALTERNATING CURRENTS.

BY M. A. DE MERITENS.

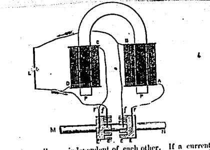
~~(Translation.)~~ Electrician April 17/1880

Are magneto-electric machines preferable to dynamo-electric machines for the regular and economical production of light? This question, which was long ago propounlded, has not yet received a solution. It is in fact very difficult to give a satisfactory answer to it. Each of these types of machine has its advantages and its drawbacks. The magneto-electric machine has on its side the invariable magnetism of its inductors. If the velocity of the coils under induction is augmented or diminished, only the tension of the current* is modified; the quantity remains very nearly the same. As there is no solution of continuity in the collectors, the voltaic arc increases or diminishes with the movement; but no danger of extinction is to be feared. It is this consideration which has caused a preference to be given to magneto-electric machines for the illumination of lighthouses. The mechanical force needed to set these machines in movement is less than that which is requisite for dynamo-electric machines. As the former are provided with inductors in which the magnetism is permanent, they effect a saving of all the work absorbed in the magnetisation of the inductors in their rivals. But, on the other hand, the magneto-electric generators are very bulky. Their cost price is considerable, and this consideration contributes in great measure to restrict their use for industrial purposes.

The dynamo-electric machines are smaller in dimension, supply a larger quantity of electricity and are cheaper. But the smallest change in the velocity of the motor which drives them alters the conditions and the value of the light. The mechanical force necessary to produce a given quantity of light is greater. It is requisite to have two machines in order to obtain the alternating current: one which serves solely to magnetise the inductors of the other, and a second which produces the alternating current which generates the light. The exciting machine has either a commutator or a collector, which contains as many interruptions as there are coils under induction, and frictional contact-pieces passing successively over each of these divisions, and in intimate contact with them. The smallest imperfection in the working of this essential organ of the machine modifies or destroys the magnetic power of the inductors, and immediately affects the light.

I have sought means for giving to each of these two types of machine the advantages of the other; and I think I have arrived at a satisfactory solution. The problem was a complex one. It was necessary:—1st to arrange so as to have but a single machine to set in motion in lieu of two, and 2nd to get rid of all the drawbacks of the commutator, which is attended with considerable loss both when it produces sparks and when these are avoided. In the latter case it is necessary to short-circuit the current for a certain period at the moment of the change in the direction of the current, and the loss is equivalent. If, instead of a commutator, we adopt a collector similar to that of the Gramme machine, the loss of useful work, though not so evident, is scarcely less. Four or six of the coils under induction are short-circuited at each revolution; it is a case of the commutator which gives no sparks. These coils produce necessarily an extra current at the moment of the change in the direction of the current. The breadth of the brush and the great number of conducting wires of which it is formed may divide and dissimulate the spark, but none the less it exists. The loss of useful work is therefore very nearly the same in the two cases.

The arrangement I have adopted will, I think, overcome all these drawbacks. There is no necessity to throw the alternating currents into the same direction in order to produce the magnetisation of the inductors. In the case of the magneto-electric machine, let us suppose that each of the permanent magnets which constitute its inductors is provided with two coils A B, C D.



These two coils are independent of each other. If a current enters at A and leaves at B in the first coil, and enters at C and leaves at D in the second, we shall always have at P and P_1 two poles of contrary sign. If the current traverse only the coil A B, without passing through the coil C D, the electro-magnet A B C D will still have its two poles at P and P_1. And the same will be the case if the current should traverse only the coil C D, entering at C and leaving at D, without passing through the turns of wire on the coil A B.

I have at my disposal an alternating current, that is to say one which regularly changes its direction each time that a fresh coil in the ring arrives opposite the pole of one of the inductors. Let us now consider the shaft M N of the machine, which carries, besides the circle of coils under induction, the collectors E E_1, upon which bear the frictional contact-pieces F F_1, from which the current is taken. I have added to the collectors E E_1 two other collectors e e_1. These are divided into as many equal parts as there are coils in the ring; and, since there are sixteen of these, e and e_1 are divided into sixteen equal parts. Eight of these parts are sunk so that the circular surface of the collectors e e presents successively a raised surface and a depressed surface of equal extent. Each of these divisions of e e_1 corresponds to a coil upon the ring. The collectors e e_1 are keyed to the shaft M N so that a raised portion of e may be exactly opposite a depressed portion of e_1. Conductive contact exists between e and E, and between e_1 and E_1.

These details being understood, I attach the extremity A of the coil A B to the contact-piece F, and the end C of the coil C D to the other contact-piece F_1; the two other ends B and D of the coils communicate with the lamp L. Moreover, the end B of the coil A B is connected with the contact-piece f, and the end D of the coil C D to the contact-piece f_1.

Let us now examine what will take place during the movement of the ring. Let us suppose the piece f to be over one of the depressions on e; in this case f_1 will be on one of the raised portions of e_1. The current will traverse the coil A B, pass to the lamp L, and return to the machine without traversing the coil C D, since its terminals are united through the collector E_1 e_1. When f passes from a depressed to a raised portion of e, f_1 will pass from a raised to a depressed portion of e_1. The direction of the current is now altered, and is opposite to that indicated by the arrows in the cut. The current enters the coil C D at C, and leaves at D, passes to the lamp L, and returns to the machine without traversing A B, since the terminals of this coil are connected through the collector E e.

One of the two coils of the electro-magnet is always in action. We work with a one-sided electro-magnet, in which the excited coil is alternately on one or on the other arm of the magnet, according to the direction of the current. We can in this manner obtain, by means of alternating currents, magnets so powerful that one of them in my possession is able to support more than 500 kilograms.

If the coils of the electro-magnet offer much resistance, an extra current spark will appear at the contacts made by f and f_1. But this spark does not result in any loss of light. It does not belong to the current which passes by the lamp L, and, were it not for the objection that in course of time it deteriorates the contacts, I should allow it to remain. But, in view to the preservation of the machine, it is best to get rid of it.

We know that, in order to produce a powerful magnetisation, a current of large quantity and weak tension is necessary. Of the sixteen coils which form the ring, I take four, which I connect for quantity, and which furnish the current required for the stout wire composing the coils of my magnets. Here there is no longer any spark at the collector, and the magnetisation is considerable. The small model of my machine, which produces, with its permanent magnets only, and the sixteen coils on the ring, a light equivalent to 170 gas burners, can be worked with its magnets surrounded with the coils, and with only twelve of the coils on the ring—since four of the coils constitute the special magnetising circuit. The light produced is then equivalent to at least double that generated under the former conditions.

I have, therefore, demonstrated in theory and in practice that it is not necessary to send in the same direction the alternating currents in order to work dynamo-electric machines. The consequences of this fact are of the greatest importance. The losses of current necessarily occasioned by commutators, or by collectors sending the currents in the same direction are here absolutely avoided. It is no longer indispensable to have two machines in motion in order to produce the alternating current. The magneto-electric machine can render the same service as the dynamo-electric machine, whilst at the same time preserving its own special advantages. Lastly, the cost price of the generator is reduced. We have, then, an important progress here realised in the generator of the current.

I hope soon to be in a position to indicate another improvement in relation to the lamp, when I have the honour of bringing before the conference this second portion of the application of electricity for the production of light.

Telegraphic Journal April 15 1880

A NEW YORK correspondent of the *Standard* says: "That of the 200 paper carbon lamps tried by Mr. Edison, only two remain at present undestroyed. A professor of Harvard University has sent him 50 specimens of fibres to test for the carbon horse-shoes instead of the paper formerly used. Mr. Edison finds manilla is the best of them for his purpose." Amongst those who have the best opportunity of judging what he has done, or is likely to do, little hope seems to remain of his ultimately attaining success with his incandescent lamps.

DEPREZ'S MAGNETO-ELECTRIC MACHINE.

Le Mai April 10 1880

DEPREZ uses a horse-shoe magnet, placing between the two branches a Siemens coil, which is revolved around an axis parallel to the branches of the magnet and provided with proper commutators. The length of the helix is nearly equal to that of the rectilinear branches of the magnet, so as to use nearly all the inductive power of the branches.* With a battery of five Bunsen elements and a magnet weighing 1·7 kilogrammes (4·54 pounds), he obtained as satisfactory results a with a Gramme machine, which had a permanent magnet weighing at least 20 kilogrammes (80·4 pounds).—*Bull. de la Soc. Franc. de Phys.*

EDISON AT HOME.

Call Upon the Greatest Inventor of the Age.

Denver Tribune

He Talks Freely of His Progress and Plans.

April 25 1880

The Wizard Defends the Electric Light, and Says, "You Just Wait."

Edison Coming West to Investigate Ore Reduction.

A New Water-Proof Invention---Cloths, Curls and Leather Preserved.

Vanderbilt---Minnie Fitch---The Whale.

[Special Correspondence of The Tribune.]

NEW YORK, April 15.—I went out to Menlo park on Wednesday to see what progress Edison was making with the electric light and the ore milling process, and to see if he had any new schemes in his head.

I was surprised to find him looking so well. He was disguised in a new suit of blue flannel and about twenty pounds of extra flesh, which he has robed himself in since I saw him last fall. "Yes," he said, in response to congratulations, "I am getting fat. I weigh 190 at least; I guess more. Sleep from 11 to 7 every night, eat three straight meals a day—that's the secret of it."

"Why," said I, "you've grown young ten years this winter."

"I have escaped from the hard work and worriment that the electric light imposed," he said. "Since I finished that I have nothing to worry me."

The visitors looked at one another inquiringly, till one got the courage to say: "But your lights, Mr. Edison, are not up in New York yet, and even the fifty that were glowing here night and day for months have been put out. How is this?"

"There is a wide difference between completing an invention," said he, "and putting the manufactured article on the market. The public, especially the public of journalism, stubbornly refuses to recognize this difference. I have solved all the problems I was engaged on in the matter of the electric light, and have finished it. I can light a city at one-fourth to one-half the price of gas; I have proved it here, and I have put out my lights because there is no longer any need of them. The lamps, conductors and generators are now being made for the demonstration on a larger scale, first here, then in New York. But this involves all the details of manufacturing, and it takes time."

"The public impatience is probably caused," I said, "by the great extortions of the gas companies."

"Yes, but it is always so," he said. "It was years after photography was invented before the first photograph was taken; years after the steamboat and telegraph were invented before they were actually set going, and it was ten years after Stephenson made his first locomotive before he set the 'Rocket' on the track between Liverpool and Manchester. He and Fulton got even more used to being called 'fool' and 'failure' and 'fraud' than I have. So I don't mind it much."

"How long before you will light up again here?"

"Not till we get six or seven hundred lamps set and ready. You see the new posts?" And following him to a window we saw radiating in all directions lines of white posts surmounted with the familiar glass globe, the most distant being half a mile. There are about 150 of these around the fields and more are being added every hour. "It may be ten weeks before they are all set and ready. Then we shall have six hundred lights going at once, run by the surplus power of our 80-horse-power engine. Here is the central room," and he led us through a door into another apartment.

The floor was cut full of holes foot square and a yard apart, over which sat such dynamo machines as were ready to operate. These are to generate electricity from the horse-power, which comes from the engine on belts through the holes in the floor.

"It will probably take fifteen dynamos for Menlo Park," he said, "producing fifty lights each."

"Then when you go to New York and light your first district there," I said, "you will need one of these generators to every fifty lights?"

"Yes; only we shall make them larger. Double the size of the generator and it produces four times as many lights, quadruple it and it yields sixteen times as many, and so on. For New York we shall build dynamos five times as large as these, and they will give us 1,000 lights each."

The dynamo, or generator, I might explain, is a colossal magnet set up on end, the arms looking like two stovepipes standing up on a block of iron. In this block of iron a large spool or brush is made by the belt to revolve rapidly, and this generates the electricity.

"We might now set these up in all buildings that have steam engines or other power," said he, "and proprietors could get their lights for nothing. All mills, factories, daily newspaper offices and large hotels can get their light free, needing only this generator and the lamps. But we have not yet got them for sale."

"How about the ore milling process?" I asked.

"I am not ready to say much about it," he said, "except that we have machines that we believe will add greatly to the value of tailings, but I am trying the experiment of keeping our plans and our method secret. About August I shall go out West and establish works as soon as I get the electric light entirely off my hands."

Although always accessible to any body who has any real right to see him, Mr. Edison is sometimes too much engrossed and preoccupied to talk. But we had found him particularly communicative this morning, and we discreetly listened.

"You see," he went on after a minute, "this business of illumination is only one, and perhaps not the greatest, function of electricity obtained from horse-power. There is no doubt that railroads will be run by this electricity before very long."

"Railroads?"

"Yes; not all, probably, but some. I do not see why most of the lighter and smaller railroads in this country, especially the narrow-gauge roads on the frontier and in the new States, should not be run by electricity."

"How? Have a big battery on the engine?"

"Oh, no; have no power aboard the train except that which is fed from the track. Suppose, for instance, it were a narrow gauge road; very light rail and light engine and cars. Have the rails insulated, then supply them with a store of electricity from fifteen-horse-power engines placed ten miles apart along the track. The electricity climbs from the rails up through the wheels, to the train and propels the driving wheel by the aid of a light dynamito machine on the engine. See? The rails would be reservoirs of electricity, with more being pumped in all the while. The beauty of it would be that the electricity would give the wheels a powerful traction; they would grasp the rails like a hand of iron, and the train would climb a hill as a boy climbs a ladder. The train couldn't get off very well unless the track turned over. Such a road would not need grading at all; it might be very uneven; it could run up and down hills and mountains anywhere. No more tunnels or cuts or fillings. It could go up and down hill 1,000 feet to the mile, only going slower than on level ground. And such a road could be built and operated for one-fourth the cost of an ordinary narrow-gauge. It is especially adapted to the great wheat prairies and the hilly mining regions. There is no doubt whatever that such roads will be built soon, though I have hardly time to undertake it myself. A freight train wouldn't need conductor, engineer or brakeman; it could be regulated from either terminus of the road by telegraph. Let the electricity out of a section and the train comes to a stand still; reverse the current and the train could be stopped within fifty feet. This is the cheap railroad of the future. I feel certain of it."

We left to catch the train to New York. As we went out we crowded past a dry goods box full of books in the entry whose bright uniformity of binding attracted me to look at them. I picked up one and read on its back, "Annales de la Chemie et de la Phisique"—the cehmical annals of France for half a century. About half of the books in Edison's library are in foreign tongues.

THE BRITISH MUSEUM AND THE ELECTRIC LIGHT.—On Saturday morning orders were received to remove all the lamps in the reading room of the British Museum and the approaches which have been used during the last three months in conveying the electric light and enabling readers to remain in the Museum library up to seven p.m. During the month of April, therefore, the reading room will be closed at six o'clock every evening, to which hour the galleries will also remain open. The electric light has, however, been such an eminent success as an experiment that the temporary lamps will be substituted by permanent ones, and these will be extended to all parts of the Museum, so that during next winter the public can be admitted up to six or seven o'clock every evening. Great disappointment has been expressed by the authorities at the delay in removing the natural history and zoological departments from the British Museum to the new museum at South Kensington, which was specially built for this purpose, and was ready for their reception in February last; but orders were received from the Treasury, and repeated on Saturday, that matters must remain *in statu quo*, from the simple fact that no money had been voted to cover the extra expense of removal.

—Engineering.

The Progress of the Electric Light.

Cork trade journal 27 1882

The electric light being now fairly launched upon its practical career, it is both useful and instructive not only to observe the steps in the general public, to have the latest novelties exhibited and the whole question intelligently discussed in such a manner was done during the two last meetings of the Society of Telegraph Engineers. The occasion of a paper by Mr. Alexander Siemens, a nephew of Dr. C. W. Siemens, F. R. S., was seized by the President, Mr. C. F. Varley, F. R. S., to bring together those inventors who had novel lamps to show, and the result was a very interesting meeting which completely filled the hall of the Institution of Civil Engineers, and testified by the number of strangers present that the electric light is a name to conjure by, and that public interest in its success does not seem to have abated.

After tracing the principal causes which led to the recent revival of electric lighting—the illumination of Paris boulevards during the Exhibition year and the Edisonian "scare"—Mr. Siemens dealt with the merits and demerits of electric light apparatus, under the two heads of dynamo-electric machines and lamps; but in illustrating his remarks in very properly confined himself to the apparatus with which he is best acquainted, and for which it is natural that he should have a prepossession, namely, that of the eminent firm with which he is connected, Messrs. Siemens Brothers.

It must be considered as beyond a doubt that, for producing powerful centres of light, electricity is already far superior to gas, both in point of economy and beauty; and every improvement in the apparatus for producing the electric light only renders the superiority more apparent. Dr. Hopkinson has shown that a dynamo-electric machine yields in electricity some 90 per cent. of the mechanical power expended on it, and therefore we cannot expect much improvement in this direction. In the old system of dynamos the current from the rotating armature was passed through the coils of the field magnets and the lamps one after the other in circuit; but in late machines Wheatstone's plan of splitting up the current after it has traversed one part round the magnets, and the rest through the lamps, was adopted, because by its means the strength of the inducing magnets was less subject to variations with variations in the resistance of the external circuit. A still better method, however, is to have a separate machine to excite the magnets to a constant strength, such as is employed by Dr. Siemens in lighting the British Museum. Another point to be attended to is the proportion between the resistance of the voltaic arc and the rest of the lamp circuit. If, for instance, the arc gives 1 ohm, and the rest of the circuit only 0.1 ohm, then when the carbons touch there will be a reduction of 90 per cent. in the total resistance of the working circuit. It is better, therefore, to make the resistance of the rest of the circuit 1 ohm as well as the arc, so that when the carbons touch, the fall in resistance will only be from 2 ohms to 1 ohm instead of from 1.1 to 0.1.

There is, Mr. Siemens pointed out, far more room for improvement in the lamps than in the machines. A good electric lamp should be a single, and, therefore, convenient and cheap; it should keep lit a long time, and should be steady, without affecting the others in circuit; it should burn steadily, silently, and be capable of easy adjustment. A great number of patents have been taken out for electric lamps recently, but it would have been better for the inventors if they had first taken the trouble to consult Colonel Bolton's summary of English patents on gingerees, for many of these old contrivances over again are really old.

Incandescent carbon wicks, first patented by De Moleyns in 1841, and recently worked out by Regnier and by Werdermann, are subject to the defect of consuming rapidly in oxygen of the air, and as they give out a feebler light than the arc, they are consequently more costly than the arc, but on the other hand their steadiness is matchless, and owing to the very feebleness of their light they are best suited for domestic illumination. Perhaps the best incandescent lamp hitherto invented is that of Lane-Fox, which is especially designed for lighting mansions, picture-galleries, ships, and theatres, does not expose the curtain to the air so that it is liable to burn rapidly away; neither does it in close it in a vacuum or a vessel filled with nitrogen gas after the method of Edison and of Messrs. Sawyer and Mann. The incandescent carbon is simply enclosed in an air-tight vessel, and allowed to burn all the oxygen present into carbonic oxide. The inventor of an hour, and the waste of a small piece of carbon, suffice for this process, and when it is completed the carbon pencil burns only at the rate of 1 in. per hour, and a 20-cp. light is found in practice to last 100 hours. There is only one carbon pencil of small diameter employed, and it stands upright and is pressed down in a groove cut across a copper block which forms the negative electrode, to the incandescent point slowly consumes away, the carbon rod, sinking shorter and shorter, sinks within the vertical tube protecting it.

It is of great importance to secure a perfectly air-tight vessel so as to prevent air from entering and forming an explosive mixture with the carbonic dioxide, and the best air-tight joint Mr. Andrew has yet obtained is the "water joint" of Mr. Brougham. The water allows the heated carbonic dioxide within the receptacle of the carbon to escape but prevents the external air from entering. This vessel was lighted by 20 of these lamps, each giving a 20-candle light, and all fed by one small Gramme machine of the A type.

Mr. Siemens then turned to electric lamps giving a "voltaic arc," and explained those invented by Von Hefner Alteneck, the chief assistant of Dr. Werner Siemens, and by Dr. C. W. Siemens, but as these have been already described in our pages we need not dwell upon them here. The one forms, however, decerve mention. The first is the pendulum lamp, regulated by the current passing through a solenoid, which attracts a movable core and liberates an oscillating frame. The frame bears a vertical rack carrying the positive carbon, and feeds the latter downward's until the arc is re-established, when the frame is lifted by the action of the solenoid. In the other lamp the carbons are placed in a horizontal position one over the other, and the feeding mechanism is set in operation of the current in a solenoid on a moveable core is, by means of two bell-crank levers and two pulleys, made to draw the two carbons together. A reflector placed over the arc collects the rays and throws them by projecting them downwards.

Some valuable figures showing the cost of Siemens' light were then cited by the author. From these it appears that to maintain a 6-cp candle light by Siemens' alternating machine, four horse power are required, and 3 lb. of carbon are consumed per hour. With a gas engine to give the power the relative cost of gas and electricity for 6,000 candles is 4s. 10d., and 2s. 7d., the saving by the use of electricity amounting to 47 per cent. By the use of Siemens' permanent magnet machine, however, a saving of no less than 87 per cent. is claimed. With good steam engines to supply the power these percentages would be still higher. But such powerful lights, it must be remembered, are of limited application, and, therefore, gas shares need not be affected by results of this kind. At the Albert Hall a nightly consumption of 250 000 cubic feet of gas costing £7 7s. 6d., is obviated by the employment of the electric light and a saving of 98 per cent. effected; and at Blackpool six electric lights of 6,000 candle power, and costing £5 5s. 10d., displace for £7 5s. worth of gas, with a saving of 64 per cent. At the British Museum, where the use of Siemens' electric light has doubled the time after dusk permitted to readers, four lights of 1,000 candles each are maintained within the reading room, and seven of 1,000 candles each in the vestibule and outside front. These in the reading room are fed by four continuous current machines, the others by one alternating machine, and a fixed exciting machine is used for all. The lights are all worked up to their full power. In the morning after the fresh carbons are put in they are learned a little to see that all is right, and the engine fires kept up all day, so that the light can be started in a moment after dusk has set in. By this plan the cost is raised a little; but notwithstanding the total cost for 300 hours of lighting is only £100 1s. 1d., or about 6s. per hour, comprising 2s. 9d. for the light, and 3s. 3d. for engine driver and other attendant expenses. The cost of gas would be 16s. per hour, and thus a saving of 60 per cent. is effected.

During the meeting Mr. Crompton exhibited his lamp, and for absolute steadiness and great splendor it made a fine display. A full description was given of it in 'Engineering,' vol. xxviii., page 17, but we may say here that its great success lies in the fact that the movable part of the lamp is regulated by the current in a manner so as it is made as possible. Instead of making the regulating current actuate a heavy armature or movable core, as is often done, Mr. Crompton makes it influence an armature in a soft iron armature, and this again attracts a second three-pronged armature, and this again attracts a second three-pronged armature of very small mass. The attraction of this second armature (which by virtue of its small mass is sensitive to slight variations in the current) is opposed by the first armature) causes it to apply a light friction-brake to a wheel which is the last of a train of wheels driven, as in the Serrin lamp by the weight of the descending upper carbon which it controls, feeding it to the arc in an absolutely uniform manner.

The adjourned discussion on Mr. Siemens' paper was opened on the following Wednesday evening by the reading of the secretary of a very interesting communication from M. Berly, the representative in this country of the Société Générale d'Electricité, who after referring to the early history of the Jablochkoff system of electric lighting, and the steady progress which it has been making since it was first installed in the side room of the Grands Magasins du Louvre two and a half years ago, described the four installations of the system in the Place and Avenue de l'Opera and the Paris Hippodrome in 1878, and stated that the Municipal Council of Paris has just renewed the contract with the company which he represents for continuing the lighting the Place and Avenue de l'Opera, the Place du Theatre Francais, and the facade of the Opera House itself for another year, ending in March, 1881. The progress of the system in London is somewhat interesting; it has been steadily extending on the Thames Embankment, starting from twenty lights in December, 1878, to which were added in May, 1879, a further series of twenty lights, and in October of the same year ten more were added by the lighting of Waterloo Bridge, bringing the number of lights all fed from the one station at Charing Cross to fifty, since which time the system has been set on the Victoria Station of the Metropolitan District Railway, and to the board room of the Metropolitan Board of Works, the current for all the lights being supplied by the machine at Charing Cross driven by the same engine of Messrs. Ransomes, Head & Co.

In addition to this experimental adoption of the Jablochkoff system for public lighting, it has also been introduced at the private establishments of Messrs. Shoolbred & Co., in Tottenham Court-road, Messrs. Crocker & Sons, Mr. Nevil, Messrs. Siemens Brothers, and others. But the most complete installation that has yet been made, was in the Palais de l'Industrie for the fine art exhibition familiar to all as the Paris Salon, which is lighted by no less than 256 Jablochkoff lights and the present moment there are as many as 1,716 Jablochkoff lights in regular use, 196 of which are in this country. Concerning the question of the cost of the system, considerable advances have been made, for whereas the Metropolitan Board of Works originally paid the rate of 6d. per light per hour, it was, as the system became extended, reduced first to 5d., then to 3d., and it is now supplied at the rate of 2½d. per light per hour, and at this price the contract has been given for lighting the Victoria Embankment and Waterloo Bridge for another year to terminate on the 10th of April, 1881. Again the Jablochkoff candles have not hitherto been reduced in price, but their period of burning has been increased. The first candles were supplied at 9d. each, but in a short time the cost was reduced to 7½d., then to 6d., and then to 4d., at which figure their price remains. The new candles are capable of lasting nearly two hours. Besides the reduction in cost, other minor improvements have been made, and a very interesting series of experiments have lately been conducted with a view to ascertaining the precise manner in which the candles are consumed, and the best distance at which light can be satisfactorily maintained from the machine or apparatus, and upon the very important economic question as to the employment of the earth as a return circuit. By coupling up the various circuits running between the Victoria Station and Victoria Docks and working up to their full power. In the morning after the fresh carbons are put in they are learned a little to see that all is right, and the engine fires kept up all day, so that the light can be started in a moment after dusk has set in. By this plan the cost is raised a little; but notwithstanding the total cost for 300 hours of lighting is only £100 1s. 1d., or about 6s. per hour, comprising 2s. 9d. for the light, and 3s. 3d. for engine driver and other attendant expenses. The cost of gas would be 16s. per hour, and thus a saving of 60 per cent. is effected.

Among the other lamps recently perfected, that of Mr. Heinrichs was exhibited last evening, this apparatus has already been described in these columns, and the improvements lately introduced by M. Heinrichsmann into his system were exhibited and explained.

It may be convenient to mention here that the lecture theatre during the evening was exclusively illuminated with Mr. Crompton's lamps, and those behaved in a most admirable manner, although far from the satisfaction of their inventor. We may also refer to an interesting review prepared by Mr. Conrad Cooke, at the request of the President, of the progress made in the question of electric lighting during the past eighteen months, and in the course of which he reminded the meeting that as electrical engineers they must all be interested to a great extent in the zeal and enterprise with which the Societe Generale d'Electricite had during the time of the Paris Exhibition demonstrated the complete applicability of the electric light to street illumination, and by so doing, had first set into motion that great wave of public interest to which so much of the recent extraordinary development of the subject was due. He considered that the improvements in the system in Paris and the very interesting experiments of M. Berly of the greatest importance, for they went to show that what was at first considered a very extravagant system could under proper management be made an economical one, and they demonstrated to conclusion the feasibility of lighting the largest rooms in the country, if not the world, from a central station, say from two or three centres. A radius of 3½ miles represented a circle of nearly 40 square miles, and M. Berly's experiments had shown that the electric light was illuminant at that distance from the generating station. Referring to the Bapieff system which was introduced under very informal patronage, he was somewhat surprised that it had not extended beyond the walls of the Times office, and had considered that some description of the system of this system which rendered it unfects must have been discovered in this system which rendered it unsuitable for general adoption, but he had within the last few days learnt that the light was giving great satisfaction to the authorities of the Times, so much so that it has been greatly extended, and was still further intended to other departments.

Turning next to the Wredentown system, which he considered probably the weakest of all systems of electric lighting, Mr. Cooke attributed the failure, mainly to its occupying an intermediate position between the Jablochkoff and the incandescent lights partaking of the character of both, the carbons, instead of being of two united a sectional area at the point to conduct the whole of the current, became highly incandescent by the passage through it of a portion of the current, the excess emptying as a sort of false leakage or arc which surrounded the incandescent point, and by this duplex nature of the source of light the arc and the incandescent burned, for diminishing intervals of time, and therefore tending to a mutual compensation.

Mr. Cooke referred to the Brush system, which he considered as likely to play a very important part in the future development of the electric light. Mr. Cooke, turning to the question of regulators, said, judging from the performance of the Siemens "pendulum" lamp, it appeared that that regulator worked the best so long between the feeds, and when it did not so to work with sufficient rapidity; he had, however, seen the feed it did not do so that the lamp was frequently extinguished, and the same form of lamp performing with the greatest steadiness, and the discussion was probably due to imperfect adjustment to the current. He considered Mr. Crompton's lamp to have very special claims to having solved the question of regulating the electric arc, for in it the existing solved the question of regulating the electric arc, for in it the existing arc was acted on so slowly or so rapidly as they are commenced, and in practice lamps act slowly or rapidly as they are commenced, and in practice lamps act slowly or rapidly as they are commenced, and in practice lamps are fed by a continuous motion rather than by an alternate feeding and stopping action, which must tend to produce fluctuations in the light.

Mr. Crompton pointed out that the cost of cables would be an expensive item in electric lighting. He had tried the "earth" as a return wire, and found that it was the varying resistance of the earth plates; and, moreover, he had observed that the mass of the wire had something to do with the conduction independently of the resistance.

Mr. Ladd, as representing the Brush system, claimed for it the merit of being the one most perfectly adapted for the illumination of large places, not only on the ground of absolute steadiness, great power, and simplicity, but on the point of economical working; he instited simplicity, but on the point of economical working; he instited that the Brush system in the Liverpool Station, where the system is at members to go to the Liverpool Station, where the system is at work, and judge for themselves, and he felt sure that they would come to the conclusion that for a powerful steady light it could not be excelled. Mr. Crompton, in the course of a number of places where the present, in consideration of the fact that the Brush system has been adopted, all of which installations have given the greatest satisfaction. Mr. J. S. Shoolbred called special attention to the very interesting statistical information contained at the end of Mr. Siemens' paper relative to the question of cost, a question which after all must, to a great extent, determine the success or failure of any system as a practical application.

The President, before proposing a vote of thanks to Mr. Siemens for his paper, spoke upon the general question, and in the course of his remarks called attention to the urgent need of some more scientific standard of photometric measurement than that extremely unsatisfactory so-called unit, a normal candle, which conveyed no sort of idea of what was intended and gave rise to endless confusion, and we most

completely endorse all he said with respect to the extremely unsatisfactory state of the question of photometry which is acknowledged on all sides. But the problem is one which is not by any means simple of solution and has occupied the attention of scientific men for a long time past. With respect to the comparison, however, of electric light systems with other systems of illumination, and with one another, we cannot but think that the suggestion made by Mr. Preece is a valuable one, namely, to estimate a light, or a system of lighting, not by its specific intensity but by the area of ground it is capable of illuminating to a given standard or at a given cost of production. This is the practical question to be solved, and we should be very glad to see it adopted in making comparisons between different illuminants.

THE BRITISH MUSEUM AND THE ELECTRIC LIGHT.—On Saturday morning orders were given to suspend all the lamps in the reading room of the British Museum and the approaches which have been used during the last three months in conveying the electric light and enabling readers to remain in the Museum library up to seven p.m. During the month of April, therefore, the reading room will be closed at six o'clock every evening, to which hour the galleries will also remain open. The electric light has, however, been such an eminent success as an experiment that the Treasury, and reported on Saturday, that matters must remain *in statu quo*, from the simple fact that no money had been voted to cover the extra expense of removal.

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negative to the other. Mr. Bidwell also showed by a simple experiment that the action of Edison's receiver was electrolytic. He caused the same passage of a current to lessen the friction of a metal strip on a drum covered with moist paper, and thereby thinned the drum by the evolution of hydrogen.

Professor Ayrton pointed out that the rubbing action in these experiments assisted the current by bringing up fresh electrolytic matter, a fact which had been taken advantage of in the construction of several batteries.

Professor Adams remarked that this explanation did not seem to explain how the current was *reversed* in the cell composed of *two* tin-foil plates.

Professor Guthrie then demonstrated by experiment a curious anomaly in frictional electricity. When flannel is rubbed with ebonite the flannel is + electrified, when ebonite is rubbed with glass the ebonite is + electrified, and we should therefore expect that when flannel is rubbed with glass the flannel would be still more + electrified; but instead of that it is really feebly negative. Perhaps this fact that the best of friction entering into one substance more than the other affected such results.

The Secretary then read a note from Mr. Ridout stating that he had succeeded in Dr. Guthrie's funnel experiment mentioned at last meeting, and, by means of a stream of water flowing out of a glass funnel, had attracted a glass cone towards the mouth of the funnel. The angle of the cone was greater than the angle of the funnel.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT an ordinary general meeting of the Society, held March 24th, Mr. W. H. Preece, President, in the chair, the minutes of the last ordinary general meeting having been read and confirmed, and the list of new and proposed members having been read, the discussion on Mr. Alexander Siemens' paper on "Recent Improvements in Electric Lighting" adjourned from the last meeting, was continued.

At the commencement of the discussion a communication from M. Berly was read by the Secretary.

In 1877-8 Jablochkoff candles were in use at the Magasin du Louvre; this number was since increased to 120, produced by means of a 100 horse-power engine. These had been worked for 2½ years without intermission and with perfect success.

In February, 1878, the Avenues Picquois and other buildings were illuminated by the Jablochkoff system. The Place de Circnl Carrée was also lighted.

In 1878 the Metropolitan Board of Works commenced to light the system on the Thames Embankment, using lights being used; subsequently other lights were added, on Waterloo Bridge and also the Embankment to Blackfriars Bridge. The number of lights now in use is 200. Messrs. Goodhew's establishment, in the Tottenham Court Road, was also lighted by the Jablochkoff system, 25 lights being now in use; several other establishments, Messrs. Nicolls, in Regent Street, and Messrs. Samuel Brothers, Ludgate Hill, amongst these. The Picture Gallery, or Salon, in Paris, has also been lighted by the system, 16 dynamo-batteries of 16 lamps each being employed for the purpose. The total number of candles at present in use is as follows:—56 in Paris, 428 in the provinces, and 823 in foreign countries, or 1,308 in all. In this country there are 198. The cost for a large number of candles was 2d. per hour per candle, but this has now been reduced to 2½d. per hour. The cost of the candles, which was originally 8d. each, is now reduced to 4d., the candles burning two hours each, this would be shortly increased to three hours. As regards cost per horse-power, this had been reduced from 9d. per horse-power per lamp to 3d. per horse-power per lamp. An improvement in the candles was effected by covering them with a coating of electro-type copper. A form of candle which rolls itself if extinguished had been tried in the British Museum in 1879.

A system of automatic switching from one candle to another, so as to introduce a fresh one on the first being consumed, was now under consideration and trial.

As regards dynamo-machines, M. Berly referred to the Gramme Alternating Current Machine* as being an excellent apparatus.

Gas engines were largely in use for driving the dynamo-machines, and worked very successfully.

In speaking of the progress of the light, M. Berly referred to the fabulous estimates which had been made from time to time as to the impossibility of burning a large number of lights except at an enormous expenditure of power and labour. The engine power (nominal) of the Thames Embankment lights was equal to 20, and this lighted four and a-half miles of footings. M. Berly predicted a great future for the electric light.

Mr. Mackenzie then explained a lamp invented by himself.

Mr. Heinemann gave further explanations of his lamp, and stated that it would burn for 30 hours, the brightness which existed was explained to be due to defective carbons, it being difficult at present to make them sufficiently hard in the ring shape.

Mr. Hedges next explained his lamp. This consisted of two carbons, the ends of which pressed at an angle against a block of lime which was kept continually rotating. The arc formed between the ends of the carbons, and the heat produced, rendered the lime incandescent, thus incensing the light.

Mr. H. F. Joel then exhibited an improved form of Wardermann lamp. In this arrangement the pencil of carbon pressed against a heavy disc of copper, the latter being hinged; the weight of the disc normally raised the grip of a clip which held the carbon-rod, the latter being pressed upwards by means of weights. As the rod consumed, the copper disc tended to fall down, thus releasing the clip and allowing the rod to rise. The whole arrangement of the lamp was such that the carbon-rod could be replaced with great ease when consumed. The current was turned off and on by means of a switch similar to an ordinary gas tap. When turned off the current was shunted through a resistance formed of carbon-rods. The resistance of the lamp when burning was 1·6 ohms, and the average resistance when not burning was 30 ohms. The faces of the copper clip were now formed of carbon, as it was found that a better contact was obtained by this arrangement. As regards economy, Mr. Joel stated that by recent improvements the economy had been nearly doubled, and the principle compared favourably with the arc lights.

In reply to Professor Ayrton, Mr. Joel stated that the resistance of the lamp was ascertained by the substitution method, that is to say, a resistance was inserted in the place of a lighted lamp, and varied until the original strength of current was obtained.

Mr. S. A. Phillips then explained Mr. Brockie's arc lamp, a full description of which is given on page 114 of the present number.

Mr. Conrad Cooke summarised the progress which

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* *Telegraphic Journal*, January 15th, 1880.

THREE MONTHS' EXPERIENCE OF ELECTRIC LIGHTING AT BLACKPOOL.*

By Alfred Haslam.

During this meeting I propose to place before you some particulars of the working of our electric lighting, together with the capital cost and the working expenses of the electric light during the three months it has been in use. I do not think it of interest and only tedious to you, but in the case would be generally, inasmuch as it is the only town in which electricity has been tried in the best advantage, and on a practical working scale.

In the beginning of August last year our town council unanimously agreed to light the central portion of their town with electricity, and for a length of about three miles, by means of the electric light, in a manner so entirely anything that had ever been attempted before; this system of lighting to be employed every season during the autumn months, and on days of festivity. The opening day was to be the 15th of September, and I may here say that they have accomplished their object of having created a complete success.

The committee appointed, together with my father, their gas engineer, first proceeded to inspect the various electric systems, lamps, and apparatus, at the exhibition at the South Thames Embankment lights; but we thoroughly satisfied were they that in all these there was nothing but what some large gas lamps would supersede, that they resolved to strike out the safer and experiment of having lamps capable of lighting, and employing four naked lights of 2,000 candles each, placed at the corners, we use as the roof of each of the two piers. The arrangement was therefore a considerable, 1000 yards long, and 50 feet wide, the two piers, at the Promenade are 250 yards apart, and these on the piers about 120 yards from the shore. The wires are placed in glass shot lanterns 60 ft. above the level of the roadway. This is necessary with the high voltage we employ, and is to be working after the contractors had completed.

The site selected as being convenient for the machinery was the Corporation Depot, situated, 400 yards from one end of the Promenade, and 250 yards inland. Here was built the engine and dynamo building, 60 ft. by 25 ft., and a boiler house, 40 ft. by 30 ft., fronting, which formed the entrance to the yard. The boilers were placed on each side of the entrance, and the engine and dynamo house at the end, and two boundary gear to prevent dust rising. Upon this were fixed, as they arrived, two portable 16 horse power engines and boilers, and at the opposite end were the electric machines, which also were fixed, all being driven from a countershaft which ran between them and the engines. From each of the six machines there were two wires, which passed from the one corner across the yard to the pier, to connect the lamps. You will, no doubt, wonder what the old machine was for. Well, at first the idea of the six machines had to perform the duty of producing their own electricity, but that duty we have taken from them by specially devoting a dynamo and this machine to that purpose solely, and this was found to be a most satisfactory plan.

The first difficulty we had to contend with was the laying of the wires inside the 2 in. and 3 in. cast-iron pipes, for having been decided to place them underground, hitherto from time. This proved to any easier, inasmuch as the way was in the pipes laid, and it was desirable to have as few joints as possible. It therefore cost as much to put the wires through as it would to make the trenches, as careful had we to be in order not to damage the insulation, and to keep off the water. The wires were therefore drawn in by an endless rope for us. A rope or two of wire or two of wire rope, a series of light winds set in, with their usual effect of bringing the wires through the water over the Promenade, to the commencement of valleys, last to the detriment of our work; but we soon got over this first location and pipes with any water. The wires at the time we time to stay, we perceived, and completed the whole of the work about the end of the year, and were ready for the preliminary trial to take place on Saturday, the 15th; but, alas! all our efforts were of no avail, for the insulation of the wires had yielded to the water, and it was quite useless for the purpose, so there was no alternative but to withdraw them. This we did on the following Monday evening, and drew out the whole of the wires, which were found to be lamp-posts. By the Saturday night we had temporarily connected the wires, and had two of the most successful trials that could be desired. By the following Monday morning we had collected together the most suitable poles in the town, and these we set to work and placed them up telegraph fashion, and secured the wires thereto with iron staples, these being found to be the most satisfactory. During the time the wires were being fixed experiments and trials were going on in the engine-house, and by Thursday, September 20, all was finally ready, and Mr. Wells were then

think with remarkable steadiness, considering the drawback of the unsteadiness of the engines.

It was hoped on that night we should be all right, but there were I beheld, from an elevated position, the lights dazzling down their twilight white beams on the vast crowd of at least 70,000 persons who had come to Blackpool to witness this grand event, to see the town put on new for one all annihilated. Well, I must say the gas could never figure when burning in the lamps where the electric lights were lit, of which a good many of you present were eye-witnesses, and I am sure you were pleased as the night's work, and no serious accident occurred, was finally extinguished, for it would have been useless to have had the lamps left all in darkness, which might have occasioned a very accident. As we got more accustomed to the eccentricities and freaks of our new and wayward sister, we gained in confidence because we found out how to apply the remedy. In nine cases out of ten the cause was the rock battling the carbons getting fast, and a man was usually on the look-out, and directly with the lamp to see the cause, when he did the keeper would ultimately the passing pebble and position was restored. Sometimes, however, more serious mishaps would occur, owing to the exposed position of the lights, and in the storm gales of wind and rain. The delicate working parts were affected by corrosion and damp, and in such cases there was no alternative but to take the lamp in for readjustment; as it had to remain extinguished for the time. This was a great loss to us, as it was a heavy paying light with it off. Upon all these occasions, however, we took out the spare lamp and substituted it, and thus we had very simplemindedly explained. The reason is this, that owing to all the circuits being of different lengths, and having different resistances, each lamp had to be accurately adjusted and tried in the test-room, with the current flowing all through the wire. Thus, supposing No. 1 lamp went out, and could not be got to work again; it is 1100 yards away, and No. 2 lamp is 1000 yards away, and the men in charge of people the two wires travelling, bring the lamp back, and set to work adjusting the spare lamp, and by the time this is all would require, say, half an hour; this is not all; it has and lost it up, the whole occupying 1½ hour, during which the light would be out, and would need another adjustment, who would afterwards have nothing to do, and some lights would never be visited although at least be always at work.

The mode of working which we have found to be the most advantageous is the following:—Our engineman and assistant look after the engines and boilers, while another very great attention in their staking, for the least simply pressure of steam will throw all the lights out of order. Another man is kept to sit the machines and keep all going right in their department, as also to look after all lamps that may require attention, and to see that all the six machines, but always one in abeyance, on which all the connections are made, and which we have suitable for this appliance. The hour for starting work is one o'clock p.m., and then the mode of procedure is as follows:—All the lamps men start out and fix the carbons in the lamps, clean the same, and load them up again. To the whole operation occupies 2½ hours if all is well. Occasionally a carbon will break in the lamp, and they have to be changed, which is a tricky sight, and this the men are very careful to do, as these babbs they take with them. On these occasions there have been a short fog every time. They now return to the machine room, clean the engines, and go carefully over the machines and belts, and then all is ready for lighting, which generally lasts five hours. We should have to go out this time, hence a second time if we had a light all night; therefore, with extra assistance, we have to go out a second time, and work until about four o'clock in the morning. This period of lighting is one that all is looked for, and is most in proper order all the lamps brought in, as well as to instruct the men in any repairs and alterations to be made. It is also very requisite to go round two or three times a week to see the arteries fixed to the lamps, as they are often a little, and to see that the current is working the lamps all right through.

By way of a little description of the work to be done, I think I could not do a better one than to give you the particulars of the cost of all this, and I will not over system in comparison with the others, so that you may see the proportion of the outlines between large lights and the small ones, comparatively speaking—those of the divided current, or Jablochkoff system. The following figures will show the amount of the capital account. These are the expenditure up to the 31st December, inclusive, as from the reports of Messrs. Siemens Brothers, and of the Metropolitan Board last May, but to the end of the year added the expenses which I find necessary to work their plant permanently, and this enhances the capital. Each item that is added is marked with an asterisk (*). It must be noted that the apparatus at Westgate was only temporarily fixed:

Capital Account.

Blackpool.

Six lights—2,000 candles available.

	£	s.	d.
Two 16 horse-power engines and boiler with reserve power	1,175	0	0
Counter-shaft	22	0	0
Coupling	30	0	0
Seven Hoolahan (Siemens") ...	800	0	0
Seven Siemens' lamp and six batteries	1,125	0	0
Terminals	12	0	0
Switches	22	0	0
Supply of cable	150	0	0
Posts and poles	450	0	0
Engine-house	300	0	0
Foundations	60	0	0
Gas and water fittings	9	0	0
Steeplometer	10	0	0
Voltameter	5	0	0
Tools	10	0	0
Galvanometer and battery ...	20	0	0
Labour erecting, and sundry bills ...	300	0	0
Total	4,500	0	0

Westgate.

Six lights—1182 candles available.

	£	s.	d.
One 12 horse-power engine and boiler	500	0	0
Six Siemens' lamps, complete ...	750	0	0
Six Jablochkoff lamps, complete ...	210	0	0
Terminals, &c.	7	0	0
Sailing	5	0	0
2,200 yards of cable	110	0	0
Six lamp-posts	12	0	0
Engine-house	300	0	0
Foundations	25	0	0
Gas and water fittings... ...	9	0	0
Steeplometer	10	0	0
Voltameter	5	0	0
Tools	10	0	0
Galvanometer and battery ...	7	0	0
Labour erecting, and sundry bills ...	40	0	0
Total	1100	0	0

Thames Embankment.

Twenty lights—4000 candles available.

	£	s.	d.
One 20 horse-power engine and boiler, with reserve power... ...	875	0	0
Counter-shaft	30	0	0*
Two Granzine machines	350	0	0
Twenty Jablochkoff lamps, complete	700	0	0*
Terminals, &c.	5	0	0
Switches	30	0	0*
2000 yards of cable	100	0	0
Twenty lamp-posts	80	0	0*
Engine-house	300	0	0*
Foundations	50	0	0*
Gas and water fittings	9	0	0*
Steeplometer	10	0	0*
Voltameter	5	0	0*
Tools	10	0	0*
Galvanometer and battery ...	7	0	0*
Labour erecting, and sundry bills ...	60	0	0*
Total	2660	0	0

Below I will compare the working expenses were are now at, and those of the others for one night of 5½ hours:

Blackpool.

50,000 candle power.

	£	s.	d.
One engine man	0	5	0
One assistant	0	3	6
Attendant and supervision	0	1	0
Oil, tallow, tapes, &c.	0	0	7
Water for boiler and general use ...	0	0	3
Gas	0	0	0
Carbon, with waste, 16 ft. at 9d. ...	0	12	0
Fuel, coke, and coal, 11 cwt. per night	0	0	6
Interest at 5 per cent.	0	11	5
Repairs and maintenance, 10 per cent.	1	2	4
Total	3	0	10

Westgate.

1182 candle power—four hours lighted.

	£	s.	d.
One engine man	0	4	0
Attendant and supervision	0	2	0
Oil, tallow, tapes, &c.	0	0	7
Water for boiler and general use ...	0	0	2
Gas	0	0	0
24 candles at 8d., 16s. 8d., dropped to 2d.	0	4	5
Fuel, coke, and coal	0	0	6
Interest at 5 per cent.	0	0	1½
Repairs and maintenance, 10 per cent.	0	0	3
Total	1	10	10

Thames Embankment.

4000 candle power.

	£	s.	d.
One engine man	0	5	0
One assistant	0	3	6
Oil, tallow, tapes, &c.	0	0	7
Water for boiler and general use ...	0	0	3
Gas	0	0	0
20 candles, each lasting 1½ hours=30 candles, at 2d. each	0	12	6*
Fuel, coke, and coal	0	0	6
Interest at 5 per cent.	0	0	1½
Repairs and maintenance, 10 per cent.	0	0	3*
Total	1	9	6

Now, it is a very difficult matter to put the proper interest to these tables, inasmuch as the longer the lights are burned the less is the cost per hour; but as I must compute it in some way, so as to arrive at the actual cost, I shall take our own as we intend to use it, or I will give it you as nearly as I can. We intend to keep our lights burning from seven to eight hours, and other than to burn from 5 to 5½ hours. The following calculations I wish me be made accordingly. In the preceding table you will note that we have two engines and boilers, and during the last week we kept the plant going with only one running; therefore, we shall compute favourably with the others in having reserve power, which is far better for safety than to be without such safety, and I may say it would be very necessary to have such power in this town, for on one occasion we were without any motive power for about a keeping up the illuminating power, and were fixed heavily for occasionally leaving part of the town in darkness.

Before closing my paper, I will say a word or two on some of the objects which our lights have produced in different states of its atmosphere, and conclude with a few remarks on the cost of working the electric light against our other allies. The four lights we have on the Victoria Promenade at Blackpool very well for a length of 1500 yards, but not exceeding that, having a decided diversity under them, and not so much midway between them, though amply sufficient for any requirement. If there had been six lights on this length, the effect would have been uniform throughout, and the same applies to the reliability of the light undoubtedly, as we should not have to have noticed particularly has been on some nights when the fog has been able to cut off the two ends of the lights at a distance inland of about 11 mile. This effect, I am of opinion, was caused by the reflection of the vapour from the clouds which I noticed hanging about in large masses pretty low on the horizon, and appearing like some kind of particular benefit to those of the fishermen, who have to go out to sea in the darkness, and enable them to find their lines to take fish, and they have many a time been able to see distinctly. The opposite effects are produced in a dense fog. I have only been able to see the lights at a distance of 100 yards, and I could see at the same distance one of the large 100-candle lamps that we have fixed in another part of the town, owing to the difference in the colour of the light.

The strong concentrated light of an electric lamp is very bad for the eyesight, and I would not recommend any ordinary eyesight to look at them. Occasionally a carbon will break in the arc, and the men employed, have had painful experiences in this result, although at the time we were unconscious we were being affected. While experimenting with the lights, I had a very painful time of it, and by this I do not mean that it is not very interesting, but after the novelty has worn off it will be no longer so. I have had, when I have set up and kept the lights going, and studied from light, as it is impossible to shut them, so painful are they. This result has been experienced by others, and I mention it in case of a great many who have visited the room to see the experimenting operations.

The great idea of the divisibility and distribution of electricity for lighting purposes is one that commends itself, having large houses and warehouses in view, and the principal streets, with small branches to each consumer—has not for a moment been thought of at the time of the electricians, though this is the plan the anxious public are waiting for. In my opinion the electric current have a storage for your supply, as with gas, where you create a large reserve, and, as it were, manufacture your own electricity, have those who require it simply turn on an outlet for the supply, and, by the great old law of gravitation, they get all they want from the stock, while a fresh supply is being made. This is the only way in which I can see our business, but we must be content to go on as we are, and must be consumed; for electricity must be made as it is used, otherwise it cannot be created, and as it moves it disappears. The same electricity does not move round again! A never-ending mystery, and one that puzzles us to know and makes room for more. Now, as it is impossible to store electricity in any considerable quantities, we can look at the object and see the difficulties, some as it is being generated; therefore, the greatest care must be taken to prevent any breakdown. This will be found a great disadvantage, assuming that a town is to be supplied, for it would seem that the apparatus would have to be constantly going in order to supply light when any consumer might at his option desire to avail himself of it during the day or night. It would be like working a gas works without holders for the supply, and this is a great objection to the system of speaking, namely, increased wear and tear and tear of retorts, plant, and now and then all darkness for a short time in the town, if a sudden stoppage took place on the mains, owing to a large establishment lighting up suddenly

tronic. The feature in electric lighting that not as yet shown itself, it being now at the end of the month of May of the year following that in which we lighted and put out the last consumer here that power left to like, which we will close up via right if he has to pay the bill, and another difficulty is care more pressed in the way of electric lighting for towns.

I am, of course, assuming that there is no difficulty in generating electricity, for it is mere mechanical power that is required. Nothing could be so easy, economical, and consequently, I might add, so certain. This leads me to say that the lighting systems of the present day, which are nearly all alike in their working, as regards dividing lights. The plan adopted is to put from half a dozen up to, say, twenty lights on one circuit—that is to say, one machine has twenty lights put on its wire from leaving the machine to coming back. The distance may be slight, or as long as your wire has conductivity to allow it to be, and the lights may be put on singly, or collectively, as you send through the number of lamps indefinitely; that is to say, the limits of the power of the machine are soon reached, and the more breaks or resistances you put on the circuit, so each of the lights is less in proportion, for the law of the flow of electricity is inversely as the resistance. Thus, let us suppose the current is represented by 100; now if you put on resistances equal to 100 more, you would cut in the internal resistance of the machine, which is equal to the best result of the Siemens machines, and you have doubled the resistance in the current; therefore, the total current is reduced to 50, of which the outside circuit has 25 available, that is to say, double the resistance, and the current is halved; treble the resistance, and the current is one-third as much. Therefore, you see soon the quantity the lights are reduced to, and you soon see the impossibility of doing as that you could not have small lights as successful as large ones. The same is the case with lamps burning by incandescence; you all know that it is only the resistance to the current—low that converts electricity into heat.

I really cannot see the reason for gas directors becoming alarmed lest they should be driven out of the field for lighting purposes, and I am afraid that the electricity, with its delicate working parts, and consequent extremely cut-off arrangements—all which are claimed to be simple in action, but which I am certain would soon get out of order if left to take care of themselves in any ordinary house—I am afraid, I say, that the out-off arrangements now in operation would be and occasionally, under ordinary usage, would be out of order, and consequently cause the loss of whole houses. For public museums, large halls, and for lighting the main thoroughfares at large towns, where known light is wanted that is near the meridian necessary by most local authorities, there, I say, gas and electricity will come into competition; but I can't opinion that our main thoroughfares are well illuminated during business hours by the sun light, although where the gas is in the street lamps it is usually lighted for about an hour or half an hour's wasting of money in the morning, as many of the results power being every 60 yards or so apart. After business hours there is, comparatively speaking, not anybody out of doors, and gas keeps are ready for the purpose of giving light. The scope which electricity has is necessarily very limited, there not being so very many large spaces which will need to be lighted up so brightly as to only consume the light of the sun, moon, and stars. There is a larger field open for it in the transmission of motive power, in which electricians may reap more remunerative employment for their labours if they will accomplish their grand idea of utilising the tides, and the Falls of Niagara, in supplying the general method of supplying motive power for the great industries of the world.

working of metalliferous mines has ceased to be attended with the profits which were formerly obtained from them, chiefly on account of foreign competition; but if it were possible to effect the reduction of the ore raised by a cheap fuel on the spot a great revival of the mining industry would ensue At the present time mining in Cornwall and Devon would be considerably advanced were fuel for smelting purposes available in the locality at a cheap rate; at present the coal for the purpose has to be conveyed at a considerable expense from a distance, or, on the other hand, the smelting products have to be conveyed to the neighbourhood of the coal-pits, the expense of carriage in either case being heavy. Now, in both Devon and Cornwall the fuel exists, not in the form by which it is commonly known, but it exists in the numerous streams and waterfalls, and in the tide which surrounds their iron-bound coasts. The conversion of motive power into electricity and heat has been proved to be possible. Will some scientific and commercial genius practically apply the knowledge which has been obtained? The theoretical possibility of the idea we have suggested is, we imagine, unquestionable; its practical possibility, we think, is as certain.

Whilst advocating the application of electricity to the smelting of metalliferous ores by means of power converted into heat by electricity, we would by no means insinuate that the reduction of the ores must necessarily be effected in this way. The science of electro-metallurgy daily shows that many may be reduced from their salts by the electric current; cannot it effect the reduction of metals from their natural earthy condition by a process equally simple with that of electro-plating, and do it in an economical manner? The motive power necessary to effect the results exists in inexhaustible quantities; it only wants to be applied. Let electro-metallurgists and electricians ponder the question out, as we feel certain they will do in time, and another triumph will be won by means of electricity.

CROMPTON'S ELECTRIC LAMP.

Its general principle this lamp possesses but little novelty; it is rather a refined and well designed arrangement adapted from old patterns, but the improvement effected in the mode carrying out of first principles renders the lamp one of the best yet designed.

There are two distinct movements in the lamp, by one the carbons are separated to a definite distance, and by the second; they are allowed to approach together until checked by a slight increase in the current, consequent thereon. A

two hundredths of a millimetre; the feel, therefore, is practically continuous and causes the light to be proportionally steady.

The pinion into which the wheel, a, gears is not fixed to the wheel, c, but is connected to the latter by a ratchet wheel, so that the rod, n, can be drawn up when it is required to insert a new carbon, without turning all the wheels in the train.

The course of the current through the electro-

(3)

magnet and carbons is quite simple; thus, the current, entering at w, passes through the electro-magnet, a, direct, thence to the frame of the apparatus and the upper carbon, and from there to the lower carbon and back to the dynamo machine.

The screw, d, when screwed down presses the strap, r, against the brake-wheel, A, and prevents it from turning; this is only required for security during transport.

THE NEW SAWYER ELECTRIC LAMP.—This lamp," says the *Scientific American*, "burns upon the incandescence principle, and the material employed is nitrogen gas," if it be not very different from that used in the Bouligaire or the old Sawyer-Mann lamp exhibited some years ago. The gas itself is contained within a globe two inches in diameter and ten inches high, sealed at the bottom to a brass socket, which, while adhering perfectly to the globe, is yet sufficiently elastic to compensate for the unequal expansion of the two. It entered only at a temperature of 200° Fah. The globes are charged by the process invented some time ago by Thomas B. Stillman, which is so simple in its details and so rapidly operated that a single workman can prepare fifty lamps per hour at a cost of about thirty cents, in such a manner that according to Stillman's calculation, the amount of atmospheric air remaining is only an infinitely small fraction of the normal quantity. The cost of the nitrogen is stated at eight-tenths of one cent, and that of its purification as one and one-fifth cents; the total cost of recharging a lamp, when the nitrogen is exhausted or becomes mixed with air, being, inclusive of the wages of the workmen, two and three-fifths cents, against a cost of seventy cents for the process usually employed. "The carbon" pencil, seven inches in length and about three thirty-seconds of an inch in diameter, is fed upward as fast as disintegration takes place at the point of contact, by means of a regulator, which will be substituted by an automatic feeder as soon as the arrangement can be perfected. Mr. Sawyer says that one of these pencils, used for five hours a day, will last at a minimum calculation from his experiments, not less than ninety days, and, at a maximum, for two years. The cost of the pencil is a trifle less than two cents, and the cost of replacing and recharging with nitrogen also and three-fifths cents. The leg of asbestos and the large spiral conductors at the base of the carbon, which were distinguishing features of the Sawyer-Mann lamp exhibited about a year ago at No. 92 Walker-street, have been discarded. Two small steel rods take the place of the latter. "The globe, which is not unlike the chimney of an ordinary kerosene lamp in general appearance, is imbedded in a nickel-plated base, which may be highly ornamented or not, according to the taste or means of the user. Photometric tests, it is said, have been made with a 600 candle-power dynamo, such as is used by the companies for the same purpose, and each light was registered as equal to twenty-seven of the ten-inches standard candles, or a little more than twice the value of a four-foot gas burner, which usually registers from ten to twelve standard candles. Mr. Sawyer claims that his system of distribution is entirely novel and original, but declines for the present to give a description of it, the patents not having been as yet secured. The regulator, we are told, is based upon the plan used by the old Berlin house of Siemens Brothers, by which only such a volume of current is supplied as is necessary to overcome the resistance. The light is readily toned down by a glimmer-burning solution in the wall. In its capital purposes this light is much like gas. It is yellow, steady, and soft, and does especially well for reading in the day. It has none of the blue rays incident to the voltaic arrangement, and the shadow cast by intervening objects is softened and mellowed at the margin. For practical purposes it is intended that the power of each lamp shall not exceed that of two ordinary gas jets."

[It is stated that seven lamps are operated upon one circuit worked by four horse-power. The economy of this system does not appear to be marvellously great. Seven lamps of 25 standard candles each, or 1925 candles in all, for four horse-power, is not a very wonderful achievement.—The Eng. Edit.]

5 ft. gas burner. = 10 to 12 candles. (?)

ever saw, namely, New Rush or Kimberley. It is simply a collection of canvas tents and sheds of galvanized iron, the larger being used for stores and drinking saloons, canvas theatres, and churches of various denominations. Here dwell the diggers, men of every nation under the sun, each individual attracted together by the glitter of the diamond. The Celestial has not, strange to say, yet his food in three yet to receive his kicks and halfpence smilingly; but one may see any day on the streets or in the inns a Lascar cooking next to a Frenchman, a Yankee with a New Zealander, an Irish patriot talking drinks with a Japanese, and even a Russian on friendly terms with a Turk. When all sorts of men meet like this for a common object far from home and old prejudices, they rely only on their merits, and friendly and forget differences of race and creed. A friendly goodwill makes the heterogeneous elements work together amicably. We found the diggers both hospitable and kind, although, perhaps, rather addicted to taking and giving drinks. We were heartily welcomed by them all; for, rough natives as they were, they had the feeling that we had somehow brought them nearer by six days to their old homes.

ELECTRIC LIGHTING IN AMERICA.

[The following letter deserves careful reading. It is not often that we can commend the scientific enterprise of newspaper correspondents, but this communication to the *Standard* of the 13th inst. is worthy of reproduction, and we can only hope that the writer may continue to send us good material in the future.—ED. *E.*].

NEW YORK, APRIL 2.

The value of the small incandescent light invented by Mr. Edison last December continues to be much discussed. This lamp was a carbonized filament of bristol board burnt in the form of a horse-shoe, enclosed in a hermetically sealed glass bulb, three inches in diameter, and heated by a current of electricity. The resistance of the filament was claimed to be 100 Ohms. When the public exhibition was given on Fourth-street there were forty-five of these lamps in use in the buildings and streets of Menlo Park, the light being maintained by three dynamo-electric machines.

I visited the shops a few days ago, and had a long conversation with Mr. Edison. While still confident that his lamp is to be ultimately an unqualified success, Mr. Edison surprised me by saying that only two of his paper carbon lamps were then in existence. The rest, nearly 300 in number, had been destroyed by the action of the electric current, one after the other. From some cause, which no one understood at first, the platinum conducting wires would, after a short period of satisfactory service, suddenly grow hot in some lamp. The glass bulb then would crack, and the pressure of the air outside would burst in the glass at two points, and the carbon would then consume almost instantly. This accident occurred to one of the lamps, finally, while Mr. Edison had it under observation. He discovered that the contact between the ends of the paper carbon and the conducting wires was not perfect. A vehicle was formed there, the wires grew hot, and the lamp was destroyed before his eyes. He sought then to remedy the trouble by copper-plating the ends of the carbon, in order to make a more perfect contact with the conducting wires. This expedient was not successful, and the paper carbons kept going out. Sometimes they would burn out within ten minutes without any rupture of the glass bulb. A record duration of each of them was seven hours. Some lasted that time.

Two of these inventions are still in use, and are lighted every night. One is in the store, the other in a house within the new enclosed for one thousand seven hundred hours. It is the defects of the light-are to cure, and that he will yet solve the long-agitated problem of electric illumination of small buildings. This lamp which holds out so well is now being made the subject of special study, and I regret to say that no one who looks at it admires Mr. Edison's opinion. Within the glass bulb of this lamp there is now a deposit of fine black powder, which is thickest in the lower part of the bulb, and globe of a gaslight. This phenomenon indicates the early destruction of the lamp. It reveals the fatal and inevitable defect of carbon as a material for a small incandescent light. It shows that even in the remarkable vacuums produced by the mercurial air pump carbon will volatilize. This has been the trouble invariably with all this class of inventions in America so far. No carbon vacuum lamp has been produced here the interior of which would not be covered with a deposit of volatilized matter after being in use for a few hundred hours. Rupture of the burner has invariably followed the appearance of the deposit in the course of time. Mr. Sawyer, the rival of Edison, has come definitely to the conclusion that this sort of thing cannot be prevented, and he has abandoned all hope of perfecting a permanently durable lamp of this class.

Edison has now been brought face to face with the true character of the problem before him. Nature has supplied only two materials for an incandescent light. He has tried these both, and finds both defective. Platinum melts, and carbon volatilizes. The only question seems to be, how long can carbon be made to last? With a view to ascertaining the truth he has begun a new series of experiments. A Professor at Harvard University has sent to him fifty different varieties of fibres of grasses and woods, obtained from all parts of the world, some of them having been obtained for the University during the explorations of Agassiz in South America. He is trying the value of these for carbons. The object is to obtain a filament more tenacious naturally than paper, and one which shall be fruitless throughout its whole length. It is found to be durability to have the filament of unequal size. If at any point in the length of the carbon the diameter is smaller than elsewhere the force of the electric current concentrates there and causes a rupture. Mr. Edison finds that manila fibre is the best of the fifty submitted to him. It is remarkably strong, even, and elastic when carbonised, and gives as good a light as paper. Its existence in bigger than that of paper. About twenty lamps with this material for the burners have now been made. I saw about a dozen of them lighted at Mr. Edison's shops a day or two ago. There is nothing noteworthy about them, except that it takes more power to make them give a sixteen-candle light than it did the paper carbon lamps. When fully incandescent they had the same beauty and brilliance of this class of lights in general. How many can be maintained per horse-power is not known. They would be beautiful lights to introduce into dwellings, and could they be depended upon they would make a great sensation. But I now begin to believe that neither they nor any other small incandescent carbon lamp will ever be introduced to dwellings to any very extensive degree. Edison's people will not be are willing to submit to some inconvenience for the sake of obtaining a light which will not consume the air. There is no reason to believe that the manila carbons will last much longer than the paper carbons. Experience has taught that lesson. People who use the Edison lamps, therefore, must expect breakages, sudden extinction of lights, and other annoyances of a similar character, in fair proportion of which will occur on occasions when they will be most inconvenient. It is doubtful whether if any one would wish to purchase additional purity of air in houses at such a cost. I am certain that no one in New York does, nor will any one here give any encouragement to household illumination with these lamps until they are proved to be proof against accident.

Mr. Edison is greatly vexed at the growing popular incredulity in regard to his reiterated assertion that a satisfactory system of illumination has been perfected. He recently asked Professor George F. Barker, of the Edison Electric Light Company, at Philadelphia; Professor Rowland, of the John Hopkins University at Baltimore; and Professors Brackett and Young, to investigate the subject and announce the result of their inquiries to the public. This committee of scientific gentlemen spent a few days at Menlo Park the early part of the present month, and a night before last, Professor Barker made a report in the form of a lecture at Philadelphia. He had a number of the carbon lamps in the hall, and used an electric current of one-horse, consuming twenty-one cubic feet of gas per hour per horse-power, to generate the current. The lecture was an unfavourable exposition of the qualities and modes of generating the electric light. It contained no new and important information. It was, in fact, a disappointment to all who were hoping for a clear criticism of the value of Mr. Edison's achievements. Of the durability of the lamps at Menlo Park nothing definite was known, as only one of them had lasted forty-one hours less than six hundred hours. The fact that disaster had overtaken them all except two was duly referred to. Of the economy of the light it was admitted that, so long as gas can be made for eighty cents per thousand cubic feet, the electric light can be produced no cheaper. Professor Barker repeated the claim which has been made at Menlo Park, that ten sixteen-candle lights can be produced per horse-power, but no demonstration of this was made on the platform. Mr. Edison hopes to obtain ten good lights per horse-power, but he does not do it yet. It is upon his ability to do that that the whole claim of superior economy of the incandescent light is based, and why this unsupported assertion should continually be made by himself and his friends surpasses all comprehension. It is doing him great injury in the estimation of all practical men. It is the well-known failure to annihilate natural

THE ELECTRIC LIGHT.

EXPERIMENTS are in progress at the North Shore Mills, Liverpool, under the direction of Mr. Ward, engineer of the British Electric Light Company, with the Ambre incandescent lamp, which is said to possess several special advantages. The light is contained in a globe hermetically sealed, and, as the carbon burns the light becomes feebler from exhaustion with the air, they are not subject to combustion, or the illumination is so slow as to be almost imperceptible. The lamps is simple and effective. It is self-adjusting, devoid of mechanical appliances, and, as the carbon points are not actually consumed, it will remain illuminated for many hundred hours. The avoidance of any renewal of the carbon points is an obvious advantage, as is the fact that the new system admits of a complete subdivision of the current of electricity.

ABSTRACT OF PATENTS.

2301. ELECTRIC LIGHTING, *R. Werdermann.*—*Dated* [illegible]

The upper electrode is screwed by a stump connected to an arm placed in a horizontal position, and provided to a sliding piece on a fixed vertical bar. In order to adjust the light, the upper electrode is screwed further under the light, and a portion of the rays pass through it, and are reflected upward upon a small deflector fixed above the electrodes.

2322. ELECTRIC LAMPS, *C. D. Abel.*—*Dated* 11th June, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*

The two carbon electrodes are carried by two pistons, plungers, or fluids contained in two closed vessels filled with liquid, in communication with each other, the relative heights of the liquid in the vessels and the weight of the pistons and arms projecting therefrom carrying the carbons being so proportioned that the piston carrying the upper carbon will tend to descend in its vessel, causing the liquid to flow therefrom into the other vessel, and thereby raising the second piston with the lower carbon.

ELECTRICAL TELEMETER.—In the *Revista Militare* is described by M. G. Le Cordier de Tréhérin, of the French Navy, for the purpose of determining at any moment the distance of a movable and inaccessible object, two sides of a triangle are indicated by a telescope through which the object is observed from station A, and by a base line, say 1,000 metres in length, between this station and another station B, at which the object is observed through a second telescope. On the base line and at a distance, say of one metre from the terminal point, about which moves the telescope at A, is pivoted a pointer which, by means of a succession of currents produced whenever the telescope at B is moved, is consequently maintained exactly parallel with this instrument. It will be seen that this pointer gives at station A the third line of a triangle exactly 1,000 times smaller than that formed by straight lines from the inaccessible object C to the extremities of the base line between the stations A and B. The pointer may thus be made to indicate on a scale at A the exact distance at any moment of the movable object, whenever the observers at A and B are *both* at their posts. The apparatus for the transmission of the currents from B is somewhat similar to that in the alphabetical instrument of Messrs. Siemens; whilst in the receiver at A a shaft carrying an endless screw is influenced by two electro-magnets, so as to move a toothed wheel, to the axis of which is attached the pointer which is maintained parallel with the direction of the telescope at B.

ENIGMATIA.—The *Operator* says, "The opinions of scientific men in Europe as to the ultimate success of Edison's light seem much divided." We thought otherwise; and it still seems to us that the scientific opinion of Europe is practically unanimous, and is that Edison has failed. In fact we have not heard of one solitary individual possessing any scientific standing in Europe who has expressed the opinion that Edison has succeeded.

mittee of the Society of Telegraph Engineers or British Association should be appointed to consider these points, and decide authoritatively the exact nature of the future to be employed.

Electrical Notes.

ON THE EFFICIENCY OF EDISON'S ELECTRIC LIGHT.

By Professor H. A. Rowland of the Johns Hopkins University, and Prof. G. F. Barker of the University of Pennsylvania.

The great interest which is now being felt throughout the civilized world in the success of the various attempts to light houses by electricity, together with the contradictory statements made with regard to Mr. Edison's method, have induced us to attempt a brief examination of the efficiency of his light. We deemed this the more important because most of the information on the subject has not been given to the public in a trustworthy form. We have endeavoured to make a brief but complete test of the efficiency of the light, that is, the amount of light which could be obtained from one horse-power of work given out by the steam engine. For if the light be economical, the minor points, such as making the carbon strips last, can undoubtedly be put into practical shape.

Three methods of testing the efficiency presented themselves to us. The first was by means of measuring the horse-power required to drive the machine, together with the number of lights which it would give. But the dynamometer was not in very good working order, and it was difficult to determine the number of lights and their photometric power, as they were scattered throughout a long distance, and as this method was abandoned. Another method was by measuring the resistance of, and amount of current passing through, a single lamp. But the instruments available for this purpose were very rough, and so this method was abandoned for the third one. This method consisted in putting the lamp under water and observering the total amount of heat generated in the water per minute. For this purpose, a calorimeter, holding about 11 kil. of water, was made out of very thin copper; the lamp was held firmly in the centre, so that a stirrer could work around it. The temperature was noted on a delicate Bandin thermometer graduated to 0°1 C.

As the experiment was only meant to give a rough idea of the efficiency within two or three per cent., no correction was made for radiation, but the error was avoided as much as possible by having the mean temperature of the calorimeter as near that of the air as possible, and the rise of temperature small. The error would then be much less than one per cent. A small portion of the light escaped through the apertures in the cover, but the amount of energy must have been very minute.

In order to obtain the amount of light and eliminate all changes of the engine and machine, two lamps of nearly equal power were generally used, one being in the calorimeter while the other was being measured. They were then reversed and the mean of the results taken. The apparatus for measuring the light was one of the ordinary Bunsen instruments used for determining gas-light, with a single candle at ten inches distance. The candles used were the ordinary standards burning 120 grains per hour. They were weighed before and after each experiment, but as the amount burned did not vary more than one p. c. from 120 grains per hour, no correction was made.

As the strips of carbonized paper were flat, very much more light was given out in a direction perpendicular to the surface than in the plane of the edge. Two observations were taken of this in the photometric power, one in a direction perpendicular to the paper, and the other in the direction of the edge, and we are required to obtain the average light from these. If I_0 is the photometric power perpendicular to the paper, and I that of the edge, then the average λ will evidently be very nearly

$$\lambda = I_0 \int_0^{\frac{1}{2}\pi} \cos\alpha \sin\alpha \, d\alpha + I \int_0^{\frac{1}{2}\pi} \sin^2\alpha \, d\alpha,$$

$$\lambda = \tfrac{1}{2} I_0 + \tfrac{\pi}{4} I.$$

In the paper lamps we found $I = 1_0$ nearly; hence $\lambda = \frac{\pi}{4} I$, nearly.

The lamps used were as follows:—

No.	Kind of carbon.	Size of carbon.	Approximate resistance when cold.
880	paper	large	147 ohms.
881	"	"	147 "
850	"	small	170 "
869	"	"	154 "
817	fiber	large	87 "

The capacity of the calorimeter was obtained by adding to the capacity of the water the copper of the calorimeter and the glass of the lamp and thermometer. The calorimeter and cover weighed 0·103 kil. and the lamps about 0·035 kil.

First experiment, No. 201 in calorimeter and No. 880 in use.

might remain in one town, and with his battery send a locomotive and train to any distance required.

It would seem from the above that the idea of railway car propulsion by electricity was projected in this country more than thirty years before Mr. Siemens' motor was introduced to the public.

THE ELECTRIC RAILWAY AN AMERICAN INVENTION.

On page 137 of the present volume of the Scientific American will be found translations and descriptions of Siemens' electrical railway motor, which was operated at the Berlin Exhibition in 1879. Since that publication our attention has been directed to a similar plan described in the Scientific American as long ago as September 25, 1847, which reads as follows:

"Mr. Lilly and Dr. Colton, of Pittsburg, Pa., have invented a new method of railway propulsion, which is both novel and ingenious. The machine is a small locomotive, and is placed upon a circular railway, around which it is driven by electricity. The power is applied not to the locomotive, but to the track, in a very curious manner. Two currents of electricity, negative and positive, are applied to the rails, and by them communicate to the engine. The latter is provided with two magnets, which, by a process of alternate attraction and repulsion, drive the car over the track. A piece of lead is placed on the locomotive, making in all a weight of ten pounds, and on the application of the battery, the machine moved with astonishing rapidity up a plane inclined about five degrees. Heretofore the propelling power had been used on the car itself—in this instance, however, the power is placed on the rails, and an engineer

ON THE DYNAMO-ELECTRIC CURRENT AND CERTAIN MEANS TO IMPROVE ITS STEADINESS.*

By C. WILLIAM SIEMENS, D.C.L., F.R.S.

The subject of my paper relating to the early conception by Dr. Werner Siemens of the dynamo-electric principle, and to the subsequent discovery of gradation of electro-magnetic power, which I claimed in the subject presented, the one by Sir Charles Wheatstone and the other by himself, to the Royal Society in February, 1867. The machine then designed by him, and shown in operation on that occasion, is again brought forward with a view of indicating the progress that has since taken place in the construction of dynamo-electric machines, particularly those by Gramme and Siemens-von Alteneck. The paper next points out certain drawbacks to the use of these machines, both of them being subject to the disadvantage that an increase of external resistance causes a falling off of the current; and that, on the other hand, the short circuiting of the outer resistance, through contact between the carbon electrodes of an electric lamp, very much increases the electro-motive element of the machine and the power necessary to maintain its motion, giving rise to rapid heating and destructive sparks in the machine itself.

An observation in Sir Charles Wheatstone's paper is referred to, pointing to the fact that a powerful current is set up in the shunt circuit of a dynamo-electric machine, which circumstance has since been taken advantage of to some extent by Mr. Ladd and Mr. Brush, in constructing current generators.

The principal object of the paper is to establish the conditions under which dynamo-electric machines worked on the shunt principle can be made to give maximum results. A series of tables and diagrams are given, the results of experiments conducted by Mr. Lundell, electrician, employed on the author's works, which lead up to the conclusion that, in constructing such machines on the shunt principle, the resistance on the rotating helix has to be considerably reduced by increasing the thickness of the wire employed, and that on the magnets has to be increased more than tenfold, not by the employment of thin wire, but by augmenting the length and weight of coil wire employed.

The results of this mode of distributing the resistances is summarized as follows:—

1. That the electromotive force, instead of diminishing with increased resistance, remains at first nearly, and then more slowly towards an asymptote.

2. That the current in the outer circuit is actually greater for a unit and a half resistance than for one unit.

3. With an external resistance of one unit, which is about equivalent to an electric arc, when thirty or forty webers are passing through it, 2·44 horse-power is expended, of which 1·29 horse-power is usefully employed, proving an efficiency of 53 per cent., as compared with 45 per cent. in the case of the ordinary dynamo-machine.

4. That the maximum energy which can be demanded from the engine is 2·6 horse-power, so that but a small margin of power is needed to suffice for the greatest possible resistance.

5. That the maximum energy which can be injuriously transferred into heat in the machine itself is 1·3 horse-power, so that there is no fear here of destroying the insulation of the helix by excessive heating.

6. That the maximum current is approximately that which would be habitually used, and therefore the economy of heating brushes are quite capable of transmitting.

Hence the author concludes that the new machine will give a steadier light than the old one with greater economy of power, that it will be less liable to derangement, and may be driven without injury at a speed by a smaller engine; also that the new machine is free from all objection when used for the purpose of electro-deposition.

This construction of machine enables the author to effect an important simplification of the regulator of arc lamps, consisting him to dispense with all wheel and clockwork in the arrangement. The two carbons being pushed onward by gravity or spring power are clocked laterally by a pointed metallic abutment, situated at such a distance from the arc itself that the heat is only just sufficient to cause the gradual wasting away of the carbon in contact with atmospheric air. The carbon holders are connected to the iron core of a solenoid coil, of a resistance equal to about 50 times that of the arc, the ends of which coil are connected to the two electrodes respectively. The weight of the core (which may be varied) determines the force of current that has to pass through the regulating coil in order to keep the weight in suspension, and this in its turn is dependent upon the resistance of the arc. The result is that the length of the arc is regulated automatically, so as to maintain a uniform resistance signifying a uniform development of light.

* Abstract of a Paper presented to the Royal Society.

tometer; capacity of calorimeter $= 1{\cdot}153 + {\cdot}009 + {\cdot}007 = 1{\cdot}169$ kil. The temperature rose from 18°·28 C. to 21°·11 C. in five minutes, or 1°·75 F. in one minute. Taking the mechanical equivalent as 775', which is about right for the degrees of this thermometer, this corresponds to an expenditure of 3,486 foot pounds per minute. The photometric power of No. 580 was 17·5 candles maximum, or 13·1 mean, λ.

When the lamps were reversed, the result was 3,540 foot pounds for No. 580, and a power of 13·5 or 10·1 candles mean.

The mean of these two gives, therefore, a power of 3,513 foot pounds per minute for 11·6 candles, or 109·0 candles to the horse-power.

To test the change of efficiency when the temperature varied, we tried another experiment with the same pair of lamps, and also used some others where the radiating area was smaller, and, consequently, the temperature had to be higher to give out an equal light.

We combine the results in the following table, having calculated the number of candles per indicated horse-power by taking 70 per cent. of the calculated value, thus allowing about 30 per cent. for the friction of the engine, and the loss of energy in the magneto-electric machine, heating of wires, &c. As Mr. Edison's machine is undoubtedly one of the most efficient now made, it is believed that this estimate will be found practically correct. The experiment on No. 817 was made by observing the photometric power before and after the calorimeter experiment, as two equal lamps could not be found. As the fiber was round, it gave a nearly equal light in all directions as was found by experiment.

Lamps used in		Photometric power		Capacity of Calorimeter in pounds.	Rise of temperature in degrees F.	Energy per minute in foot pounds.	Mean number of candles per horse-power of electricity.	Mean number gas jets of 16 candles each per horse-power of electricity.	Mean number of gas jets per indicated horse-power.
Calorimeter	Photometer	Measured perpendicular to paper, L.	Average, λ						
201	580	17·5	13·1	2·57	1°·75	3486·	109·0	6.8	4·8
580	201	13·5	10·1	2·82	1°·62	3540·			
580	201	38·5	28·9	2·74	2°·44	5181·	204·3	12·8	8·9
201	580	44·6	33·5	2·76	2°·29	4898·			
850	809	19·0	14·3	2·81	1°·14	2483·	133·4	8·3	5·8
809	850	12·2	9·2	2·79	1°·54	3330·			
817			17·2	2·73	1°·28	2708·	209·6	13·1	9·2

The increased efficiency, with rise of temperature, is clearly shown by the table, and there is no reason, provided the carbons can be made to stand, why the number of candles per horse-power might not be greatly increased, seeing that the amount which can be obtained from the arc is from 1,000 to 1,500 candles per horse-power. Provided the lamp can be made either cheap enough or durable enough, there is no reasonable doubt of the practical success of the light, but this point will evidently require much further experiment before the light can be pronounced practicable.

In conclusion, we must thank Mr. Edison for placing his entire establishment at our disposal in order that we might form a just and unbiased estimate of the economy of his light.—*American Journal of Science.*

THE EDISON LIGHT.

A Criticism of the Article in the "American Journal of Science"—What it is that Electricians want to Know?

(To the Editors of the *Evening Post.*)

In the *Evening Post* of Saturday last, referring to the publication in the *American Journal of Science* of the result of certain tests of the Edison electric light, you say:—"The examinations . . . have been elaborate, and the results are open to scientific inspection and criticism in the tables of formulas and the propositions and corollaries deducible therefrom." It appears to me, on the contrary, that the article in question is rather more remarkable in respect to what it fails to say than otherwise, and that it avoids with considerable skill the real point in question, the practical and commercial value of Mr. Edison's system of lighting.

It is well known to those who are even tolerably familiar with the subject that electric lighting by incandescence is by no means a new thing; and although it may, perhaps, not be so well known, it is equally true that the subdivision of the current, the automatic regulation of the light, its maintenance with absolute steadiness for months at any required degree of intensity—all this had been accomplished long before Mr. Edison attacked the problem. The problem remaining to be solved concerned solely the economical production of the light.

Now, what the public would like to know is simply this: First, What quantity of electricity per second is required to produce in the lamp an electric light having the photometric value of say ten standard candles? Second, What is the cost of generating that quantity of electricity and of conveying it to the point where it is to be converted into light?

Any physicist can answer these questions with perfect accuracy provided the proper data are placed in his hands, and moreover such data can be obtained by simple and direct methods in every day use. There is no occasion for any mystery about it.

The illuminating power of any electric light or any number of them is readily ascertainable by the photometer. The amount of electricity in vebers (units of current) per second, passing through the conductor which supplies the lamp, can be measured with the utmost ease by means of a tangent galvanometer, an instrument which is among the essential appliances of every working electrician. The electrical resistance of the three parts of the conducting circuit, namely, the generator, the leading wires and the lamp, may be ascertained by the same instrument with facility and accuracy. The horse-power absorbed in driving the generator is measurable by a dynamometer.

Now it appears to me, and I think most electricians will be willing to agree with me, that all that we need to be able to form a judgment of the practical value of the light is a statement of the following facts:—

1. Horse-power required to drive the generator.
2. Electro-motive force of the generator.
3. Resistance of the circuit.
   a. Of the generator.
   b. Of the leading wires.
   c. Of the lamp.
4. Actual current in vebers per second required to produce light.
5. Value of light so produced in standard candles.

This will tell us exactly what is put into the system and what can be got out of it in plain figures, which it is not possible to do from the article in the *American Journal of Science*, as the very essential point of the resistance of the circuit is carefully left out of the calculation.

It certainly tends to excite a mild form of surprise, to say the least, when we find in the article referred to such statements as these:—

"The dynamometer was not in very good working order, and it was difficult to determine the number of the lights and their photometric power, as they were scattered throughout a long

THE ELECTRIC RAILWAY AN AMERICAN INVENTION.

On page 137 [illegible] of the [illegible] illustrations and descriptions of Siemens' electrical railway motor, which was operated at the Berlin Exhibition in 1879. Since that publication our attention has been directed to a similar plan described in the Scientific American as long ago as September 25, 1847, which reads as follows:

"Mr. Lilly and Dr. Colton, of Pittsburg, Pa., have invented a new method of railway propulsion, which is both novel and ingenious. The machine is a small locomotive, and is placed upon a circular railway, around which it is driven by electricity. The power is applied not to the locomotive, but to the *track*, in a very curious manner. Two currents of electricity, negative and positive, are applied to the rails, and by them communicate to the engine. The latter is provided with two magnets, which, by a process of alternate attraction and repulsion, drive the car over the track. A piece of lead is placed on the locomotive, making in all a weight of ten pounds, and on the application of the battery, the machine moved with astonishing rapidity up a plane inclined about five degrees. Heretofore the propelling power had been used on the car itself—in this instance, however, the power is placed on the rails, and an engineer might remain in one town, and with his battery send a locomotive and train to any distance required.

It would seem from the above that the idea of railway car propulsion by electricity was projected in this country more than thirty years before Mr. Siemens' motor was introduced to the public.

ON THE DYNAMO-ELECTRIC CURRENT AND CERTAIN MEANS TO IMPROVE ITS STEADINESS.*

By C. William Siemens, D.C.L., F.R.S.

The author, after alluding to the early conception by Dr. Werner Siemens of the dynamo-electric or accumulative principle of generating currents, makes reference to the two papers on the subject presented, the one by Sir Charles Wheatstone and the other by himself, to the Royal Society in February, 1867. The machine then designed by him, and shown in operation on that occasion, is again brought forward with a view of indicating the progress that has since taken place in the construction of dynamo-electric machines, particularly those by Gramme and Siemens-von Alteneck. The paper next points out certain drawbacks to the use of these machines, both of them being subject to the disadvantage that an increase of external resistance causes a falling off of the current; and that, on the other hand, the short circuiting of the outer resistance, through contact between the carbon electrodes of an electric lamp, very much increases the electric excitement of the machine and the power necessary to maintain its motion, giving rise to rapid heating and destructive sparks in the machine itself.

An observation in Sir Charles Wheatstone's paper is referred to, pointing to the fact that a powerful current is set up in the shunt circuit of a dynamo-electric machine, which circumstance has since been taken advantage of to some extent by Mr. Ladd and Mr. Brush, in constructing current generators.

The principal object of the paper is to establish the conditions under which dynamo-electric machines worked on the shunt principle can be made to give maximum results. A series of tables and diagrams are given, the results of experiments conducted by Mr. Lauckert, electrician, employed at the author's works, which lead up to the conclusion that, in constructing such machines on the shunt principle, the resistance on the rotating helix has to be considerably reduced by increasing the thickness of the wire employed, and that on the magnets has to be increased more than tenfold, not by the employment of thin wire, but by augmenting the length and weight of coil wire employed.

The results of this mode of distributing the resistances is summarised as follows:—

1. That the electromotive force, instead of diminishing with increased resistance, increases at first rapidly, and then more slowly towards an asymptote.

2. That the current in the outer circuit is actually greater for a unit and a half resistance than for one unit.

3. With an external resistance of one unit, which is about equivalent to an electric arc, when thirty or forty webers are passing through it, 2·44 horse-power is expended, of which 1·29 horse-power is usefully employed, proving an efficiency of 53 per cent., as compared with 45 per cent. in the case of the ordinary dynamo-machine.

4. That the maximum energy which can be demanded from the engine is 2·6 horse-power, so that but a small margin of power is needed to suffice for the greatest possible requirement.

5. That the maximum energy which can be injuriously transferred into heat in the machine itself is 1·3 horse-power, so that there is no fear here of destroying the insulation of the helix by excessive heating.

6. That the maximum current is approximately that which would be habitually used, and which the commutator and collecting brushes are quite capable of transmitting.

Hence the author concludes that the new machine will give a steadier light than the old one with greater average economy of power, that it will be less liable to derangement, and may be driven without variation of speed by a smaller engine; also that the new machine is free from all objection when used for the purpose of electro-deposition.

This construction of machine enables the author to effect an important simplification of the regulator to work electric lamps, enabling him to dispense with all wheel and clockwork in the arrangement. The two carbons being pushed onward by gravity or spring power are checked laterally by a pointed metallic abutment, situated at such a distance from the arc itself that the heat is only just sufficient to cause the gradual wasting away of the carbon in contact with atmospheric air. The carbon holders are connected to the iron core of a solenoid coil, of a resistance equal to about 50 times that of the arc, the ends of which coil are connected to the two electrodes respectively. The weight of the core (which may be varied) determines the force of current that has to pass through the regulating coil in order to keep the weight in suspension, and this in its turn is dependent upon the resistance of the arc. The result is that the length of the arc is regulated automatically, so as to maintain a uniform resistance signifying a uniform development of light.

* Abstract of a Paper presented to the Royal Society.

The Edison Light

To the Editor of the Scientific American:

With this I send you the report of Profs. Brackett and Young on the efficiency of Mr. Edison's machine for generating electricity.

As undoubtedly comparisons will be drawn between the figures there given and those which have been given by Dr. Hopkinson for the Siemens machine, an analysis of his figures is not out of place. In *Engineering* for May 9, 1879, a full report of the tests of Dr. Hopkinson may be found.

He assumes, in calculating the work which is done in the circuit, that agreably Daniell's cell has an electromotive force of 1·075 volts, though this form of cell is the weakest of any. In the calculations which the makers of other machines have rated the efficiency of their machines, 1·079 volts has been assumed as the electromotive force of a Daniell's cell. As the work varies with the square of the E. M. F., its figures for work in the current must be multiplied by $\left(\frac{1\cdot079}{1\cdot075}\right)^2$ = 0·919; that is, 91·9 per cent of the work given by his figures should be taken in comparing the Siemens with other machines. I take experiments 9, 10, 11, and 12 as representing very nearly the conditions of practical use. These show, according to his figures, 2·803 erg-tens in the current to 4·101 erg-tens given the machine by the belt, or 91·5 per cent as the efficiency of the machine. Using the correction mentioned, 84 per cent will be the true number. Taking the resistance of the machine as 0·083 ohm, which it would be after running a short time, these experiments show 23 per cent in outside work; that is, of 9·55 horse power given the machine by the belt, 2·20 horse power was effective outside.

Profs. Brackett and Young show 70·7 per cent convertel, and 62·9 available outside.

I hope this statement will be sufficient to end the discussion into which I was drawn some time since regarding Mr. Edison's machine. He then claimed that ⅔ of the power in the current could be made available; now tests show ¼ of the energy in current are available.

It is not "childish," then, to make an armature with about one eighth of an ohm resistance, as was claimed by others at the time.

Yours, FRANCIS R. UPTON.

REPORT OF COMPARISON BETWEEN THE FRONT AND EDISON DYNAMOMETERS, AND UPON THE EFFICIENCY OF THE EDISON DYNAMO-ELECTRIC MACHINE, BY PROFS. C. F. BRACKETT AND C. A. YOUNG, OF THE COLLEGE OF NEW JERSEY, PRINCETON, N. J.—EXPERIMENTS MADE APRIL 3, 1880.

FIRST COMPARISON BETWEEN THE DYNAMOMETERS.

The lever arm of the Prony was held down by the action of a spring balance applied at division 12, corresponding to a virtual circumference of 15 feet. The weight of the balance was 0·41 pounds, which is to be added to all its readings. The balance was read by Mr. Upton. After the experiment, the Edison dynamometer, immediately no work, as read by Prof. Brackett, indicated the mean of five readings, ranging from 920 to 923; 921·2 pounds. During the experiment, the readings were made by Prof. Brackett and recorded by Prof. Young.

Duration of test, 10 minutes.

Number of revolutions of Prony shaft, determined by counter, 5,604.

Number of revolutions of main shaft, 1,893.

Mean indication of Edison dynamometer, deduced from Prof. Brackett's ten readings, varying from 920 pounds at beginning to 923 at end of experiment, 921·7 pounds.

From this, taking the mean reading of the zero, 224·2 pounds, we have $\frac{924\cdot2 - 224\cdot7}{2}$ = 348·25 pounds.

Mean tension on Prony arm, 9·011 pounds, varying gradually from 10·01 pounds at beginning to 7·00 pounds at end of experiment, including weight of scale.

Work registered by Prony, 9·011 (lb.) × 12 (ft.) × 5,604 (rev.) = 812,460 ft. lb.

The diameter of main pulley is 38 inches.

The angle between belts of Edison dynamometer is taken at 45°. Assume K = $\left(\frac{88}{12} \times \sin.22°\right)^2$ = 10·7297. Then the Edison dynamometer registered K (ft.) × 1889 (rev.) × 34·23 (lb.) = 693,880 ft. lb. That is, the Prony recorded 86·6 per cent of the work carried by the Edison dynamometer.

The comparison does not seem to us satisfactory on account of the considerable change in the conditions during the experiment.

SECOND COMPARISON.

Constants and observers as before.

Duration of test, 4 minutes.

Number revolutions of Prony, 2,281.

Number revolutions of main shaft, 770.

Mean tension on arm of Prony, 11·85 lb., varying from 11.00 to 10·97 in seven readings.

Initial reading of Edison dynamometer (mean of five), 204·2.

Final reading of Edison dynamometer (mean of five), 204·2.

Mean during comparison, 341·97.

(Mean of seven readings, varying from 910 to 913 lb.)

Work according to Prony, 11·85 (lb.) × 12 (ft.) × 2,281 (rev.) = 810,880 ft. lb.

Work according to Edison instrument, K (ft.) × 770 × $\left(\frac{204\cdot2 - 911\cdot57}{2}\right)$ = 833,360 ft. lb.

In this comparison the Prony registers 98·2 per cent of work indicated by the Edison dynamometer.

We regard this test as fairly good, the conditions having been very constant, and the outstanding difference of 0·8 per cent being reasonably accounted for by slip of belts and friction of journals between the two dynamometers.

TESTS OF THE EFFICIENCY OF THE DYNAMO-ELECTRIC MACHINE.

During both these tests the thermometer of the calorimeter and the Edison dynamometer were read as often as every minute, and great pains were taken to keep the water thoroughly stirred. The calorimeter was a galvanized iron vessel, 16·42 inches in diameter and 21½ deep.

The wire coil was wound upon a light wooden frame, so constructed as to serve as a very efficient stirrer.

The thermometer was an excellent instrument, by James Green, graduated to fifths of a Fahrenheit degree, each degree being about three-sixteenths of an inch in length.

Prof. Brackett read the dynamometer.

Prof. Young read the thermometer and made the records.

Mr. Upton and others, the speed of the main shaft and the indications of the high resistance galvanometer in the laboratory.

CONSTANTS.

Weight of calorimeter (empty)	23·93 lb.
Heat capacity of same (taking specific heat at 0·112)	2·63 lb.
Weight of wooden frame	2·71 lb.
Heat capacity of frame (s. taken at 0·30)	1·71 water lb.
Weight of wire coil (541 turns, each turn weighing 2·64 grammes)	2·72 lb.
Heat capacity of wire (s., 0·10)	0·27 water lb.
Resistance of coil in calorimeter	1·720 ohms.
Resistance of leading wires taken as ¼ of coil	0·0357 ohm.
Resistance of wire on reversing armature	0·140 ohm.
Resistance of coil on field magnets	1·470 ohms.

FIRST TEST.

Total weight of calorimeter with contained water and everything in place	197·6 lb.
Hence from preceding data the heat capacity of whole	172·77 water lb.
Temperature of air	72·2°
Temperature of water at beginning	63·8°
Temperature of water at end	80·7°
Gain during experiment	16·7°
Duration of experiment...10m. 50s.	10·833 m.
Dynamometer at beginning (fred)	204·2
Dynamometer at end (fred)	205·
Mean dynamometer zero	204·6
Speed of main shaft, beginning	174 per min.
Speed of main shaft, end	170
Mean	172
Mean reading of dynamometer during experiment	771·75 lb.
(Varying from 790 to 781, 10 readings.)	

E. M. F. of current maintaining field was 61 divs. of galvanometer, on which 108 d. corresponded to 16 Daniell cells, *i.e.*, E. M. F. = $\frac{61}{108} \times 16 \times 1{\cdot}079$ volts.

Energy expended on driving armature, as indicated by dynamometer = K (ft.) × 172 (rev.) × 12·833 (min.) × $\left(\frac{204\cdot6 - 771\cdot75}{2}\right)$ = 2,844,600 foot pounds.

Energy expended on field of force $\frac{6}{5} \times \frac{48{\cdot}25 \text{ (ft. lb.)}}{1{\cdot}47 \text{ (ohms)}} \times 12{\cdot}833 \text{ (m.)} \times \left(\frac{61}{108} \times 16 \times 1{\cdot}079\right)^2$ = 19,634 foot pounds.

Hence, total energy expended, 2,864,234 foot pounds.

Energy Realized.

a. In calorimeter = 172·77 × 10·7°	2,237,426 ft. lb.
b. In leading wires ¼ of above	7,453 ft. lb.
c. In armature ¼ of calorimeter, 172	181,393 ft. lb.
Hence, total energy realized	2,426,147
Total available (*a* + *b*)	2,231,845
Hence,	
Total efficiency	84·5 per cent.
Total available	78·2 per cent.

Remarks.

During this test the driving power was about 6½ horse power; the electromotive force of the field current, 0·27 volts, giving a current through the magnet wires of about 4½ webers; and the current developed by the machine was about 45 webers through a total resistance of 1·805 ohms.

SECOND TEST.

Total weight calorimeter and contents	200·00 lb.
Hence by preceding data, heat capacity =	172·27 water lb.
Temperature of air	71·4° to 71·9°
Initial temperature of water	62·3°
Terminal temperature of water	72·9°
Gain	10·7°
Duration of experiment	9 minutes.
Speed of main shaft, beginning	176 per m.
Speed of main shaft, middle	171 per m.
Speed of main shaft, end	177 per m.
Mean	175·33
Dynamometer reading before exp.	205
Dynamometer reading after exp.	205
Mean dynamometer zero	205
Mean reading of dynamometer during the experiment (6 readings, between 645 and 655)	656

Electromotive force of field (by high resistance galvanometer) = $\frac{143}{108} \times 16 \times 1{\cdot}079$ = 14·001 volts.

E. M. F. of dynamo current = $\frac{656 - 205}{2} \times 23 \times 1{\cdot}079$ = 10·05 volts.

E. M. F. of armature of dynamo current broken, $\frac{200}{51} \times 20 \times 1{\cdot}079$ = 129·71 volts.

Energy Expended.

a. In driving armature according to dynamometer, K × 175 (rev.) × $\frac{656 - 205}{2}$ = 3,827,500 ft. lb.

b. In maintenance of field of force, $\frac{6}{5} \times 24{\cdot}25 \text{ (ft. lb.)} \times 9{\cdot}3 \text{ (m.)} \times \left(\frac{14{\cdot}001}{1{\cdot}47}\right)^2$ = 72,150 ft. lb.

Hence,

Total energy expended	3,899,730 ft. lb.

Energy Realized.

a. In calorimeter, 172×12·27	2,359,700 ft. lb.
b. In leading wires ¼ of above	7·033 ft. lb.
c. In armature ¼ of *a*	183·930 ft. lb.
Total energy realized (*a* + *b* + *c*)	2,451,163 ft. lb.
Available (outside of machine) (*a* + *b*)	2,367,233 ft. lb.

Remarks.

As a check we may compute the total efficiency from the galvanometer reading and the resistance: Energy developed, 4·01 (ft. lb.) × 9 (m.) × 10·05 (volts) × 1,866 (ohms) = 2,500,000 ft. lb.

The discrepancy is fairly explained by the defective insulation of long wires leading to the galvanometer, as it was raining at the time.

During the experiment the driving power was about 8¼ horse power, and the current was 67·4 webers (according to galvanometer, 54·4).

Even with this current the spark at the commutator was very trifling.

SUMMARY.

	Total Efficiency.	Available Efficiency.
According to first test	84·5 p. c.	78·2 p. c.
According to second test	84·5 p. c.	78·2 p. c.

The Prony dynamometer is connected to the Edison dynamometer by a belt from the same countershaft, which is also belted to the electric generators. If we should assume the correctness of the Prony, and that the loss in the transmitting power between the Edison dynamometer and the other of the armature was only the same as between the two dynamometers, the above numbers would have to be increased in the ratio of 100 to 87·8 (see above), and we should have:

Total efficiency	96·7
Available efficiency	89·0

C. F. BRACKETT,
C. A. YOUNG.

Princeton, N. J., April 10, 1880.

ON ELECTRIC LIGHTING.*

(Second Paper.)

By Dr. Hopkinson, F.R.S., of London.

Dynamo-Electric Machines.—Since the date of the Bakerian lecture, which contained the following paper, I have published the results of experiments similar to those described in this, now as well as then, with the object of testing, and, if possible, improving, the theory of former papers, and such as that shown on Fig. 1 of the former paper, and now reproduced, with slight alterations, in Fig. 1. Here

any abscissa represents a current passing through the dynamo-electric machine, and the corresponding ordinate represents the electromotive force of the machine for a certain speed of revolution. This current is supposed to pass through it. It will be found (1) that with varying speed the curve, or one proportional to it, remains unchanged in any of its features, except as represented by the speed; (2) that the electromotive force does not increase indefinitely with increasing current, but that the curve approaches an asymptote; (3) that the earlier part of the curve is, roughly speaking, a straight line, until the current attains a certain value, and that at that point the electromotive force has reached about four-fifths of its maximum value; (4) that the current is positive for all positive values of the electromotive force of the machine, a very small changeover in the resistance with speed of engine constant, or in the speed of the engine with resistance constant, causes a great change in the current. For the reason such a current, which at the same for all speeds of revolution, since the curves for different speeds differ only in the scale of ordinates. To called the "exciting current" of the machine. The exciting current for the machine exhibited in Fig. 1, where the lower line represents a current for a speed of 600 revolutions per minute, instead of 752. The resistance, varying as electromotive force is given by the slope of the line O *r*.

The current

which must therefore be constant; and it will be seen that the line cuts the upper curve at a point corresponding to a current of 15 webers, and the lower at a point corresponding to a current of 9 webers only.

Mr. Crompton and Mr. Alexander Siemens (Wolverhampton), Nov., 1879) have experimented carefully on a Gramme machine at various speeds, and with various external resistances. The resistance of the machine was 0.37 ohms. Their results are summarized in a Table at the end of their paper, which gives the current passing, with resistance in circuit from 1.75 to 200 Siemens units, and at speeds from 70 to 800 revolutions per minute. In the curves, Figs. 2, 3, and 4, number No. 1 represents the relation between electromotive force and current, as deduced from some of their observations; the points marked are plotted from their Table, making allowance, where necessary, for difference in speed. The curve, as actually constructed, is for a speed of 800 revolutions; at this speed it will be seen that the electromotive force attained about 96 volts; the critical current, when the resistance in circuit was 1.75 Siemens units, was the total resistance of 1.8 ohms. Up to this point will be seen practically; exactly as was the case in the Siemens machine examined by the author, where the resistance was 4 ohms, and the speed 720 revolutions.

The results of an elaborate series of experiments on certain dynamo-electric machines have recently been published by Mr. Schuckert, of Nuremberg. One of the machines investigated was a Gramme, differently coiled, but substantially similar to that tried by the author in 1879. It is described as having 24 divisions of the commutator; 336 coils on the armature, with a resistance of 0.4614 Siemens units; and 512 coils on the magnets, with a resistance of 0.3663; making a total resistance of 0.7502 Siemens units, or 0.7127 ohms. The curve, Fig. 2, No. 2, gives the relation of electromotive force and current produced in a speed of 750 revolutions per minute, the circuit speeds ranging from 650 to 1000 revolutions. The maximum electromotive force appears to be probably 76 volts, and the critical current 10 webers: which is the same as in the author's first experiments on a similar machine.

In the course of the same paper Mr. Schuckert describes a Siemens machine, which he has differently coiled, but used as an exciter for the differential magnet machine. It has an internal resistance of 0.74 ohms, of which 0.355 is in

* Paper read before the Institution of Mechanical Engineers.

† See ENGINEERING, vol. xxvii, page 393.

the series coils on the magnets. The machine is marked to run at 1150 revolutions per minute, the following Table gives, for a speed of 1000 revolutions, the total resistance, current, electromotive force, and force per unit of current. The horse power per unit of current is also given.

Curve No. 3, Fig. 2, gives as usual the relations of electromotive force and current. From this curve I will

Experiments on modified Alfred Varley Dynamo-Electric Machine.

Resistance.	Electric Current.	Electromotive Force.	Horse Power developed as Current.
Ohms.	Webers.	Volts.	HP.
2.624	4.52	12.2	0.07
2.761	10.8	27.0	0.39
2.898	14.1	37.0	0.69
1.291	18.1	36.1	0.88
1.668	19.8	37.2	0.99
1.579	20.0	36.6	1.01
1.565	22.8	39.3	1.20
1.440	24.7	40.0	1.32
1.145	32.2	41.5	1.79

be seen that the critical current is 11.2 webers, and the maximum electromotive force, at the speed of 1000 revolutions per minute, is 46 volts. Interpolations for this machine are made in exactly the same manner as in the experiments on the modified-steel machine, using the galvanometer, but omitting the experiment with the rheometer (compare Table, page 401, ENGINEERING, vol. xxvii.)

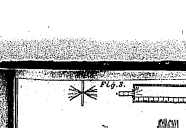
The time required to develop the current in a Gramme machine has been examined by Herwig (Wiedemann, Ann., 1879). He established the following facts for the machine he examined. A reversed current, having an electromotive force of 0.9 Grove cells, sufficed to destroy the residual magnetism of the machine completely. The time required was as far as possible isolated; there is no way, however, of time to get up the current then when the machine was in its usual state. The time was required to get up to the current when the external resistance was great, then when it was small. With ordinary resistance the current required from 2 second to 1 second to attain its maximum.

Calculation of the Electric Efficiency.—The measurement of the light and of the electric arc presents certain peculiar difficulties. The light of the arc is very unsteady, and that of a standard candle, by means of which it is usual to express luminous intensities. The statement, without qualification, that a certain electric lamp and machine give a light of a specified number of candles, is therefore wanting in definite meaning. A red light mixed with propriety be said to be any particular multiple of a green light; nor can a candle of a light of a certain colour be said to be equivalent to be a multiple of another, unless the proportions of the colours in the two lights are the same. Mr. Varley (Proceedings of the Royal Society, March, 1859) has given the results of measurements of the red, blue, and actinic light of electricity, in terms of the red, blue, and actinic light of a standard candle. The fact that the electric light is a very different thing from the light of gas or of a candle, has long been known, but has not, so far as I am aware, been expressed in definite terms.

Again, the emission of rays from the heated carbons and between electromotive force and current, as deduced from some of their observations; the points marked are plotted from their Table, making allowance, where necessary, for difference in speed. The curve, as actually constructed, is for a speed of 800 revolutions; at this speed it will be seen that the maximum electromotive force attained 96 volts; the critical current, when the resistance in circuit was 1.75 Siemens units, was the total resistance of 1.8 ohms. Up to this point will be seen practically; exactly as was the case in the Siemens machine examined by the author, where the resistance was 4 ohms, and the speed 720 revolutions.

The results of an elaborate series of experiments on certain dynamo-electric machines have recently been published by Mr. Schuckert, of Nuremberg. One of the machines investigated was a Gramme, differently coiled, but substantially similar to that tried by the author in 1879. It is described as having 24 divisions of the commutator; 336 coils on the armature, with a resistance of 0.4614 Siemens units; and 512 coils on the magnets, with a resistance of 0.3663; making a total resistance of 0.7502 Siemens units, or 0.7127 ohms. The curve, Fig. 2, No. 2, gives the relation of electromotive force and current produced in a speed of 750 revolutions per minute, the circuit speeds ranging from 650 to 1000 revolutions. The maximum electromotive force appears to be probably 76 volts, and the critical current 10 webers: which is the same as in the author's first experiments on a similar machine.

In the course of the same paper Mr. Schuckert describes a Siemens machine, which he has differently coiled, but used as an exciter for the differential magnet machine. It has an internal resistance of 0.74 ohms, of which 0.355 is in



at 2 of the powerful source of light which it is desired to measure. The intensity of the light from this image will be less than that of the actual source by a calculable amount; and when the distance of the lens from the light is suitable, the reduction is such that the reduced light becomes comparable with that from a standard lamp. The photographic (?) arc seems a very efficient reducer. It cuts the focus, to cut off stray light. One of these is shown in Fig. 3, to act as a small aperture. It is easy to see that this diaphragm will cut off all light entering from a direction other than that of the lens or reflector.

Does it do so, that observations may be made in broad daylight, or any source of light. If a dark screen be placed behind it. The long lens of the Fig. 3 is 1 foot 1 inch long, is fixed with other—the slide, shown dull red—the slide, now sold with a flelak, which reflects a great deal of the light incident at a small angle. This is used as a dark chamber, in which the intensity of the image formed by the lens is compared with the intensity of light, by means of an ordinary Bunsen's photometer E, sliding on a graduated bar.

Mr. Dalleyzer kindly made and tested the mirror for the author; he can therefore rely upon the accuracy of its curvature and thickness. It is plano-convex, the convex side being towards the source of light. The curvature is exactly 1 in. radius and the thickness is 0.1 in. It is made of Chance's patent crown glass, of which the refractive index for the D line is 1.5127, see section 1.127. The focal length *f* is therefore 1.1322 inches.

Let *u* denote the distance of the source of light from the curved surface of the lens, and *v* the distance of the image of the source it from the posterior focal plane. Neglecting for the moment the reflection at the surface of the glass,

the intensity of the source is reduced by the factor $\left(\frac{v}{u}\right)^2$.

But $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$, or $\frac{u+v}{uv} = \frac{1}{f}$; hence the factor of reduction is $\left(\frac{1}{u+1}\right)^2$. The effect of absorption is so small a thick-

ness of very pure glass may be neglected; but the reflection at the surfaces will cause a loss of 0.2 per cent., which must be allowed for. This percentage is calculated from Fresnel's formulæ, which are extremely accurate for glasses of moderate refrangibility, and for moderate angles of incidence.

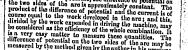
Suppose, for example, it is required to measure a light of 20 candles at a distance of 10 feet. The image of 20 in. 1 ft. will be reduced in the ratio of 1 to 1.1 and becomes a conveniently measurable quantity. By transmitting the light through glasses both the light from an electric lamp and that from the standard, a rough comparison may be made of the red or green or blue of the electric light with the red or green of the standard.

A reflecting photometer, in which a lens is used in a manner similar to that described above, is known as Sugg's "Lighthouse Illuminator," is described in the Journal of the Society of Arts, 1879, page 1. In that instrument a lens is used with any standard light. Messrs. Ayrton and Perry described a diagonsing photometer with a common lens at the meeting of the Physical Society on December 19, 1879 (Proc. of the Physical Society, vol. iv, part 1, page 1). Lenses possess, however, an obvious advantage in having a focus, and in which a diaphragm to cut off stray light may be placed.

Efficiency of the Electric Arc.—To define the electrical conditions of an electric arc, two quantities must be elected—the current passing, and the difference of electric potential at the ends of the two carbons. Instead of either one of these, we may, if we please, state the ratio of the two.

The current, and all the resistance of the arc, is therefore known, the resistance which would replace the arc without changing the current. The ratio of the two forms the electric resistance in ohms; for this use of the word, see the definition of electric resistance rests, is quite unique of the electric arc; and on the other hand, for a given material of the electrodes, a given distance between them, and

a given atmospheric pressure, the difference of potential at the two sides of the arc is practically constant. The product of the difference of potential and the current is of course equal to the work developed in the arc, and, divided by the work expended in driving the machine, may be considered as the efficiency of the whole combination. If the difference of potential be given in volts, and the current in webers, the difference between the two sides of the arc may be measured by the number given by the method in the previous paper, by an electrometer, or in other ways. The current may be measured by an electrometer, by a suitable

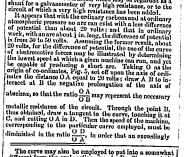


electro-dynamometer, or best of all, in the author's opinion, by passing the whole current through a coil in the form of a very small tangent galvanometer, which may be regarded as a shunt for a galvanometer of high resistance placed in the circuit of which a very high resistance has been cut out.

It appears that with the ordinary carbons used at ordinary atmospheric pressure no arc can exist with a less difference of potential than about 39 volts; and that in ordinary circumstances, as in Table 1 in page, the difference of potential is from 39 to 50 volts. Assuming the former result, about 39 volts, for the difference of potential at the arc curve of electromotive forces may be illustrated by determining the lowest speed at which a given machine can work, and will be capable of producing a steady arc. Taking O as the origin of coordinates, Fig. 5, set off upon the axis of ordinates a distance O *a* equal to 39 volts; draw A B to perpendicular at B the negative prolongation of the axis of abscissæ, so that the ratio $\frac{B\,O}{B\,A}$ may represent the necessary

metallic resistance of the circuit. Through the point B, thus obtained, draw a tangent to the curve, touching it at C, and meeting O *a* in *a*. Then the ordinate C D, corresponding to the particular curve employed, must be divisible by *a* O; in order that an exceedingly

The curve may also be employed to put into a somewhat different form the explanation given by Dr. Siemens at the Royal Society, respecting the self-regulating quantity of the electric light as produced by ordinary dynamo-electric machines. The operation of self-regulation is as follows:—If the carbons when the current is greater than a certain amount, and the distance of the arc is thus initially the carbons are in contact. Through the origin O, Fig. 6,



draw the straight line O A, inclined at the angle represented by the resistance of the arc, and draw from A a curve resembling the curves at A. The absolute of the point A represents the current passing when the carbons are separated from operating. Let O N represent the current to which the lamp is to be adjusted, and draw N P parallel to O *a* together with the curve A P. Through N draw the ordinate N P, meeting the curve in P, and the point P is parallel to O *a* draw a horizontal P D, meeting the curve in D. If the point D is to the right of D, or further from the origin, the arc will increase; if D is to the left of D, or nearer to the origin, the carbons will go on parting, till the current suddenly falls and the light goes out. If D is although to the right of D, is very near to it, a very small increase in the current will cause the carbons to re-approximate to the normal distance, giving stability to the light by causing the electro-magnets of the machine, by a shunt circuit, instead of by the whole current.

The success of burning more than one regulating lamp in series depends on the due regulation of the electro-magnet, excited by a high-resistance wire connecting the two terminals of the arc. The author has found that a speed 150 revolutions per minute is the most convenient for burning, as in the ordinary Siemens machine, and consequently the author has found it necessary to resort to expedients of the following rule for determining the number of lamps in a system of electric lighting in which the electric arc is used. We are being neither exceptionally long nor exceptionally short. Measure the difference of potential of the arc, and also the current passing through it, in volts and webers respectively. Let the product of these two numbers be called by *W*, in the horse power developed in that arc. It is also known that the difference between the horse power developed in the arc and the horse power expended to drive the machine must be absolutely wasted, and has been expended in heating either the iron of the machine or the copper conducting wires.

The Brush Electric Light.

EVERYTHING relating to electric light, its cost, its advantages, its drawbacks, its actual [illegible] is a profitable substitute to gas for lighting up large factories or railway termini, is naturally an open question; yet as [illegible] the working of the light under the [illegible] test of actual use for about a year and a half, we found both instructive and suggestive. The following information is taken from a report on the use of the Brush Electric Light in the Riverside Worsted Mill, at Providence, R. I.:

"The first machine was set up and started about the 20th of February, 1879; its success was instant and complete; so much so that this machine was accepted and another ordered at once. This second machine was started in March, when a third was ordered by telegram, which was set up and running early in April. In September we ordered two more, which are both now running, making in all five of the largest machines, having capability for [illegible] lamps, which are now regularly lighted; nearly all of our principal rooms. We could not have a severer test than we give them, as our mill runs night and day, six days per week, and we have a full force of men at work. Mr. Brush's claim of 'a dollar's worth of repairs on, say, one machine or lamp, in a year,' we find to be correct; it is strong and steady, and white; it is steadier than that afforded by both oversewer and belt; so much so that we doubt if we could get along now with the help if we were to return to the old gas lighting; certainly we should not get as good work, nor so much of it. The air of the room, too, shows a very marked difference. In our weave room, with its one hundred and fifty gas lights, the air became almost stifling after midnight in the summer; and that [illegible] opposite of the men showed how they felt it. With the electric light there is no such trouble, as the air is as good as in the daytime and noticeably cooler."

The question of the relative cost of electric and gas light is disposed of as follows:

"In reply to some changes proposed by setting up new machinery, all our eighty lamps now run on the same circuit as at first; but by actual count we have seventy-one lamps permanently placed and three displace five burners and seventy-eight gas-burners; that is, there are five hundred and seventy-eight burners already placed that would be lighted were the electric lights stopped. Estimating these burners at six feet per hour, we should use 3,468 cubic feet of gas per hour, costing, at $2 per thousand cubic feet, $6.93 per hour. The actual cost of the electric light is as follows:

The lamps consume carbons.....	$0.02
Power and belting.....	.50
Interest on cost of machines, say $12,000.....	.30
Time to run machine and lamps..	.33
Oil, wear and tear, etc.....	.07
Total cost per hour.....	$1.20

Making a saving of four dollars and seventy-three cents per hour, and this saving, for the three thousand hours the machines are in the year, is $14,190, and nearly pays for the machines. These figures are approximate, as the number of cubic feet burned for several nights to get the exact consumption of each lamp, and number of the gas-burners in use, had them, getting a strong jet foot to each burner."

The object of Mr. Edison's improvements, it must not be forgotten, is to adapt the electric light to household uses. The success of the new illuminating system for large buildings is already an accomplished fact.

EDISON'S HORSEPOWER LAMP VERSUS GASLIGHT.

THE last number received of the *Scientific American* contains a report, by Professor Henry Morton, Professor Alfred M. Mayer, and Mr. R. F. Nichols, on "Some Electrical Measurements of Mr. Edison's Horsepower Lamps," in which they say that much has been written and said within the last few months about Mr. Edison's lamp, but that the public has been furnished with only a few meagre and disjointed facts, and no connected statement bearing in the way of precise and reliable statement concerning the simplest primary facts, a knowledge of which would give the means of estimating both the scientific and commercial status of this widely discussed invention. It was, therefore, with great pleasure that they found themselves placed in possession of one of the horsepower lamps of recent construction; and to satisfy themselves as to the real facts of the case, they soon made a series of observations and measurements, by means of which they have reached a clear conception of other points which have been made at the same time but imperfectly observed, as a correspondent on this subject addressed to Mr. Edison did not evoke a reply, they were obliged to content themselves with the one lamp as a subject of experiment. They, however, remark that the behaviour of this lamp under the tests, and the agreement of the results with information otherwise obtained, convinced them that it was at least a fair specimen of the lamps of this form so far as completed by Mr. Edison.

After detailing their mode of determining the amount and character of the electric current needed to operate the lamp efficiently, they describe their arrangements for measuring the resistance of the incandescent pencils in actual use, and omitting different amounts of light; also the quantity of current flowing under the same conditions. Having done this, they had all the experimental data required for the determination of the energy expended in each case. This is found by multiplying the square of the number of amperes by the resistance in ohms, the product being the energy expended in each burner. That is, if a current of 1 ampere flowing through 1 ohm of resistance, with an energy of 10 dynes, power 10 dynes each, or 100 units power in the aggregate.

The photometrical measurements were in all these cases taken with the carbon loop at right angles to the axis of the photometer; and this was, of course, under the worst circumstances for the lamp, for, on turning the loop around so as to bring the carbon loop with its plane parallel with the axis of the photometer, the illuminating power was found to be greatly increased—the light was greatly diminished, so that it was reduced to almost one third of what it was with the loop sideways to the photometer disc. The illuminating power, in its best position, was found as 24 candles; and in the worst, as 8 candles. The average or general illuminating power was, therefore, reckoned, as above, at 16 candles.

In running this, that a Siemens or Brush machine were employed in general practice, a current of 10 webers would be obtained (as has been shown by numerous experiments) with a loss of about 40 per cent. of the mechanical energy applied to the driving-pulley. This would represent 13 horse power in all. Now, therefore, since 1 horse power would have to be applied to the pulley of the machine, so that when this loss in transformation had been encountered, there should be 1 horse power of electric energy produced. This would call for 17 horse applied to the pulley of the dynamo-electric machine by the steam-engine. Now, to produce 1-horse power in a steam-engine of the best construction, about 2 lbs. of coal per hour must be burned, and therefore 13-horse power 3 lbs. of coal must be burned. On the other hand, 1 lb. of gas will yield 5 cubic feet of gas, and there, besides, a large amount of coke, to say nothing of other residuals, which would represent practically also, a certain value. Now, between "steaming" and "gas-making" coal, we find that 2 lbs. of coal is taken to take 5 lbs. of gas coal as the equivalent of 5 lbs. of gas, which, if burned in a gas-burner of the best construction, would give from 30 to 32 candles; or 160 to 170 candles in the aggregate. There would therefore be 32 dozen lamps producing 192 candles, and gas-burners producing 160 to 170 candles, with an equivalent expenditure of fuel.

In regard to this result, the report concludes: "If such apparatus and system can be perfected with equal facility and economy, this would, of course, show startling power of the electric light; but when, in fact, everything in this regard is taken into account, electric light—which demands costly motive machinery, and that of a most delicate kind; requires much skilled management; shows more liability to disorder, loss and waste; and reveals an utter lack of the storage capacity which we have in the gas; efficiency, convenience, and economy in gas—then we see that a relatively trifling economy disappears, or ceases to have any controlling importance in the practical relations of the subject."

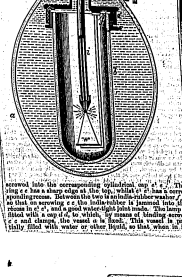
ELECTRICITY v. GAS.—At the twenty-first annual meeting of the Manchester District Gas and Coke Company, held last week, Mr. Clever, of Blackpool, [illegible] Months' Experience of the Working of the Electric Light." He described the experiment he had the result of the [illegible] trial of, the new illuminating power as a means of lighting up the Blackpool promenade and piers, then entered at some length into the question of cost, and stated "that the capital expended in the case of Blackpool was £2,800. The working expenses were £3 6s. 10d. per night of five hours. With respect to the question of electric lighting in general, he entertained no fear that it would ever supersede gas, pointing amongst other things to the difficulty which must inevitably be occasioned, if gas were used as a general illuminating power, by the fact that electricity could not be stored, but must be produced as required; so that the apparatus would have to be continuously at work for the benefit of consumers who might require light during the day or night. He also referred to the difficulty of increasing the number of lights beyond a certain number in one circuit, as that small lights could not be produced as economically as large ones. He saw no cause for alarm, for he was sure that electricity, with its delicate automatic cut-off arrangements, which would soon get out of order, would never be used for the illumination of dwelling-houses and such-like purposes, though for lighting public squares, large halls, &c., it might enter into competition with gas. In the discussion which followed, the ex-president (Mr. Newbiggin) expressed his opinion that electricity was simply an expensive luxury in lighting. Several members spoke of the failure, or comparative failure, of experiments which they had witnessed, and the President referred at some length to an experiment made in illuminating a cousing shed in Messrs. Crossley and Sons' woollen mills, Halifax, by means of the "Brush" light. Sixteen lights, with a total illuminating power equal to 2,000 candles, were in use, all supplied on one circuit by one machine of 14-horse-power. The light was steady, and was not affected as regards the other lamps by the accidental extinguishing of one or more of the number. The capital outlay was equal to a fixed annual charge of £75, to which £25 must be added for attendance. The cost of the 16 lights was 1s. 9¼d. per hour, and they displaced 200 gas burners, consuming 1,000ft. of gas, costing 8s. per hour. Calculating upon the average number of hours that a mill was lit up in a year the cost of the electric light would be £19, in addition to the fixed charges of £100, or a total of £119, while the gas would cost only £45." Some of the information given this week in other columns will cause readers to doubt the value of these expressions of opinion.

THE ELECTRIC LIGHT AT ALDION MILLS.—The electric light is now in practical work at Aldion Mills. It is supplied by the Anglo-American Electric Light Company (Limited), Hatton-garden, London; and on Thursday night, and again last night, their engineer exhibited the light, by the kind permission of Messrs. John Crossley and Sons (Limited), to a number of visitors. The devotion of Mr. L. J. *Crossley* to electrical science is too well known to need mention here, and the public are, no doubt, indebted to him for this opportunity of seeing the light in practical work. Messrs. Crossley, we understand, have adopted the system on trial. It is applied only to the carding and combing shed, a building with an area of 200 feet by 136, and hitherto lit by 230 gas jets. The light is generated by a "Brush" dynamo-electric machine (so called from the name of the inventor), and there are 17 lamps (any one of which can be extinguished without regard to the rest) in a single circuit. The circuit of the lamps, too, can be extended to any length up to 10 or 12 miles from the machine—an important consideration where one machine and engine are to be used for several buildings or rooms a long way apart. By a regulating attachment to the machine, any less number of lights than the maximum can be used, absorbing proportionately less power. Each light is in a globe, the lower part of which is transparent, and the upper part semi-transparent. Fifteen lamps were used on Thursday night, taking the place of the 230 gas lights. The effect was very fine indeed. The light was steady as that from gas, with the exception of that from two lamps, which was a very little unsteady. The arrangement of the lamps, hung perhaps three yards from the floor, caused the light to be equally diffused over the place. The writer asked a workman for his "honest" opinion about the light. The workman said he liked it much better than gas, first, because it enabled him to see work better which required his close attention, and, secondly, because there was no gloom in any part of the shed. Some of Messrs. Crossley's carpets were shown in order that the effect on colours might be noticed. It is easy to distinguish any colour by the electric light. As adjoining shed was lit with gas, and as both sheds could be seen at once, the superiority of the electric light needed no further demonstration. Halifax gas, good as it is, appeared a dingy, tawdry yellow. But the merits of the light itself are well known; what the public wish to know is something about the cost. On this point we have made inquiries, supplemented to by before our readers some facts, obtained from an impartial source, which have the merit of being compiled continually in the buyer's interest. To light the shed at Aldion Mills with gas, 1,265 feet are consumed per hour, the cost being about 9s. 11d. This does not include gas fittings and repairs. The first cost of electric lighting is rather serious. Including all plant, it has been, in Messrs. Crossley's case, about £2000. To arrive at the working cost, a cautious manufacturer would reckon on this 5 per cent. interest, 5 per cent. depreciation, and 2 per cent. for wear and tear. The machine requires 14 indicated horse-power to work it. The carbons, which are consumed by each lamp at the rate of 2 inches an hour, cost 4d. per foot. The only additional outlay is for labour, and in Messrs. Crossley's case a man will probably be employed not more than half an hour a day. Here, then, is the basis of a calculation which each can make for himself. The figures point to this general result, that where a large area is to be lit, and where the number of hours during which the light will be required per year is considerable, the cost is much less than that of gas. Where gas is used in small quantities it will, for the present, be the cheaper means of lighting; but this leaves out of question the much greater illuminating power of electricity.—*Halifax Courier.*

BROUGHAM AND ANDRE'S ELECTRIC LAMP.

Two almost simultaneous and quite various improvements that are being made in the electric lamp—the substitution of magneto machines, *vice* existing Clarke's or Holmes', and the way when the electric light is viewed simply as an experimental success, and is made fit to be of the character of a more effective of artificial illuminants. The improvements which we have describe at long way to remedy the defects which have retarded the practical use of the electric light. Electric lamps objectable to the account of many things concerning the eye are, broadly speaking, divisible into two classes—a combination of the and those relying on incandescence and the failure of two. We have named merits of the incandescent light is the each kind. Each undoubtedly preferable in the competitor of steadier, and in all respects more suitable to the competitor of the arc, as it is in the case of Messrs. Siemens and Co., Manchester at the works of Messrs. Peter Brotherhood, Limited, Sheffield, the improvement effected by the Hon. R. C. D. Brougham will place it before any other lamp on this principle now in use.

The principle of the improvement will at once be seen when we state that it reduces the consumption of carbon to about 1220*lb.* per hour, whilst a similar carbon burnt in a lamp open to the atmosphere burns about 6lb. per hour, the cost in carbons being thus reduced to one-forty-eighth of what it would be in an ordinary lamp. This is probably a maximum reduction, inasmuch as the carbons in ordinary lamps are of a larger diameter, those used in the Anglo-Brougham lamp being only 7mm. diameter. The improvement consists in surrounding the lamp, or a portion of it, with a separate cover of glass containing water or some other suitable liquid. In the accompanying diagram *A B* is the glass globe of the lamp proper, and the surrounding vessel containing the liquid. The shape of these vessels is immaterial, and we have chosen that for simplicity if the lamp is to be used in the ordinary position, but if it is to be used in a non-conformist, such as plotter of Paris. These tubes are connected to the two terminals of the battery by the binding screws *D m*. The outer tube *g g* is in electrical contact with the positive terminal by means of metal W. The inner tube *l* contains the carbon rod which rests upon the metallic wedge and falls down by its own weight, and that of a small weight placed on the top of the carbon, but within the tube. No doubt the light is also partially in incandescence of the carbon, and partially in the formation of an arc. The cap *a* on the top of the tube *g g*, through which the inner tube passes, is of vulcanite or of some non-conducting material. Round the top of the lamp globe *b b b* is a metal cylinder to be



screwed into the correspondent stimulation cap, *c c*. The ring *c c* has a sharp edge at the top, which serves to cut the rubber washer which makes the lower water-tight joint, so that by screwing *c c* the bulb-holder is fastened and the carbon is *c*, and a good water-tight joint made. The lamp is filled with a cap of *c*, by which, by means of binding screws *c c* and clamps, the vessel *a b* fixed. This vessel is pre-ably filled with water or other liquid, so that, when in the proper position the liquid rises above the cap *c*, thus excluding the consumption of air into the lamp an impossibility. So long as the liquid in *a* is above the cap *c*, no atmospheric air can enter the lamp globe *b*, a light joint is obtained, and at the same time the heat from the lamp is carried off or dispersed and the light more or less diffused.

Lamp Light.
Arc Was Superior

A section of the new electric lamp, produced by M. Jamin, member of the French Institute and Professor of Physical Science at the Polytechnic School, was printed in the *Journal* for July 22, 1870, and since that time the inventor has been engaged in improving his lamp. The new apparatus was exhibited lately at the works of the Compagnie General d'Eclairage Electrique, Paris, to a large assembly of representative persons.

Around the great hall in which the meeting occurred were 40 lamps, each containing three candles. The lighting and relighting of the lamps was effected instantaneously. This result is obtained, without touching the apparatus, by simply establishing or re-establishing the communication. Should one of the lamps become accidentally extinguished, the other lamps would not be affected by the accident. Moreover, the carbons are consumed, so that when burn as usual, the intensity of their light being unaffected by it. should one of the candles be consumed, another is instantly and automatically brought into play. The intensity of the light is completely under control, and may be graduated or regulated at will, from its full power down to the light of a sixth-light. The inventor states that the lamp may be made to burn 80 hours without any hesitation.

Mons. Jamin has stated the question of cost in this form: "Suppose a given quantity of gas to yield a certain amount of light, and that quantity to be consumed in one eight-horse power gas engine, which drives one of the small Gramme machines, sufficient for sixteen Jamin lamps, the light obtained is ten times that which would have been produced by the direct combustion of the gas itself."

It is further stated that a series of experiments have proved that one horse power will give light equal at least to as much, if not more, than fifty Carcel lamps. At the concluding meeting the whole force of a twenty-horse power engine was brought into play, and the effect declared equal to at least two thousand Carcels.—*Jour. Soc. Arts.*

Brush Electric Light at Portsmouth, Eng.

The "Inflexible" dock at Portsmouth dockyard was lighted up on the night of the 7th inst. by means of the electric light. The dock is 416 feet long by 110 feet wide, and about 39 feet deep, and the object of the trial was to ascertain whether it were possible, in time of urgent need, to work an ironclad after dark, or to continue the work of completing her for sea throughout the night.

The apparatus used was one of Brush's dynamo-machines, consisting of eight magnets and four powerful electro-magnets, and driven at a speed of eight hundred revolutions per minute. The lamps were also constructed on the Brush principle. Sixteen of these lamps were placed in the engine-room, electro-plating shop near at hand, where the generating machine was fixed. The experiment is reported to have been quite successful.—*Journal of the Society of Arts*, Lon., June 25.

THE DYNAMO-ELECTRIC CURRENT.*

By C. TOMLINSON, D.C.L., F.R.S.

THE author, after a brief reference to the discoveries by Dr. Wollaston, Professor Oersted, of the Copenhagen, and Arago, of the Paris Academy of Sciences, on the effects of electricity on magnetic needles, on the electro-magnet, and on the subject presented, the case by Sir Charles Wheatstone, and the other by himself, to the Royal Society in February, 1827. The machine then described by him, and known in various forms as the magneto-electric, is again brought forward, the view of its construction and action being taken from the original paper. The author next adverts to the recent researches of Professor Wilde, carried out chiefly at Manchester, and which have led to the use of those machines, both of them being employed in the production of the electric light. An electro-magnetic machine is one in which the intensity of external resistance causes a falling off in the quantity of current, and in which the power of the current depends on the rate of motion, through contact between the carbon electrodes of an electric lamp, very much. Under these circumstances the excitement of the machine, and the power necessary to maintain its action, will be the rapid feeding and destructive sparks in the machine itself. An observation by Dr. Gladstone to the effect that paper is perfect conductor of electricity when dry, but a non-conductor when it is moistened, which circumstance has since been taken advantage of to some extent by Mr. Ladd and Mr. Brush, in constructing current generators.

The principal object of this paper is to establish the conditions under which magneto-electric machines may be employed, and to explain how they can be made to give maximum results. A series of tables and diagrams are given, the results of experiments conducted by Mr. Lineham, carefully, employed at the author's works, which lead up to the conclusion that, in constructing such machines on the plans principle, the resistance on the rotating coils should be equal to the resistance of the whole of the wire employed, and that on the magnets has to be increased more than twofold, not by the employment of thin wire, but by augmenting the length and weight of coil wire employed. The results of this mode of distributing the resistances is summarized as follows:—1. That the electromotive force, or power to suffer, increases with increased resistance, and that of first rapidly, and afterwards more slowly, as augmented. 2. That the current in the coils of the machine is actually greater for a coil not a half resistance than for one unit. 3. With an external resistance of one coil, which is about equivalent to an electric arc, when thirty or forty webers are passing through it, a one-horse-power is expended, of which 72*l.* horse-power is expended, of which 72*l.* horse-power is available, thus giving an efficiency of 42 per cent., as compared with 6 per cent. in the case of the ordinary dynamo-machine. 4. That the maximum energy which can be demanded from the engine is 2·6 horse-power, so that but a small margin of power is needed to suffice for the greatest possible requirement. 5. That the current intensity is about 1·6 webers, and the electromotive force about 30 volts, the latter being 1·3 horse-power, so that there is no fear here of destroying the insulation of the coils by excessive heating. 6. That the maximum current is approximately that which would be habitually used, and which the commutator and collecting brushes are quite capable of transmitting.

Generally, the author concludes that the new machine will give a steadier light than the old one, with greater average economy of power, that it will be less liable to derangement, and may be driven without variation of speed by a smaller engine; also that the new machine is free from all objection when used for the purpose of electro-deposition, the construction of machine coils and magnets being such as to render the employment of the regulator to work electric lamps, enabling him to dispense with all wheel and clockwork in the arrangement. The two carbons being pushed forward by gravity or spring power, are clocked laterally by a pointed metallic abutment, situated at such a distance from the arc itself that the heat is only sufficient to cause the volatilization of a part of the carbon in contact with atmospheric air. The arc-

*Abstract of a paper presented to the Royal Society.

bon holders are connected to the iron core of a solenoid coil, of a resistance equal to about fifty times that of the arc, the coils of which coil are connected to the two electrodes respectively. The weight of the core (which may be varied) determines the force of current that has to pass through the regulating coil, and this is the only part of the apparatus, and this is in turn is dependent upon the resistance of the arc. The result is that the length of the arc is regulated automatically, so as to maintain a uniform resistance signifying a uniform development of light. ...

VEGETATION BY ELECTRIC LIGHT.

In the State-aided Academy of Agriculture at Lagnolo, Capt. Lemuel Gulliver was introduced to a inventor who had been eighty years engaged, and expected to be so for eight years longer, in extracting azotizeous from cucumbers, which were in no put in vials hermetically sealed, and let out for horticultural purposes in raw and incitement manner. Dr. Siemens has arrived at the result which the Lagnese projecter probably missed, and in a more direct manner, by means of the electric light. At a meeting, the other day, of the Royal Society, he gave a detailed account of his experiments, which are also embodied, but the issue so far is interesting and important. He found that an electric centre of light equal to 1400 candles placed at a distance of two metres from growing plants, was apparently equal, in its effect upon the growth of plants, to the sun's illumination at the present period of the year; and that plants do not seem to require rest during the night, but when the electric light remain healthy and grow continuously, even when being at the same time fenced by artificial heat. These facts constitute additional evidence of the similarity of the electric and solar light, which is manifested in other ways. It is unlikely that the electric fluid will ever be used to supplement the solar beam on a large scale, but it is obviously possible that horticulturists who grow plants under glass may be greatly benefited by its application; and artificial waterfalls in gardens, either fed by diverting a stream, or drawn from water works, would easily supply the requisite power. The paper at the Royal Society received elegant illustration from a pot of budding tulips, which, placed in the full brightness of an electric lamp in the meeting-room, in about forty minutes unfolded into full bloom.

THE DYNAMO-ELECTRIC CURRENT AND CERTAIN MEANS TO IMPROVE ITS STEADINESS.*

BY J. Hopkinson, D.Sc., F.R.S.

The author, after briefly describing the action by Dr. Werner Siemens of the dynamo-electric or self-excitative principle of generating currents, makes reference to the two papers on the subject presented, the one by Sir Charles Wheatstone and the subject presented, the one by Sir Charles Wheatstone and the other by himself, to the Royal Society in February, 1867. The principle then designed by him was that of a governor in operation on that occasion, in again brought forward with a view of indicating the arrangement that has since taken place in the construction of dynamo-electric machines, particularly those by Gramme and Siemens-cum-Alliance. The great practical importance of the subject leads to the use of these machines, both of them being subject to the disadvantage that an increase of external resistance causes a falling off of the current; and that, on the other hand, the short circuiting of the outer terminals, through contact between the carbon electrodes of an electric lamp, very much increases the electric excitement of the machine and the power necessary to maintain its motion, giving rise to rapid heating and destructive sparks in the machine itself.

An observation in Sir Charles Wheatstone's paper is referred to, relating to the fact that a powerful current is set up in the shunt circuit of a dynamo-electric machine, which circumstance has since been taken advantage of in practice not only by Mr. Ladd and Mr. Brush, in constructing current-generators.

The principal object of the paper is to establish the conditions under which dynamo-electric machines worked on the shunt principle can be made to give maximum results. A series of curves and diagrams are given, the results of experiments conducted by Mr. Lambert, electrician, employed at the author's works, which lead up to the conclusion that, in constructing such machines on the shunt principle, the resistance of the revolving helix has to be considerably reduced by increasing the thickness of the wire employed, and that on the magnets has to be increased more than is usually done. The employment of thick wire, but by augmenting the length and weight of coil wire thick wire, but by augmenting the length and weight of coil wire and speed.

The results of this mode of distributing the resistances is summarised as follows:—

1. That the electromotive force, instead of diminishing with increased resistance, increases at first rapidly, and then more slowly towards an asymptote.

2. That the current in the outer circuit is actually greater for a unit and a half resistance than for one unit.

3. With an external resistance of one unit, which is about equivalent to an electric arc, when thirty or forty webers are passing through it, 7·14 horse-power is expended, of which 2·19 horse-power is usefully employed, proving an efficiency of 32 per cent., as compared with 45 per cent. in the case of the ordinary dynamo-machine.

4. That the maximum energy which can be demanded from the engine is 2·0 horse-power, so that but a small margin of power is needed to suffice for the greatest possible requirement.

5. That the maximum energy which can be ingeniously transferred into heat in the machine itself is 1·3 horse-power, so that there is no fear here of destroying the insulation of the helix by excessive heating.

6. That the maximum current is approximately that which would be habitually used, and which the commutator and collecting brushes are quite capable of transmitting.

Hence the author concludes that the new machine will give a steadier light than the old one with greater average economy of power, that it will be less liable to derangement, and may be driven without variation of speed by a smaller engine; also that the new machine is free from all objection when used for the purpose of electro-deposition.

This construction of machine enables the author to effect an important simplification of the regulator for the electric lamp, enabling him to dispense with all wheel and clockwork in the arrangement. The two carbons being pushed onward by gravity or spring power are elevated laterally by a pointed metallic steel bevel, actuated at such a distance from the arc itself that the latter is only just sufficient to cause the gradual wasting away of the carbon in contact with atmospheric air. The carbon holders are connected to the iron core of a solenoid coil, of a resistance equal to about 50 times that of the arc, the ends of which coil are connected to the two electrodes respectively. The weight of the core (which may be varied) determines the force of current that has to pass through the regulating coil in order to keep the weight in suspension, and this in its turn is dependent upon the resistance of the arc. The result is that the length of the arc is regulated automatically, so as to maintain a uniform resistance signifying a uniform development of light.

* Abstract of a Paper presented to the Royal Society.

ANDRÉ'S ELECTRIC LIGHT FOR MANSIONS.

While the Board of Trade is debating the question whether the electric light which is to astonish the world, and which excites the spirits of gas-shareholders and all the dingy trade, should yields them their fat dividends, and while it is directed there, then for at least a month to come, a great deal of quiet, unostentatious business and progress made in practical electric lighting, both in England and the Continent. It must be regarded as a fortunate circumstance for our inventors that they are not subjected in this country to the Italian fever. Thus, for example, the Mr. Edison, has the sweet inspiration of secret working which always ensures success and confidence—one can say he was not forced to count their chickens before they are hatched, and prematurely forth what they may or they may not be capable of doing it. The true development of an invention is seclusion, secrecy, and alone can skilful experiment be made. It is said that a rich remark is earned; while, if it fails, the worker does not incur any approbrium for unsuccessful results which would not be believed.

The electric lamp of Professor André has not been often brought before the notice of the public, yet it is a lamp on which the inventor has spent a vast deal of labour and ingenuity, and one which promises to take a high place in the electric lighting of the immediate future. It is a small lamp designed for lighting private dwelling-houses, and may be said to be in this respect unlike the ordinary lamps of Siemens, Begleff, and Jablochkoff, now to vogue, but it can also be made to give a very intense light. We recently described his first form of the lamp in *The Electrician*, page 154, Vol. III., but since then we have much improved of late by several minor improvements. It may be remembered that it is based on the incandescent principle, and consists of several pencils of carbon enclosed in an air-tight glass cylinder, which forms the globe of the lamp. The pencils are placed vertically, and their points rest on a copper electrode in the bottom of the lamp. When the current is let on these electrified points glow with great brilliance. The light lasts for many hours, because the carbons are very slowly consumed one after another in the carbonic acid gas which the air within the vessel is converted into after a few burnings. Generally speaking, M. André's lamp comes between the incandescent electric lamps of Ladigin and Shaw, which consist of a solid rod of carbon wholly heated by the passage of a current in a glass vessel filled with nitrogen gas, and the incandescent lamps of Regnier and Werdermann, which consist of incandescent carbon points burning free in air. The multiple points, the solid copper electrode for all, the carbonic acid medium, the electro-magnetic regulator, in short, the whole arrangements of the lamp are peculiar to it. Indeed it must be confessed that the idea of placing the incandescent points in an atmosphere of carbonic acid, which is so easily formed by the action of the lamp itself, and, at the same time, is so essential to protect the fine carbons from unnecessary waste, is a happy and important one, though not altogether new.

The proof of an invention lies, however, in its practice, and M. André's lamp has now earned a fair title to public consideration. An exhibition of his system of electric lighting for mansions and dwelling houses came off at Stafford House on the evening of January 26, in the presence of the Prince of Wales, the Duke and Duchess of Sutherland, Sir Frederick Leighton, and several other gentlemen. The first experiment was made with six lamps of 75 candle-power each, in circuit with 1,000 yards of cable, and fed by one small Gramme machine; the second was made with 14 lamps of 75 candle-power each, in the same circuit; the third, of 20 lamps of 50 candles each, in a circuit of 600 yards, fed by one Gramme machine; and lastly 20 lamps of 25 candles each, in the same circuit of 600 yards, and fed by the same machine. The power absorbed was from 1·2 to 1·5 horse-power per lamp.

The lantern ceiling of the grand staircase was lighted up brilliantly, clearly showing from below with very fine effect the splendid decorations overhead at a height of from 60 to 80 feet.

The dining rooms, drawing rooms, and boudoir were also lighted up with large, luminous lamps, protected by pearl, pink, and yellow tissue paper, which produced a most agreeable, soft, and steady light, and when it was required to illuminate the pictures on the walls these tissues were removed so as to throw the undiminished effulgence of the lamps upon them. His Royal Highness the Prince of Wales was, we believe, greatly pleased with the light, and Mr. André declared that it was the best display of electric lighting he had yet seen. The apparatus used at Stafford House has now been removed to the country mansion of Mr. Edward Easton, C.B., who is associated with M. André in the exhaustive development of the lamp, and will there be permanently installed on the model, to be shown the public, of André's system of domestic electric lighting. It is, we think, to be regretted that M. André should have chosen so inconvenient a place to exhibit his system, but probably he will also arrange to show it in operation in the metropolis itself.

The new lamp is not, of course, to be confined to dwelling-houses, or fiery mines, but will be found equally adapted to mills, manufactories, and other large works. The North Shore Corn Mills, near Preston, are now lighted by André's lamps, and the Liverpool Corporation, who last year obtained an Act of Parliament to light the borough of Liverpool by means of electricity, are at present considering its advantages for the purpose of lighting streets.

[The above article was crowded out of our last issue, and since then we have seen the lamp in operation, and, as usual, confess this lamp the best that has, as yet, been invented. This improvement has been made since the visit paid by the Hon R. Brougham, and will be described and illustrated next week.—*Ed. E.*]

ELECTRICITY AT TELEGRAPHY

THE SOUTH AFRICAN TELEGRAPH.—The Eastern and South African Telegraph Company announce the repair of the cable recently interrupted off Durnford Point, thus establishing telegraphic communication direct with the Cape of Good Hope.

THE INFLUENCE OF THE ELECTRIC LIGHT UPON VEGETATION.—At a recent meeting of the Royal Dublin Society Dr. C. W. Siemens, F.R.S., gave a detailed description of some experiments upon the above subject which have been conducted during the last two months at his house at Sherwood, and exhibited specimens. The method pursued was to plant quick-growing seeds and plants, such as mustard, cress, and various vegetables, in pots, and after the young plants were divided into four portions, one of which was kept entirely in the dark, one was exposed to the influences of the electric light only, one to the influence of daylight only, and one to daylight and electric light in succession. The electric light was applied for six hours each evening, from 5 to 11, and the plants were then left in total darkness during the remainder of the night. The general result was that the plants kept entirely in the dark soon died; those exposed to the electric light only or to daylight only thrave about equally; and those exposed to both day and electric light throve far better than either, the specimens of mustard and carrots exhibited to the society showing the difference in a very remarkable way. Dr. Siemens only considers himself as yet on the threshold of the investigation, but thinks the experiments already made are sufficient to justify the following conclusions:—(1) That electric light is efficient in producing chlorophyle in the leaves of plants, and in promoting growth. (2) That an electric centre of action, such as the electric light placed in close proximity to a number of young plants appears to be the most effectual means of obtaining daylight at this season of the year; but that more economical effects can be obtained by more powerful light centres. (3) That the carbonic acid and nitrogenous compounds generated in diminutive quantities in the electric arc produce no sensible deleterious effects upon plants enclosed in the same space. (4) That plants do not appear to require a period of rest during the twenty-four hours of the day, but make increased and vigorous progress if subjected during daytime to sunlight and during the night to electric light. (5) That the radiation of heat from powerful electric arcs can be made available to counteract the effect of night frost, and is likely to promote the setting and ripening of fruit in the open air. (6) That while under the influence of electric light plants can scarcely harmed above heat without collapsing, a circumstance favourable to its forcing by electric light. (7) That the exposure of ordinary horticultural deposits mainly upon the care of exchanging carbonic acid, and the consequent production of such energy, such a supply of nitrogenous compounds as may be required for the plant, is rendered available. Dr. Siemens, in giving rise to a highly-interesting discussion, in which it was pointed out that the evidence afforded of the practical identity, as regards vegetation, of solar and electric light, besides the probability that it would be turned to immediate account by horticulturists, would afford great facilities for the scientific investigation of the influence exerted by light, as compared with other agencies, in promoting the formation of the constituents of more valuable constituents of plants, such as the quinine of the cinchona bark, the gluten of wheat and so forth. Before concluding his observations, Dr. Siemens placed a pot of budding tulips in the full brightness of an electric lamp in the meeting room, and in about forty minutes the buds had expanded into full bloom.

ABSTRACT OF PATENTS.

2301. ELECTRIC LIGHTING, &c. (*Provisional protection not left June 19th, 1879.*—*Sealed Nov. 6th, 1880.*)

The upper electrode is moved by a clamp connected to an armature-lever, which is pivoted at one end to the fixed upper piece on a fixed vertical axis. In order to diffuse the light more efficiently, an opal disc is placed under the light, and a portion of the rays pass through it, and are reflected upwards upon a bowl-reflector fixed above the electrodes.

2332. ELECTRIC LAMPS, C. D. Abel.—*Dated 11th June, 1879.*—(A communication.)—*Not proceeded with.* 2d.

The two carbon electrodes are carried by two pistons, plungers, or forms contained in two closed cylinders filled with liquid, in communication with each other, the pistons being forced by the liquid in the vessels and the weight of the pistons and arms regulating the distance carrying the carbons being so proportioned that the piston carrying the lower carbon is only lifted to descend in its vessel, causing the liquid to flow therefrom into the other vessel, and thereby raising the second piston with the lower carbon.

DYNAMO-ELECTRIC CURRENTS.

*On the Dynamo-Electric Current and on certain Conditions to Improve its Steadiness.**

By C. WILLIAM SIEMENS, D.C.L., F.R.S.

THE author, after alluding to the early conception by Dr. Wheatstone of the the dynamo-electric or reconcentrative principle of generating currents, makes reference to the independent discovery of the principle by Mr. Charles Wheatstone and Mr. Siemens, and by Mr. Varley, before the Royal Society in February, 1867. The machine then designed by him, and shown in operation on that occasion, is again brought forward with a view of indicating the progress that has since taken place in the construction of dynamo-electrical machines, particularly those by Gramme and Siemens and Halske. The latter machine has the very certain drawback in the use of time-switches, and of them being subject to the disadvantage that an increase of external resistance causes a falling off of the current; and that, on the other hand, the short circuiting of the outer resistance, through contact between the series electrodes of an electric lamp, very much increases the electric excitation of the machine, which, with a view to power economy in machine motion, causes a rapid fusing and destructive sparks in the machine itself.

An observation in Sir Charles Wheatstone's paper is referred to, pointing to the fact that a powerful current is set up in the shunt circuit of a dynamo-electric machine, which circumstance has since been taken advantage of by Messrs. Siemens, Ladd and Mr. Staite, in constructing current governors.

The principal object of this paper is to establish the conditions under which dynamo-electric machines worked on the shunt principle can be made to give maximum results. A series of tables and diagrams are given, the results of experiments conducted by Mr. Lauchert, electrician, engaged in the author's workshops, which lead to the conclusion that, in constructing machines on the shunt principle, the resistance on the retarding helix should be considerably reduced by increasing the thickness of the wire employed, and that on the magnets less to be increased more than tenfold, not by the employment of thin wire, but by augmenting the length and weight of coil wire employed.

The results of the method of distributing the resistance, is enumerated as follows:

1. That the electro-motive force, instead of diminishing with increased resistance, increases at first rapidly, and then more slowly towards an asymptote.

2. That the current in the outer circuit is naturally greater for a small than for a large resistance.

3. With an external resistance of one unit, which is about equivalent to an electric arc, through which the currents are passing through it, 1.61 horse power is developed, of which 1.25 horse power is usefully employed, giving an efficiency of 50 per cent., as compared with 45 per cent. in the case of the ordinary dynamo-machine.

4. That the maximum energy which can be demanded from the engine is 2.6 horse power, so that but a small margin of power is needed to suffice for the greatest possible requirements.

5. That the maximum energy which can be injuriously transferred into heat in the machine itself is 1.2 horse-power, so that there is no fear here of destroying the insulation of the coils by excessive heating.

6. That the maximum current is approximately that which would be indicated by a tangent drawn to the curve below and coinciding therein with the axis of transmitting.

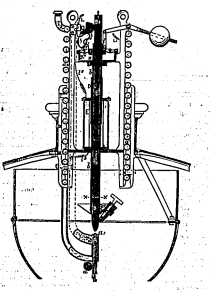
From the author concludes that the new machine will give a steadier light than the old one with greater average economy of power; that it will be less liable to derangement, and may be driven without variation of speed by a smaller engine; also that it will be free from all the objection when used for the purpose of electro deposition.

* Abstract of paper read before the Royal Society, March 4, 1880.

This consideration of machine enables the author to effect an important simplification of the regulation of the electric current, making him to dispense with all electric time-clockwork in the arrangement. The two carbons in the lamp are caused by a helical metallic retaining spring are allowed laterally from the arc itself, that is, at a point of only just sufficient to cause the gradual wasting away of the carbon in contact with atmospheric air. The carbon holder is then connected about fifty times that of the arc, the ends of the coil are connected to the two carbon holders respectively. The force of current that has to pass through the regulating coil in order to keep the weight in equipoise, and this is therefore dependent upon the resistance of the arc. The resistance, and that length of the arc is regulated automatically, so as to maintain a uniform resistance signifying uniform development of light.

SIEMENS' SINGLE CARBON ELECTRIC LAMP.

THE construction of this lamp, to which we referred in our last issue,* is as follows:—In the fig., which represents a vertical section of the lamp, A is the lower electrode, formed of an iron or steel wire loosely fitting in a water-cased tube, and pressed upwards by a volute spring, *s*, or by a weight and pulley. The mouth of the water-cased tube has a bush, *s*', closely fitting the wire A, or having a burr at its mouth, so as to prevent the wire from being pushed through it, except when its point becomes softened, fused, and dissipated by the heat of the voltaic arc. The water circulating through the casing of the electrode may flow to and from an open cistern, or it may, as shown in fig. 1, circulate through a closed coil of tube, *s*', presenting a considerable cooling surface. The upper electrode, B, is a carbon rod free to slide in a tube, *b*, having two carbon slits at the lower end of the tube, B, is provided an oblique adjusting screw, C, the point of which bears against the carbon and presses it against the ribs on the opposite side of the tube, so that being in a manner clamped between these ribs and the screw, C, it cannot slide down. Moreover, from the pressure of the carbon against the ribs, *b*, close contact results, so that the electricity enters the carbon at its point of contact with the ribs, and consequently the heating of the carbon is confined nearly to the portion of it which projects below the tube. As the lower end of the carbon gradually wastes away from the point, C, the carbon gradually slides down the tube. The screw, C, may be of copper, as a good conducting material, or its point may be of refractory metal, such as platinum, or it may be a refractory gem, such as diamond, let into the point of the screw, C, which is guarded from the heat of the arc by a shield of porcelain or refractory metal. The screw, C, works in a shield, *c*', of convex or inverted conical form enamelled or faced with porcelain on its lower surface, so as to reflect the light as well as to protect the tube, *b*, from the heat of the arc. As the carbon, B, becomes consumed and descends, the carbon, *b*, a fresh carbon, B', can be added to it; for this purpose the upper end of the new carbon is hollowed out a little, and the lower end of the fresh carbon is served with a little moistened sugar, or with tar, which, as the junction approaches the lower end of the tube, becomes carbonized by the heat, cementing the two carbons together. It is of advantage to provide in each carbon a short piece of wire, *b*', to act as a dowel, centering the carbons to one another; or the one carbon might be made with a point projecting as a tenon to enter a hole in the end of the other carbon. The automatic adjustment of the distance of the electrodes is effected in the following manner:—



SIEMENS' SINGLE CARBON ELECTRIC LAMP.

The tube, *b*, has on it, a cylindrical casing, *b*, of soft iron; or instead of a complete cylindrical casing, the iron may be put on the tube as a number of strips arranged round its circumference. Around the tube, *b*, is the coil of a solenoid, *a*, consisting of a great number of convolutions of insulated wire, so as to present very considerable electrical resistance. This solenoid coil forms part of a circuit connecting the one terminal with the other, as will be understood by tracing the course of the electrical current from the one line wire, L, to the other line wire, L'. The one wire, L, is attached to an insulated connecting piece, *f*, from which a flexible metallic strip, *f*', connects to the tube, *b*, holding the upper carbon, and a wire, *f*', connects to the solenoid coil, *a*, the other wire, L', is connected directly to the frame of the lamp, which is all in metallic connection with the lower terminals, and also by a wire, *f*', with the solenoid coil, *a*. The tube, *b*, and its carbon being a little more than counterbalanced by an adjustable weight on a lever connected to the tube by a non-conducting link, *f*, the regulation of the distance of the terminals depends upon the

A NEW YORK correspondent of the *Standard* says:—That of the 200 paper carbon lamps tried by Mr. Edison, only two remain at present undestroyed. A professor of Harvard University has sent him 50 specimens of discs to test for the carbon horse-shoes instead of the paper formerly used. Mr. Edison finds manilla is the best of them for his purpose." Amongst those who have the best opportunity of judging what he has done, or is likely to do, little hope seems to remain of his ultimately attaining success with his incandescent lamps.

EDISON'S NEW DISCOVERY.

New York Graphic Journal, Dec. 2, 1880

We clip from the N. Y. *Evening Post* the following account of a:—

"A gentleman who visited Menlo Park last week on behalf of the Boston *Journal* reports that all except two or three of the paper carbon lamps have been taken down, and that Edison admitted that they had been destroyed."

It would hardly seem credible that the above can be exact; but if it is there is much consolation in the fact that something substantial looms up in the future, if the following from the N. Y. *Times* is true:

"In the intervals of his wrestle with the electric light, Mr. Edison finds time to chip off numerous minor inventions, any one of which should be sufficient to revolutionize the world, if the world knew what was good for it. Mr. Edison's latest discovery is a method by which, it is announced, "to can extract a greater amount of gold from the rejected residuum or 'tailings' of auriferous quartz or sand than is obtained by the present processes from the virgin rocks." In other words, after the ore, crushed and triturated in the usual manner, has yielded its average of 20 to 40 dollars a ton, Mr. Edison takes the refuse and extracts from it—at the merely nominal cost of five dollars—all the way from $80 to $250, or even $1,400 a ton. It is well remarked by the New York *Herald*, from which the account of this wonderful discovery is derived, that "the wealth which is likely to result is beyond computation." Mr. Edison would seem, indeed, to have realized the dream of the alchemists and to have found the philosopher's stone. It is perhaps unnecessary to add that "before allowing his discovery to be known beyond the small circle of his confidential associates," the "Edison Ore Milling Company" was formed, "Mr. Edison himself holding a place in the Board of Directors." The confidential associates have not yet placed their stock upon the market, but it is probable that a few shares may shortly be purchased, at an advance, if any reader of the *Times* desires to go in."

THE LONTIN ELECTRIC LIGHT.

IT has long been acknowledged by electricians that for brilliancy and reliability the Serrin lamp left little to be desired, and it seems that this little has now been supplied in the Lontin, which is one step forward in the development of the same system. A number of scientific gentlemen and electricians lately met at the Three Nuns Hotel, adjoining the Metropolitan Railway, Aldgate, London, to see, previously to examining the light in use on that line, an account of the progress in perfecting the Lontin apparatus. The Lontin light has for some time past been and still is in successful use in Paris, and is not unknown to the inhabitants of and visitors to London, being that which was for some time exhibited in the Strand during last winter by Mr. John Hedlingsteel, of the Gayety Theater. Since that time, many little imperfections were noticed by those interested have been remedied, and eight lamps are now in use at the Aldersgate-street Station of the Metropolitan Railway. At the meeting in question, the chair was occupied by Mr. Alan Fenton, the general manager of that line, and Mr. C. F. Harding, who first introduced the light in this country, and in whose workshops all the machinery at present constructed, having explained the details of the improvements recently made, and been introduced since the system was first brought before the public, there was an interesting discussion, in which Mr. W. Conran, F.R.S., Mr. Tomlinson, the engineer of the Metropolitan Railway, and others took part. The opinion was without exception favorable to the quality and efficiency of the Lontin lamp, but some fear was expressed that the present high price would probably limit its application.

The economy of the system was ably maintained by Mr. Bernard Godfrey, the engineer of the Lontin Light Electric Generator and Light Company, who, by the aid of samples of the various forms of the lamp, showed very clearly the progress made up to the present time. He explained that the first cost of the lamp was really less than that which at first sight appeared, owing to the small number of electric lamps required for a given space and their durability, but to meet this popular objection efforts were still being made, and he hoped before long they would have a lamp in which the clockwork was entirely dispensed with, the result of which would be that even in first cost the Lontin would compare favorably with any lamp known. It is but nine months since the first practical application of the electric light for public illumination was initiated in London with the Lontin system at the Gaiety Theater, and it has already in spite of the indisposition of over sanguine projectors and the detraction of opponents, become admittedly a method of lighting which public bodies have to reckon with, being alone adopted on the score of power, salubrity, cleanliness, and economy, under its present improved and improving conditions, to satisfy certain large special requirements. It is to meet these special wants that the above company has acquired the only complete system of lighting which now exists. In fact, without in any way depreciating the brilliant results obtained by other inventions, it may be fairly stated that, whilst one company deals with a machine of which the subdivision is limited, and another company with the utilization of a burner or candle, each having its special feature and being dependent on others for the rest, this company holds not only the Lontin generator, but also the regulators, lamps, and methods of subdivision which enable it to supply from its own resources a complete and practical system of lighting which is neither disagreeable in color nor unsteady in light.

It was claimed for the Lontin light that it has decided advantages over the circle in steadiness, in divisibility, and in economy, the cost of the Lontin being as compared with 9.3d. for the next cheapest light. The illumination of the Aldersgate street Station on Monday was very brilliant in every part, although but eight lamps were used to light the whole of the platforms. The lamps were on four circuits, and the currents were supplied from a Lontin generator producing alternate currents and making only 400 revolutions per minute. The motive power was obtained from a Fowler's semi-portable compound engine, high pressure cylinder 9 in. diameter, and low pressure 16 in. diameter, with about a 14-in. stroke. The steam was used at 112 lb. pressure on the square inch, and the engine was making about 109 revolutions per minute. From these data practical men can calculate approximately the number of indicated horse power used. It is intended with the same machinery to illuminate the Moorgate-street and Farringdon stations also, which will be a severe and conclusive test of the efficiency of the system. It is stated that the light may be divided very greatly. As many as two or three lights have been placed in one circuit. It has been shown practically that by this machine it is possible to give a larger number of small lights; and so far as experience has hitherto gone, whatever loss there may be in illuminating power is much more than counterbalanced by the convenience of so complete a distribution; however, curiously enough, up to a point which at present appears to be between four and six lights on a circuit, a positive gain is obtained by division. These experiments are not yet completed. A machine constructed nominally for twelve lights (which would mean twelve lights of 600 candle-power each), may be arranged to produce 48 lights, should the nature of the application make such division desirable. The various patents which are the property of this company include special regulators and lamps, as well as special materials for cables and insulation, so that the whole apparatus necessary for the purposes of electric lighting used in this system is to a great extent peculiar to itself, and constructed under its own direction and control. The experiments on Monday evening were in every respect satisfactory, and promise much for the future of the light.

THE SAWYER ELECTRIC LIGHT.

The practical working of the Sawyer system of electric lighting was recently exhibited in a few gentlemen's ordinary, uptown residence on West 34th street, in this city. Seven lamps were distributed at convenient points—three in the rear of the hall, one upon the center-table, a sixth in the front parlor, and seven in the front parlor, two upon a double arm gas fixture and five upon ordinary pattern in the front parlor, and three in the back. It is stated that the seven lamps are operated upon one

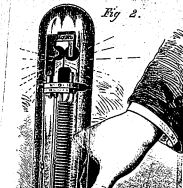


Fig. 2.

AMERICAN INDUSTRIES, No. 38.

THE MANUFACTURE OF PRINTING INKS.

On the first page of this paper we illustrate the leading processes of the printing ink manufacture, as conducted by one of the oldest houses in that branch of business. In the early history of printing it was common for printers to make their own inks; but with the more varied requirements of modern printing offices, it has been found that greater economy and generally better results could be obtained by making of this department a separate trade.

The making of first-quality printing inks is a nice operation; it requires a high degree of skill and a variety of judgment obtained only by long experience, although the general methods employed have shown but little change in many years. All practical manufacturers have, however, certain trade secrets, the value of which would be recognized only by an expert, but which they carefully guard, tending the details of grinding the color, making the varnish and lampblack, and the various pigments they employ in colored inks.

In our illustrations the view at the upper right hand corner shows the furnaces in which the lampblack is made. This is the color basis of most of the black inks, although finely divided charcoal and occasionally other blacks are also used to some extent. The making of the black is a simple and well understood process, but on the materials employed therefor and the quantity of black used depends much of the success of the ink manufacturer.

The picture to the left at the top, showing the varnish making, presents a part of the business on which, quite as much as the color, depend the distinctness and brilliancy of all fine class inks. Linseed oil is largely used for this purpose, though other oils are likewise employed, and resin oil has been extensively used in the cheaper inks. By boiling the fatty constituents of the oil—glycerine, palmitine, etc.—are volatilized. For the best inks, the oil is clarified by digesting for some hours with dilute sulphuric acid at a temperature of 212 degrees, then washing with hot water, when it will dry quickly and thoroughly; the oil is then boiled, and the inflammable vapors that rise are ignited, which, after burning for some time, are extinguished by a cover placed over the vessel. In order to promote quick drying, manganese in its different states and other driers are sometimes added. The view entitled "color plant" shows the department where the various pigments for colored inks are prepared. These are made of almost everything which can be practically worked to give the different shades desired, either mineral, animal, or vegetable, the pigments being prepared so as to be as little liable to change as possible, and then kept on hand to make the basis of the different colors, by taking exact quantities or proportions by weight of each. The cost tar or asphalt colors have been very fashionable for some years, and, although they give great brilliancy at first, it has been found they are not lasting.

The black ink making room at the right of the general view shows where the lampblack or other carbonaceous blacks employed are mixed with the varnish in the barrel and rosin. The mixing is effected in a cylindrical vessel by a revolving shaft with fingers.

The color grinding, as shown in the large view at the bottom of the page, is done by powerful iron or stone mills, in which rollers of great strength, driven by steam power, reduce the mixture to so fine a state that no coarse particles can possibly pass.

Besides the ingredients mentioned above, soap is sometimes used in order to prevent smearing, assist in obtaining sharpness of impression, and help to make the ink have the proper

perties this light is much like gas. It is yellow, steady, and soft," and consequently not irritating, to the eye. It has none of the blue rays incident to the voltaic arc arrangement, and the shadow cast by intervening objects is softened and mellowed at the margin. For practical purposes it is intended that the power of each lamp shall not exceed that of two ordinary gas jets.

The relative economy of this system of lighting we are unable to learn. "Approximate estimates" of cost make it much cheaper than gas; but in the absence of specific data for exact calculation, such estimates do not go far to satisfy the popular mind.

ELECTRICITY.

The Standard Nut Works, of Pittsburgh, Pa., has adopted the Brush electric light.

An organization to be known as the New York Land Telegraph Company has been started, for the purpose of laying another cable across the Atlantic.

The Common Council of Boston will probably pass an ordinance regulating the erection of telephone and telegraph wires to prevent interference with the Fire Alarm Telegraph.

It is stated that the Gulf Submarine Cable Company will commence laying the cable during the latter part of this month, starting at Bermuda Santiago, thence to Vera Cruz or Tampico.

THE EDISON ELECTRIC LIGHT.

The following extracts from Professor BARKER'S paper in Silliman's *American Journal of Science* for April, 1880, as from the pen of Professor MARSH, a colleague of Professor BARKER in the University of Pennsylvania, and a gentleman of distinguished professional standing:

EDITOR ENGINEERING AND MINING JOURNAL.

SIR: The recently published results of the experiments of Professors Rowland and Barker are the only reliable data with regard to the Edison light which have as yet been presented to the public; and while these results are undoubtedly mathematically correct, save the assumption, *wholly unwarranted by any quoted experiments*, that the power which reaches the lamp is to the power developed by the engine as 70 is to 100, they convey to the general reader a wrong impression of the practical working of the light as it now is.

The professors have apparently overlooked the fact that distribution of light, rather than production of light by means of electricity, is the end which must be attained by Mr. Edison before his light can be deemed a practical success.

The economy of the production of light by electricity will be found to be greatly increased as the intensity of the light produced at any one point is increased; and the experiments made show that, with a light suitable to replace an ordinary gas-jet, and without making any allowance whatever for losses in the engine, electric machine, or wires, about 754 five-foot gas-jets can be replaced by one horse-power in the form of electricity.

Taking Professor Rowland's assumption of 70 per cent of the electric light per horse-power in electricity is equal to the light per indicated horse-power at the engine, we have 754 lights per indicated horse-power. The writer is inclined to believe that about 5 lights per horse-power per hour is in excess of what Mr. Edison is now doing, as he is informed by Edison's engineer that the engine, when developing about 90 horse-power, ran about 90 lights, which, burned very much in the same manner as a similar number of gas-jets. We see that each horse-power corresponds to about 4 6 lights of the apparent brilliancy of ordinary gas-jets, which hardly ever consume as much as 5 feet of gas per hour.

The average cost of one horse-power per hour, when fuel, attendance, lubrication, and wear and tear on belts, shafting, etc., are counted in, is about 4 cents per hour. This cost is the actual result in some of the best works about Philadelphia.

The comparative cost of electricity and gas can now be computed:

	Per 1000.
For 754 lights per horse-power per hour, illuminating-gas costs	$1.00
" " " " " " "	1.00
" " " " " " "	1.00

The method of computation is very simple: 754 lights, if replaced by gas, would require 754 × 5 cubic feet of gas = 3770 cubic feet. Then we have, by the rule of three,

$$3774 : 1000 :: 4 : 107.$$

In admitting that Edison has produced 754 *separate* lights of say 17 candle-power per indicated horse-power, we give him better results than he himself can claim.

Now, it is easy to see that if the gas companies are producing gas and getting it into the holder for less than the present figures given ($1.00), it will be impossible to supersede gas by electricity until further advances have been made in the reduction of its cost, allowing that the electric plant will cost no more than the plant of an ordinary illuminating-gas company.

All those familiar with the manufacture of gas know that it is produced at a cost far below $1.07 per thousand.

The writer has no desire to depreciate Mr. Edison's work, and heartily wishes him a rapid and successful result from his labors; but it is wrong as well as unjust to endeavor to create a sensation by misconstruing the results of Professor Rowland's measurements, and by dabbling in statements as to comparative cost of electricity and illuminating-gas without actually knowing either.

WILLIAM D. MARSH,
Prof. Dyn. Eng.

UNIVERSITY OF PENNSYLVANIA, April 18.

Edison's Latest.—*The Herald* is authority for the statement that Mr. Edison has found them in the intervals of his work on the electric light to make a remarkable discovery in another field. The industry which Mr. Edison proposes to revolutionize is the metallurgy of the precious metals. The *Herald* informs us that Mr. Edison has discovered a means whereby which "he can extract a greater amount of gold from the refractile portions of tailings" of auriferous quartz and ores heretofore left by the present processes from the virgin rocks." To state it differently, Mr. Edison proposes, according to this account, after the ore has been treated by the usual processes of milling and amalgamating, and has yielded as from 75 to 95 per cent of its gold, according to the ores with which it has been worked, to take the refuse and extract from it at merely nominal cost—anywhere from $50 to $1000 per ton. Mr. Edison may probably have discovered the philosopher's stone by which to transmute baser substances into gold; but on any other supposition the statements made by the *Herald* reporter are too ridiculously canvagant to merit serious consideration. It is by permitting unobtrusive newspaper men to scatter such statements as the above broadcast without demur in examining from him, that Mr. Edison is, to say the least, not adding to his reputation.

Dr. C. Stenzera has reached some curious conclusions respecting the influence of the electric light upon vegetation. He finds that the growth of plants is considerably promoted when they are continuously exposed to the ultimate action of sunlight and the electric light. This, he holds, proves that plants do not require rest, but that growth can be materially hastened by giving them a portion of the electric light at night, and that the electric light will produce chlorophyll in the leaves of plants, and promote their growth. In lecturing on this subject, Dr. Siemens illustrated his subject by placing some budding tulips in a strong electric light, which, in about 40 minutes, caused the buds to open out in full bloom.

A New Process for Etching on Copper.—From the London *Photographic News* we glean the following particulars of a new procedure for etching on copper, which has the merit of simplicity. A copper plate is first coated with bitumen on the turning-table, in the same manner as for "photo-zincography." When the coating is quite dry, an impression from a lithographic stone on transfer-paper is applied to it, which leaves behind a greasy and fatty impression of the design. The plate is then dusted with ebb's powdered powder, which adheres only on the inked portions, rendering them very opaque. The plate is now exposed to the light, which renders the portions of the bitumen coating not covered by the powder insoluble. Then a solvent for bitumen is applied, which removes the bitumen beneath the powdered parts, laying bare the copper surface in those parts corresponding to the picture. The copper plate can now be etched with perchloride of iron or other etching liquid, and when sufficient depth has been reached, the operation can be stopped and the whole plate cleaned. The process is said to be well adopted for line work.

ON THE INFLUENCE OF ELECTRIC LIGHT UPON VEGETATION—AND—ON CERTAIN PHYSICAL PROPERTIES OF OZONE.*

The vast importance of vegetation to animal life in association in accordance with the well known fact that plants exhale oxygen, which both flower and carbonic acid are broken up in order that, conversely, plants may exhale oxygen for animals. It is well known that this reaction depends upon solar radiation; but the question now arises, Do the blood-rays of the spectrum, or that agency, or whether other sources of light and heat which are rich in them, as the electric light, possess the character of illuminating rays and the heat-radiation in order to continue the action of growth, when the true solar rays are not or is hidden behind clouds?

About two years ago I mentioned to Sir Joseph Hooker, then President of the Royal Society, that I thought the electric arc might be found sufficiently powerful to promote vegetation, and that I should be willing to undertake some experiments on the subject if he could give me any hope of confirmative results. Sir Joseph Hooker gave me sufficient encouragement to induce me so follow up the subject, and I have since then gradually matured a plan for conducting the experiment.

The apparatus which has been put up at Sherwood consists—1. Of a vertical Siemens dynamo-machine, weighing 50 kilos, with a wire resistance of 2 ohms on the electromagnets. This machine makes 1,000 revolutions a minute; it takes 3 horse-power to drive it, and develops a current of 35 to 37 webers of an intensity of 70 volts. 2. A regulator lamp constructed for continuous currents, with two carbon electrodes of 12 millims. and 10 millims. diameter respectively. The light produced is equal to 1,500 candles measured photometrically. 3. A motor, which at present is a 3 horse-power Otto gas-engine, but which it is intended to supersede by a turbine to be worked by a natural supply of water, at a distance of about half a mile from the house.

My object in making these experiments was to ascertain whether electric light could be decided effect upon the growth of plants. For this purpose I placed the regulator in a lamp-shade in a conservatory, which, although the interior of the experiments is too limited perhaps to furnish that proof in an absolute manner. I may, however, be argued from analogy that such repose is not necessary, seeing that crops grow and ripen in a wonderfully short space of time in the northern regions of Sweden and Norway and Finland, where the summer does not exceed two months, during which period the sun scarcely sets.

The next step in the course of these experiments was to remove the electric lamp from the glass house known constructed of framed glass, 9 ft. 3 in. long, 14 ft. 3 in. wide, framed glass, 9 ft. 3 in. long, 14 ft. 3 in. wide, and averaging 8 ft. 6 in. in height, and to place it in a detached glass house a house a house and a few other small trees are planted, the sides of the house all round being occupied with a considerable variety of flowering plants. The electric light was fixed as high as practicable at the south corner of the house in order that its rays might fall upon the plants from a direction and at an angle coincident with those of the sun during the middle of the day. The temperature of the house was maintained at 60° F., and the electric lamp was kept alight from 2 P.M. to 6 A.M., for one week, from February 19 to February 24, excepting Sunday night. The time was hardly sufficient to produce very striking effects, but all the plants continued in present a healthy appearance.

Of three Alicante vines the one nearest the electric light made most progress; and the same could be said of the nasturtiums and roses. It was observed that other plants, such as geraniums, continued to exhibit a vigorous appearance notwithstanding the heat of the plant. This experiment is of importance in showing that the electric light, if put into conservatories or greenhouses, does not injure the plants but rather improves their appearance and growth. The leaves assume a darker and more vigorous appearance, and it seems that the coloring of the flowers becomes more vivid; but a further period of time is necessary to establish this observation absolutely.

I decided to try the effect of electric light as a means of promoting growth in the open air and under glass at the same time.

The regulator was put back into its first position, two meters above the ground, with a sunken melon house on one side, and a sunken house containing roses, lilies, strawberries, and a variety of other plants on the other. The space of ground between these, about one meter broad and seven meters long, was covered with boxes sown with early vegetables, including mustard, peas, beans, and potatoes; and in order to prevent cold winds from injuring the plants, low protecting screens were put up across the openings of the passage between the two houses.

These experiments were continued during four days and nights consecutively, and the results observed are of a very striking and decisive character as regards the behavior of small flock-growing plants as mustard, cress, etc. The plants that had been exposed to day-light alone (comprising a fair proportion of sunlight) presented their usually healthy green appearance; those exposed to electric light alone were, in most instances, of a somewhat lighter, but in one instance of a somewhat darker hue than those exposed to daylight; and all the plants that had the double benefit of day and electric light far surpassed the others in darkness of green and vigorous appearance generally. A pot of tulip bulbs was placed in this electric stove, and the flowers were observed to expand somewhat after two days.

Although the access of stove heat was virtually stopped, the temperature of the house remained constant throughout the night at 72° F., so that the electric lamp furnished not only a supply of effective light, but also of heat. No injurious effects were observed on the plants from the want of ventilation; and it would appear that the supply of pure carbonic acid resulting from the continuous combustion of the carbonic electrodes of high temperature, and under the influence of an open flame, suffices to assimilate their vital functions. If the nitrogenous compounds which Prof. Dare has shown to be developed in the electric are were produced in large quantities, injurious effects upon the plants must undoubtedly ensue; but in no case have I

* Abstract of a paper read at the Royal Society on March 4, by C. Wilhelm Siemens, D.C.L., F.R.S.

1 Prof. Stokes has shown, in 1857, that the electric arc is particularly rich in highly refrangible invisible rays, a circumstance which seems to point to a great loss of heating them rays through glass.

in a well-conditioned electric lamp, with a free circulation of air round the carbon electrodes, the amount of these products is exceedingly small and of a different nature than is produced in a confined space.

These experiments are not only instructive in proving the sufficiency of electric light alone to promote vegetation, but they also go to prove the important fact that diurnal repose is not necessary for the life of plants, although the duration of the experiments is too limited perhaps to furnish that proof in an absolute manner. It may, however, be argued from analogy that such repose is not necessary, seeing that crops grow and ripen in a wonderfully short space of time in the northern regions of Sweden and Norway and Finland, where the summer does not exceed two months, during which period the sun scarcely sets.

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Some weeks must elapse before any definite results can be given, but growth is evidently promoted under all these various circumstances. In order to test this clearly, a portion of the plants both under glass and in the open air are shaded from the electric light without removing them from their position of equal temperature, and exposed to solar light at the same time as before. The effect upon the flowering plants is very striking, electric light having apparently more efficacy to bring them on than daylight.

Although the amount of heat given off from the electric arc is not great, compared with the gas flame (giving off the products of combustion), yet the rays of intense heat of the arc are counteract that loss of heat by radiation from the leaves into space, which, during a clear night, causes hoar frost. For this reason I expect that electric light may be usefully employed in front of fruit walls, in orchards, and in kitchen gardens, to save the fruit bud at the time of setting; and in this application electric light will probably be found a useful agent not only to promote rapid growth, but to insure a better yield of fruit.

The experiments seem to lead to the following conclusions:

1. That electric light is efficacious in producing chlorophyl in the leaves of plants and in promoting growth.

2. That an electric center of light equal to 1,400 candles, placed at a distance of two meters from growing plants, appeared to be equal in effect to average daylight in the season of the year, but that more economical effects can be attained by more powerful light centers.

3. That the carbonic acid and nitrogenous compounds generated in diminutive quantities in the electric arc produce no sensible deleterious effects upon plants inclosed in the same space.

4. That plants do not appear to require a period of rest during the twenty-four hours of the day, but make increased and vigorous progress if subjected during daytime to sunlight, and during the night to electric light.

5. That the radiation of heat from powerful electric arcs can be made available to counteract the effect of night frost, and is likely to promote the setting and ripening of fruit in the open air.

6. That while under the influence of electric light plants can sustain increased stores both without collapsing, a circumstance favorable to forcing by electric light.

7. That the expense of electro-horticulture depends mainly upon the cost of mechanical energy, and is very moderate where natural forces of such energy, such as waterfalls, can be made available.

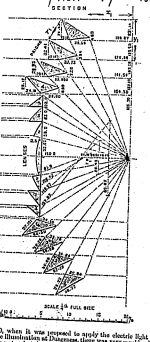
Since writing the above my attention has been drawn to an article in *Nature*, vol. xxi., p. 311, giving interesting observations by Dr. Schübler, of Christiania, on "The Effect of Uninterrupted Sunlight on Plants in the Arctic Regions." These observations fully confirm the conclusion indicated by my experiments with electric light. Not only are plants able to grow continuously, according to Dr. Schübler, but when under the influence of continuous light, they develop more brilliant flowers and larger and more aromatic fruit than under the alternating influence of light and darkness, whereas the formation of sugar appears to be dependent chiefly upon temperature.

It would follow from these observations that, with the aid of stoves and electric light, fruit, exciting both in sweetness and aroma, and flowers of great brightness, may be grown without solar aid. Dr. Schübler mentions that, in removing an arctic plant from the dark and placing it under the influence of the Arctic midnight sun, the leaves opened slowly, and it is interesting to observe that the same effect took place when an *Aesculus hyppocastanum* was placed (in the open air) under the influence of my midnight lamp.

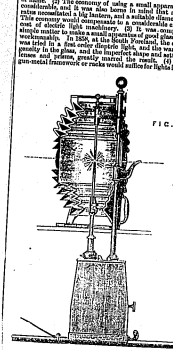
DIOPTRIC APPARATUS IN LIGHTHOUSES FOR THE ELECTRIC LIGHT.

SIR,—I have recently read a paper on this subject by Mr. James Chance, published in volume 57, 1876-77, part 2, of "Minutes of Proceedings of the Institution of Civil Engineers." Absence from England when it was read and discussed prevented me from attending the meeting, or I otherwise should have done so. I would ask you to be kind enough to insert in your valuable journal the following remarks, which I feel may will be of interest to several of your readers.

Engineer April 1880



In 1850, when it was proposed to apply the electric light to lighthouse illumination and purposes, there was very considerable discussion as to what class of dioptric apparatus should be employed. It was finally decided to adopt the zone order, for the following reasons:—(1) The size of the luminous point, which, it was considered advisable to have a distinctive optical character, to enable the nautical amount of divergence might be obtained. Previously, the order of apparatus had been proportioned to the size of flame. (2) The economy of using a small apparatus would be considerable, and it was also known that a small flame gave a more concentrated light, and a smaller diameter of lenses. This economy would compensate to a considerable extent for the simpler matter to make a small apparatus of good glass and good workmanship. In 1849, at the South Foreland, the electric light was tried by Mr. Faraday, the electric light, and the want of homogeneity in the glass, and imperfect shape and setting of both lenses and prisms, greatly marred the result. (4) Very thin gun-metal frames were or rules would suffice for lights illuminating

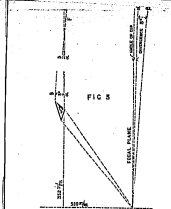


the whole horizon, and in those illuminating only a portion of the horizon—which is the more common—it was practicable to use only one very thin rack, that might be fixed, or might be divided into two parts not coming in the same vertical plane, so that the shadow would be obstructed. A modern catoptric construction would also little light. Thus a practically uniform light could be obtained.

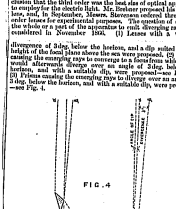
The two first apparatuses for the electric light used at Dungeness illuminated 252° 0m., and were of the fifth order, with one fifth inclined holophotal rack to each. The effect was far from perfect, and the glass changed colour very considerably. The apparatus first used, as shown indicated in Fig. 3, was constructed entirely to replace those temporarily in use. In the refracting drum, as inclined to the horizontal, with the direction of the refracted ray, was used in the 2nd, 3 and 4th orders.

This soon year the Trinity House authorities established a sixth order light at Cape la Hève, as shown in Fig. 2; and in further information, see "Minutes of Proceedings of the Institution of Civil Engineers," by M. Léonce Reynaud.

A zone dioptric apparatus for the electric light was exhibited in the machinery annexe in the 1862 Exhibition. The effect of the electric light in the focus of an annular lens of the third order, if I remember correctly, was also exhibited.



In 1862 Messrs. D. and T. Stevenson, of Edinburgh, proposed the adoption of a tilted order apparatus for the electric light. (3) "Lighthouse Illumination," by Thomas Stevenson, second edition, will contain the interesting chapter on the electric light, and in it some of the experiments made with the apparatus are very refined, such. In July, 1862, Messrs. Chance, Brothers and Co. submitted designs and specifications to the Trinity House for electric lights for the high and low South Foreland Lighthouses. The epitied portion of the specification was drafted by Mr. James Chance, whilst the mechanical portion of the apparatus, and the directions were left to myself. All the fittings, lights, and apparatus were to be complete. It was my conviction that the tilted order was the best size of optical apparatus to employ for the electric light. Mr. Brebner proposed his laws of lens, and, in September, Messrs. Stevenson ordered three tilted order lenses for experimental purposes. The question of causing the whole or part of the apparatus a small diverging rays was considered in November 1863. (1) Lenses with a vertical



divergence of 2deg, below the horizon, and a dip added to the height of the focal plane, so that the sea was very pressed. (2) Prisms causing the sweeping rays to converge to a focus from which they would afterwards diverge over the sea, as in the case of (1) above the horizon, and with a suitable dip, were proposed—see Fig. 4. (3) Prisms causing the sweeping rays to diverge over an angle of 2deg. below the horizon, and with a suitable dip, were proposed —see Fig. 4.

It was however finally decided by Mr. James Chance that the tilted order should be used, which was afterwards exhibited in Paris in 1867, should have (1) its lenses and prisms calculated for the emission of parallel rays of light. Mr. Chance's opinion at that time was, that however accurate practically the refractor might be worked, there was sure to be sufficient

divergence or convergence. The result proved Mr. Chance's opinions incorrect, and in the Souter Point electric light, designed by him in 1870, a portion of the refractor emitted diverging rays. A divergence of 3 deg. below the horizon, as proposed in 1866, was adopted, but, in addition, there was a divergence of 1 deg. above the horizon. The design for the 1867 electric light was entrusted by the Trinity House to Messrs. Chance, and their senior partner, Mr. James Chance, gave the optical portion the benefit of his great skill in such matters. The whole of the calculations were made by myself, with the valuable assistance of Mr. Raybould. The whole of the mechanical portion of both light and lantern was left to myself.

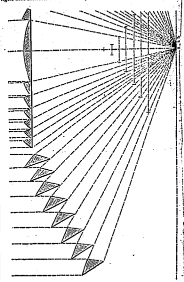
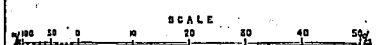


FIG. 5

SECTION—1867 PATTERN



In connection with the application of the electric light to lighthouses the name of Lady Howard de Walden should not be forgotten. She not only devoted much time to the matter, but used her influence and purse in a most liberal manner. In the reply to the discussion on the paper I read before the Institution of Civil Engineers, in 1868, "On Lighthouse Apparatus and Lanterns," I stated "It was questionable if the third order was the most suitable size for the electric light. A second order would be the better for the speedy admission of an oil lamp into the focus in the event of an accident happening to any part of the electric light-producing apparatus." In Mr. Chance's paper, "On Dioptric Apparatus in Lighthouses for the Electric Light," he says:—"Mr. Douglas has lately suggested that a second order apparatus, having a diameter of 1·40 metre, would afford greater convenience for the light-keeper." Mr. Sautter proposed a first order for electric lights of greatest intensity; and, finally, Mr. Chance agreed with him. This is indeed good news for the manufacturers of lighthouse apparatus. So, after all, the first experiment with the electric light in a lighthouse was made with the size of apparatus now approved of.

DAVID M. HENDERSON, M. Inst. C.E.

Shanghai, January 29th.

THE EDISON LAMP TESTS.—Professor Morton writes to the Editor of the *Scientific American* a reply to Mr. Ramsdell's criticism of the tests of Edison's lamp. Mr. Ramsdell's letter will be found on page 250 of our issue last week. The following is Professor Morton's reply:—Your correspondent, Mr. William C. Ramsdell, in his letter of April 9, in your issue of May 1. p. 281, shows that he is unacquainted with the very elements of the subject about which he writes, and criticises the conclusions reached by myself and others only because he does not understand them. In the first place he seems to think that electromotive force is the same thing as the energy involved or work done in a given circuit. If he had examined any of the text books on electricity he would have found that electromotive force expresses simply the specific power which any combination (battery or magneto-electric machine or the like) possesses for causing the transfer of electricity from one place to another. In a given couple, say a Smee battery, it is the same in a cell the size of a thimble and in one as large as a bath-tub. It is very correctly measured by the product of the current into the resistance where these are known, but when its value is obtained we have *not* found that of the energy expended or work done in the same circuit. For the latter we must have the product of the current *squared*, into the time, into the resistance, into the constant ·737335, if we would express the result in foot pounds. Had Mr. Ramsdell been acquainted with these matters he would have been saved the absurdity of announcing that it would require the same expenditure of fuel to run twelve lamps as it would be needed to run one. It is curious that this *reductio ad absurdum* of his own did not open his eyes. Why should he stop at twelve lamps? His own method of calculation would give him the same result with a thousand, or a million, and thus reduce the cost of lighting the country to that required for one lamp. It is hardly necessary to point out that in the calculations made in our paper it was *not* assumed that the twelve lamps were in series. Theoretically it would make no difference as to the total energy expended how they were arranged, but, of course, any one acquainted with the subject would know that to place them in series would introduce great practical difficulties. Our calculation as given is correct for an arrangement in parallel circuits; but Mr. Ramsdell's calculations are simply absurd.

A new form of electric lamp has been invented by Mr. Charles Stewart, M. A. It consists of a number of square carbon rods placed radially in a disc of wood or metal, in such a manner that the inner ends of the carbon rods form a complete circle. There is a circular opening in the wooden disc through which the electric light is seen from underneath. The carbons which are all forced toward the centre by a uniform pressure, move forward as they are consumed, and together form the positive electrode of the lamp. The negative electrode consists of a covered hemispherical cup of copper which before the current enters the lamp, rests upon the ring formed by the carbons. On the current entering the lamp an electro-magnet raises the metal electrode, and the electric arc is then formed between the circle of carbon and the metal electrode. There is a flow of water through the latter to keep it cool. The inventor claims for his lamp the following advantages: (1). It is automatic in its action. (2). Burns for a considerable period. (3). Throws no shadows. (4). Simple and inexpensive in structure. (5). The intensity of the light may be increased if desired.

THE ELECTRIC LIGHT AT THE SLATE QUARRY, DES FRESNAIS.—The Angers Slate Quarry Company has decided to supersede gas in the subterraneous workings by the electric light, generated by the Gramme machine, and their engineer, M. Blavier, has for this purpose provided a 16 horse-power engine, working expansively, 6 continuous current dynamo-electric machines, and a suitable cable. At the present moment a single gallery, of 2,000 square metres is illuminated, the engine working up to from 4 to 5 h.-p. only. The following is the plant employed, with its cost:—

Two Gramme machines	3,230fr.
Three Serrin lamps (1 extra)	1,200 ,,
Various accessories	75 ,,
Cable, 1,400 metres	2,230 ,,
Prime motor, including boiler	10,000 ,,
Total	16,755fr.

The following items constitute the expense of lighting for the period of 22 hours, during which the illumination is continued in each day:—

Coal consumed (560 kilogs.)	16fr 80c.
Carbon burners.—(3·75m.)	8 ,, 40 ,,
Maintenance, lubrication (maximum)	5 ,, 00
Stokers & attendants (4 men)	12 ,, 00 ,,
Interest @ 10 per cent. on 20,000fr.	6 ,, 60
Consumption of oil during the descent for the workmen	1 ,, 20 ,,
Total	50fr 00c

The former expense in lighting with gas was 54fr.; but it is calculated that, for an equal expenditure, electricity would give ten times the illuminating power obtained with gas.

THE ELECTRIC LIGHT AT THE BLEACHING WORKS OF BREUIL-EN-ANGE.—The *Révu Industrielle* gives some interesting particulars relative to the system of electric illumination, which for some months past has been adopted at this establishment. The plant and its cost are as follow:—

1	Gramme Machine	1,500fr.
11	Reynier Lamps	1,100 ,,
11	Automatic Lighters	275 ,,
1	Interrupter	30 ,,
1	Galvanoscope	30 ,,
5	Commutators	150 ,,
20	White Glass Globes	40 ,,
10	Reflectors of tinned iron	50 ,,
285	m. of cable, and conducting wires	240 ,,
	Total	3,415fr.

The distribution of the 11 lights is as follows:—

1. Scouring Shed, 46·2 × 16·6 metres, 4 lights.
2. Bleach room, 19·7 × 16·6 metres, 1 light.
3. First drying room, 66·2 × 11·5 metres, 2 lights.
4. Second ditto 66·2 × 11·5 metres, 2 lights.
5. Engine room 10·7 × 5·6 metres, 1 light.
6. Room for generating machine 11·5 × 6·8 metres, 1 light.

At the velocity of 1,275 revolutions per min. the Gramme machine produces a light of from 8 to 12 Carcel *becs* (? about 100 candles) for each lamp, absorbing less than 3 horse-power. The expense for one hour's lighting is stated thus:—

Carbons for the 11 lamps	0fr. 65c.
Motive power, 3 h.-p., @ 0fr. 06	0 18*
Total	0fr. 83c.

Giving for an illumination of 700 hours a total expenditure of 581fr. The electric light has been found superior to gas-light, from every point of view, for the operations carried on at these works.

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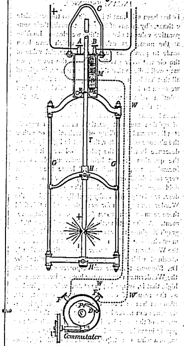
enced, and the light is practically, absolutely steady. It is found that during the fall of the contact piece, D, from the pin, P, to the disc, S (only one inch), the re-adjustment is effected with certainty.

It will be seen that the carbons in this lamp cannot possibly run together permanently, even although the current should materially decrease, this being a fatal fault in all lamps depending upon current strength for their regulation, and one which gives much trouble to the users of the electric

Fig. 1.



light. No care need be taken as to the speed of the engine, as far as regulation of this lamp is concerned, as the speed may be altered even fifty per cent. without putting it out of gear, a most important advantage in any lamp, and one which no regulator possesses; this feature, together with the simplicity of the lamp, constituting the chief advantages of the system.

Several lamps may be put in circuit and regula-

VEGETATION UNDER THE ELECTRIC LIGHT.

At a recent meeting of the Royal Society, London, Dr. Siemens gave a detailed description of some experiments in connection with the subject which had been conducted during the last two months at his house at Sherwood, and exhibited specimens. The method pursued was to plant quick-growing seeds and plants, such as mustard, cercis, loasa, canariensis, and salvia, in pots; these pots were divided into four groups, one of which was kept entirely in the dark, one was exposed to the influence of the electric light only, one to the influence of daylight only, and one to daylight and electric light in succession. The electric light was applied for eight hours each evening, — from five to eleven, — and the plants were then left in darkness during the remainder of the night. The general result was that the plants kept entirely in the dark soon died; those exposed to the electric light only, or to daylight only, drove about equally; and those exposed to both day and electric light throve far better than either, the specimens of mustard and of carrots exhibited to the society showing this difference in a very remarkable way. Dr. Siemens considers himself as yet only on the threshold of this investigation, but thinks the experiments already made are sufficient to justify the following conclusions:—

(1.) That electric light is efficacious in producing chlorophyll in the leaves of plants, and in promoting growth. (2.) That an electric course of light equal to 1400 candles placed at a distance of two metres from growing plants appeared to be equal in effect to average daylight at this season of the year; but that more economical effects can be obtained by more powerful light centres. (3.) That the carbonic acid and nitrogenous compounds generated in diminutive quantities in the electric arc produce no sensible deleterious effects upon plants enclosed in the same space. (4.) That plants do not appear to require a period of rest during the twenty-four hours of the day, but make increased and vigorous progress if subjected during daytime to sunlight and during the night to electric light. (5.) That the radiation of heat from powerful electric arcs can be made available to counteract the effect of night frost, and is likely to promote the setting and ripening of fruit in the open air. (6.) That while under the influence of electric light plants can sustain increased stove heat without collapsing, a circumstance favorable to forcing by electric light. (7.) That the expense of electric horticulture depends mainly upon the cost of mechanical energy, and is very moderate where natural sources of energy, such as waterfalls, can be made available.

In the discussion which followed the reading of the paper it was pointed out that the evidence afforded of the practical identity, as regards vegetation, of solar and electric light, justifies the probability that it would be turned to immediate account by horticulturists, would afford great facilities for the scientific investigation of the influence exerted by light, as compared with other agencies, in promoting the formation of the active principles or most valuable constituents of plants, such as the quinine of the cinchona bark, the gluten of wheat, and so forth. Before concluding his observations, Dr. Siemens placed a pot of budding tulips in the full brightness of an electric lamp in the meeting-room, and in about forty minutes the buds had expanded

[illegible] light, and American invention employing [illegible] fair to witness the jubilee[illegible] candle and all other European contrivances for the shade. It is remarkable that the more successful an electric light is the less public parade it makes; and the Brush lamp has gone into use so quietly that very few even of those in the taste of the matter. About 1,500 of them are now in use. A large number of letters have been received by the writer from cotton-mill and factory owners in this part of the country, in reply to circulars sent out to their experiences with the electric light. From these replies, it does not appear that the electric arc is always a cheaper means of illumination than gas, but sometimes it is remarkably so. The Brush Company's company report that they have never known a case where the electric light was put in that the light, being the first experiment, which ever did that. They never could get light enough in their dingy shops at any reasonable cost, but the volatile light is just the thing for the purpose. They do not know what the light costs them, and do not care. Mr. John Wanamaker has just invested about 13,000 dols. in engines, electric machines, and Brush lamps, and he reports that allowing 5 per cent. interest on the investment, and 5 per cent. for wear and tear, he saves 60 per cent. on his bills for lighting. I have received one statement from a large cotton factory in Rhode Island which has been using the volatile arc light since February, 1876, which is almost incredible. The concern has invested 16,000 dols. in generators and lamps, using 80 lamps in place of about 500 gas-lights. It finds that it now gets a vast increase of light at a cost of only 8,000 dols. a year, whereas it formerly paid out over 28,000 dols. a year for gas. This concern runs all night, and says that the men would not on any account go back to gas-light, because the air of the mill is so much better.—*N. Y. Sunday Times, Chicago Tribune, and Cincinnati Commercial.*

SOME ELECTRICAL MEASUREMENTS OF ONE OF MR. EDISON'S HORSESHOE LAMPS.

BY HENRY MORTON, PH.D., A. M. MAYER, PH.D., AND A. R. THOMAS, AT [illegible]

(Additions and corrections [illegible] 581.)

In reading the above named article in print what we noticed some errors which require correction and some points calling for a more full explanation.

In the second column, ninth line from top, it is said that the loss of weight in one of the electrodes was 1·0021 grammes.

This was, in fact, the amount *gained* by the cathode, the ion of the anode being a little greater. The gain of weight was, of course, what it was intended to take, so that the error was only in the expression, and not in the process or result.

In the next place, in the foot note at the end of the second column, it is simply stated that the average of the maximum and minimum lights in azimuths at right angles and in the plane of the loop was taken as the average luminous power of the lamp. Our reason for this, however, was not mentioned, but was, in fact, that we found by measuring the light at every azimuth varying by ten degrees between 0° and 180°, that this was approximately the true expression for the total amount of light emitted. We are from the article of Profs. Rowland and Barker, in the *American Journal of Science*, that they, assuming certain conditions and discussing the same in a mathematical manner, have reached a different result; but as experiment alone can finally reach to be attained in fact, it is evident that the assumptions on which the mathematical reasoning is based do not include all the conditions present in the experiment.

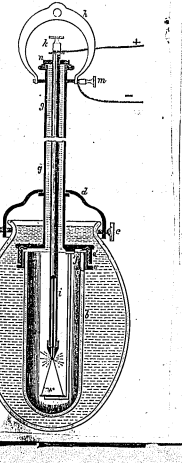
Two other sets of experiments, made since those given in our paper of April 17, in which the candle power of the loop was in its best position, 17·6 and 19·6 candles, corresponding to averages of 11·7 and 12·5 candles respectively, showed a consumption of energy of 0·404 and 0·410 horse power per lamp; or 9·6 and 9·1 lamps per horse power. This would give 213 candles and 220 candles respectively per horse power of electric energy consumed or transformed in the lamp. Those results certainly agree very closely with each other and with our former determinations.

THE BROUGHAM-ANDRE LAMP.

In our account of the exhibition of the André lamp at Stafford House, given in our last issue, we mentioned that the Hon. R. T. D. Brougham had recently made some improvements, which [illegible] fair to make this lamp the best of its kind. The illustration given below will enable our readers to understand the question.

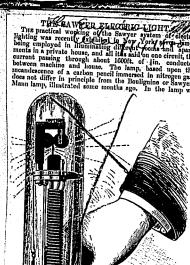
The Lamp Controller.

The lamp is regulated by [illegible] consumed lamps, *F g. 1*, as pointed by insulating material. The interior tube, *i*, contains the carbon rod, 2 mm. in diameter, which falls by its own weight on to the wedge-shaped mass of copper, *n*, connected to the outer tube, *g g*, by the conductor, *f*, the outside cylinder of carbon connected to the negative pole of the battery, the interior to the positive. The cup, *n*, is of vulcanite. A small weight is placed above the carbon rod to assist its descent. The glass globe, *b b*, is furnished at its open end with a brass cylinder, *c*, which is slightly bevelled, while the cup of *h* has a corresponding groove. Between the two is placed an India rubber washer, *f*, so that by screwing up *c* into the cup *e*, the washer is forced into the recess and a good water-tight joint is made. The globe *b b* may be called the lamp globe, to distinguish it from *v a*, which is another glass globe, of any required shape, containing water or some liquid non-absorbent of light rays.



THE SAWYER-STARLING LIGHT.

The practical working of the Sawyer system of electric lighting was recently described in the *Times*, and is now being employed in [illegible] of Messrs. Peek, Frean & Co.'s premises in a private house, and all this within one circuit, the current passing through [illegible] 10001. of lin. conductor between machine and house. The lamp, based upon the incandescence of a carbon pencil traversed in nitrogen gas, does not differ in principle from the Bouliguine or Sawyer-Mann lamp, illustrated some months ago. In the lamp we



now illustrate the glass is 5in. diameter and 10in. high, sealed at bottom by a cement sufficiently fusible to allow for changes by alteration of temperature, and which only softens at 400 deg. The globe is charged by Stillman's method; the cost of charging is considerably less than a cent. The carbon pencil is 7in. in length and about ⅛in. diameter, and is fed up by hand to allow for the slow disintegration that takes place. An automatic regulator is being made; Mr. Sawyer says one pencil will last from ninety days to two years when used but five hours per day. The cost of a pencil is about 1d., and that of replacing and refilling with nitrogen about 10 cents. Our illustration is from the *Scientific American*.

Mr. W. C. Rasmussen [illegible] Edison Lamp.

To the Editor of the Scientific American:—I have read to-day with much interest the results of Messrs. Morton, Mayer, and Thomas's experiments with an Edison electric lamp, published in the *Scientific American* of April 17. The results additional, so far as they relate to the resistance of the loop while giving lights of different intensities and the current required for a light of fifteen candles, are calculable; but those given relative to the cost of one hundred and twenty candles are of no value, because it is (evidently) presumed that the twelve lamps are to be in series in a single circuit, whereas in Mr Edison's proposed system each one of the twelve lamps would be placed in a branch circuit by itself, or, in other words, in multiple arc, and the cost would then be much less than the Stevens Institute experimenters report. The resistance of the armature of Mr. Edison's generator is so small that it may be neglected entirely without seriously affecting the value of the calculations, and the resistance of the leading wires may also be made so small that their neglect will not make any appreciable difference. This being the case, let us see what would be the actual amount of coal required to maintain twelve electric lights in multiple arc, having a total intensity of one hundred and twenty candles.

"Determining upon this conclusion, however, let us determine the electromotive force required to supply a current of 9·905 webers, in a circuit of 76 ohms resistance. Multiplying the current by the resistance gives 9·905 × 76 = 68·78, which would be the required electromotive force in volts. Now, then, place the twelve lamps of 76 ohms resistance each in multiple arc, and their joint resistance will be one-twelfth part of that of a single lamp, or 6·1-3 ohms. As the current generated by the machine is to be divided among twelve branch circuits, so that each circuit will receive a current of 0·905 weber, it is obvious that the total current generated by the machine must be twelve times that required for a single circuit, or 10·860 webers. Multiplying the current by the resistance (as we did for the single lamp) gives 10·860 × 6·1-3 = 68·78, which is the required electromotive force, in volts, and is exactly the same as that required for a single lamp. Hence, even with a Brush or Siemens machine, where forty per cent. of the original energy is lost, the amount of coal required to operate twelve lamps giving an intensity of one hundred and twenty candles is only five twelfths of one pound, instead of five pounds, as calculated by the aforesaid experimenters.

"This shows a pretty large margin below the cost of producing a somewhat less light by coal gas, and in practice the margin would be still greater, for Mr. Edison's generator is said to transform considerably more than sixty per cent. of the original energy into effective current."

The Edison Lamp.—The following results of the experiments made by Professor Henry Morton, [illegible] Mayer and B. T. Thomas on Edison's "eiderdown" lamp are of considerable practical importance:—The resistance of the horse-shoe shaped carbon whilst in its incandescent condition was 79·5 ohms; when cold its resistance was as high as 114 ohms. The current traversing the carbon was 1·079 webers per second, its mechanical value being ·116 horse-power for each lamp. The maximum luminous effect under these conditions was 20·6 standard candles; the mean value being 14·26 candles. Allowing a loss of 40 per cent. in the conversion of mechanical into electrical energy, one horse-power would maintain in action five lamps, each having a mean illuminating power of 14·26 candles, or a total of about 70 candles. These figures alone are sufficient to condemn the Edison lamp; for the worst of regulator lamps would give twenty times the illuminating power (in one form) for an equal expenditure of power; and even the Reguier, or Werdermann lamps, under the most unfavorable conditions, would afford six or eight times as much light as the Edison lamp under the best conditions. The defective result is sufficiently accounted for by the combination of two conditions which are most detrimental from an economical point of view, viz., a comparatively low temperature and large radiating surface.

ELECTRIC LIGHTING.

To the Editor of the Times.

Sir,—To the Editor of the Times.

Sir,—In your article on the Inauguration of the "Jamin Electric Light," in Engineering of June 13th, it is claimed as a feature of the system that the lighting and extinction of any lamp or series of lamps can be effected from a distance without the necessity, "as in the Jablochkoff system," for an attendant to go round from lamp to lamp.

This is clearly to an oversight, as over since the Jablochkoff system was first introduced it has been in use here universally. The fifty lamps on the Embankment and Victoria Bridge are every night lighted and extinguished from the works. The ten lamps at Victoria Station, nearly two miles distant, are also under the same control. In York the 400 lamps which illuminate the Salon, probably the largest illustration of electric lighting, are likewise all controlled from the works.

I am, Sir, your obedient servant,

July 16, 1880. Jules Gaudard,
Managing Director.

The Société Générale d'Electricité,
120, Cannon-street, June 17, 1880.

Galvanic Experiments.—The *Journal of the Chemical Society* says of [illegible] made by M. P. Dreschsel, that the method employed is to [illegible] rapidly reverse the galvanic current from platinum poles through the solution operated upon. By acting in this manner on commercial ammonium carbonate (containing ammonium carbamate) for a period of eight hours, and then evaporating on the water bath, a salt crystallising in fine white needles was obtained. It was found to contain 64·09 per cent. platinum, and is the salt of a platinum base; its composition could not be satisfactorily settled on account of want of material. Concentrated hydrochloric acid gives a bright green, nitric acid a sky blue crystalline precipitate with its solution. About 0·1 grain platinum was dissolved in ten hours by the ammonium carbonate. On working the commutator more slowly, the temperature of the liquid rises, and no precipitate is formed, but by simultaneous cooling a crystalline precipitate occurs, which contains 39·6 per cent. platinum, and is also the salt of a platinum base; this yields an bright green precipitate, but an almost colourless one with hydrochloric acid, consisting of microscopic needles. By operating on a solution of glucose, mixed with sodium phosphate, with very large platinum electrodes, prevented from touching each other by a sheet of filter-paper, the places on the platinum where the paper had rested were found at the end of the experiment to be covered with a brownish translucent substance, easily removable in large plates; this on ignition left a large amount of platinum, but its properties have not as yet been investigated. H. Rolle remarks in a note to the paper that these interesting results have induced him to extend his earlier galvanic experiments, and to study the action of rapid change of poles on a number of salts.

The Electric Light for Steamers.—A very successful application of the electric light has been exemplified in the lighting of the Orient steamship Chimborazo, which left Gravesend on the 25th for Australia. The installation consists of a Gramme machine generating the current by which seven lamps are fed, the machine being 2 nom. horses are worked. Four of these feed the three saloons, and one each the engine-room, forecastle, where the mess of the crew is taken, and chief cabin. The lamps are placed in globes, but a resistance coil and automatic switch renders each independent from its neighbour. Several spare lamps are carried, which can be worked from the same machine. The whole current can also be switched on to a Crompton arc lamp, which can be installed in a special lantern fitted with a reflector. This might be used when in port for the purpose of cargo working. The actual illuminating power of the lamps here is 600 candles, while each of the seven subsidiary lights is about seventy. The whole of the arrangements have been carried out under the superintendence of Mr. Killingworth Hedges, C.E., the incandescent lamps and Gramme machine being supplied by the British Electric Light Company. The extension of the lighting to the other parts of the ship will be completed on her return.

Engineer July 2 1880

ARCHIVE

IMPROVED ELECTRIC LAMP.

The lamp shown in the engraving will be recognized as an Edison lamp, the vacuum globe and the carbon horseshoe being the principal elements. Mr. John H. Guest, a well known electrical inventor of Brooklyn, N. Y., judging from his own experience in fusing platinum with glass in the manufacture of thermostatic fire alarms, concluded that the principal trouble with the Edison lamp would be the entrance of air around the wires passing through the glass of the vacuum globe, devised a simple plan of sealing the joint between the wires and the glass by means of mercury, thus interposing an effectual barrier to the entrance of air at that point.

The invention is so clearly shown in the engraving that scarcely a word of explanation is necessary. In the lamp shown in Fig. 1, the wires that convey the current to the carbon horseshoe are sealed in the ends of curved glass tubes communicating with the globe, and these joints are inclosed in small globes formed on the ends of the glass tubes and filled with mercury.

In this lamp Mr. Guest has made provision partially or wholly preventing the circulation of air, should any remain in the globe after exhaustion with the air pump. The device by which this is accomplished is simply a small globe connected with the lower portion of the lamp globe by a contracted passage, the theory being that the cooler and heavier portion of the air will be drawn into the auxiliary globe by its own gravity.

Fig. 2 shows a lamp in which the tubes that support the wires extend downward into the lamp globe. Those tubes at their junction with the vacuum globe are fused to the platinum conducting wires, and the tubes act simply as lateral supports to the wires inside the globe, allowing the wires to expand freely lengthwise. The tubes are sealed outside the globe in the manner shown in Fig. 1.

Another improvement made by Mr. Guest consists in inclosing the ends of the platinum wire conductors in the ends of the material of the carbon before it is carbonized, the wire being formed into a loop to increase the conducting surface and to insure a good connection with the carbon.

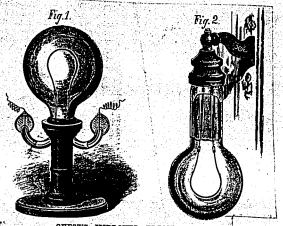


Fig. 1. Fig. 2.

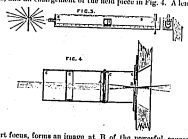
GUEST'S IMPROVED ELECTRIC LAMP.

cannot with propriety be said to be any particular multiple of a green light; nor can one light, which is a mixture of colours, be said with strictness to be a multiple of another, unless the proportions of the colours in the two cases are the same. Captain Abney (*Proceedings of the Royal Society*, March, 1879) has given the results of measurements of the red, blue, and actinic light of electric arcs, in terms of the red, blue, and actinic light of a standard candle. The fact that the electric light is a very different mixture of rays from the light of gas or of a candle, has long been known, but has been ignored in statements intended for practical purposes.

Again, the emission of rays from the heated carbons and arc is by no means the same in all directions. Determinations have been made in Paris of the intensity in different directions, in particular cases. If the measurement is made in a horizontal direction, a very small obliquity in the centre of the positive carbon will throw the light much more on one side than on the other, causing great disturbance in the results obtained.

If the electric light be compared directly with a standard candle, a dark chamber of great length is needed—a convenience not always attainable. In the experiments made at the Smith Institute by Dr. Tyndall and Mr. Douglas, an intermediate standard was employed; the electric light was measured in terms of a large oil lamp, and this latter was frequently compared with a standard candle.

Other engagements have prevented the author *from fairly attacking* these difficulties; but since May, 1879, he has had in occasional use a photometer with which powerful lights can be measured in moderate space. This photometer is shown in Fig. 3, and an enlargement of the field piece in Fig. 4. A lens, A,



of short focus, forms an image at B of the powerful source of light which it is desired to examine. The intensity of the light from this image will be less than that of the actual source by a calculable amount; and when the distance of the lens from the disk is suitable, the reduction is such that the reduced light becomes comparable with a candle or a carcel lamp. Diaphragms, C, are arranged in the cell which contains the lens, to cut off stray light. One of the two is placed at the focus of the lens, and cut off all light entering from a direction other than that of the source; so effectually does it do so, that observations may be made in broad daylight on any source of light, if a dark screen is placed behind it. The long box, DD, Fig. 3, of about 7ft. length, is lined with velvet—the old-fashioned dull velvet—not the new sort with a finish, which reflects a great deal of the light incident at a certain angle. This box serves as a dark chamber, in which the intensity of the image formed by the lens is compared with a standard light, by means of an ordinary Bunsen's photometer, E, sliding on a graduated bar.

Mr. Dallmeyer kindly had the lens made for the author; he can therefore rely upon the accuracy of its curvature and thickness; it is plano-convex, the convex side being towards the source of light. The curvature is exactly 1 in. radius, and the thickness is 0·04 in.; it is made of Chance's hard crown glass, of which the refractive index for the D line in the spectrum is 1·517. The focal length, *f*, is therefore 1·933 inch.

Let *n* denote the distance of the source of light from the curved surface of the lens, and *v* the distance of the image of the source from the posterior focal plane. Neglecting for the moment the loss by reflection at the surface of the glass, the intensity of the source is reduced by the factor $\left(\frac{f}{v}\right)^2$. But $\frac{1}{v} + \frac{1}{n} = \frac{1}{f}$, or $v = \frac{nf}{n-f}$; hence the factor of reduction is $\left(\frac{f}{n-f}\right)^2$. The effect of absorption in so small a thickness of very pure glass may be neglected; but the reflection at the surfaces will cause a loss of 8 per cent., which must be allowed for. This percentage is calculated from Fresnel's formulæ, which are certainly correct for glasses of moderate refrangibility, and for moderate angles of incidence.

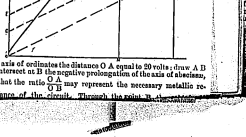
Suppose, for example, it is required to measure a light of 2,000 candles: if it be placed at a distance of 40in., it will be reduced in the ratio 467 to 1, and becomes a convenient and measurable quantity. By transmitting through coloured glasses both the light from an electric lamp and that from the standard, a rough comparison may be made of the red or green in the electric light with the red or green in the standard.

A dispersive photometer, in which a lens is used in a somewhat similar manner, is described in Stevenson's "Lighthouse Illumination;" but in that case the lens is not used in combination with a Bunsen's photometer, nor with any standard light. Messrs. Ayrton and Perry described a dispersive photometer with a concave lens at the meeting of the Physical Society on 12th December, 1879 (*Proc. of the Physical Society*, vol. iii., p. 184). The concave lens possesses, however, no obvious advantage in having a real focus, at which a diaphragm to cut off stray light may be placed.

Efficiency of the Electric Arc.—To define the electrical condition of an electric arc two quantities must be stated—the current passing, and the difference of electric potential at the ends of the two carbons. Instead of either one of these, we may, if we please, state the ratio difference of potential / current

distance of the arc, that is to say, the resistance which would replace the arc without changing the current. But such a use of the term electric resistance is unscientific; for Ohm's law, on which the definition of electric resistance rests, is quite untrue of the electric arc; and, on the other hand, for a given material of the electrodes, a given distance between them, and a given atmospheric pressure, the difference of potential on the two sides of the arc is approximately constant. The product of the difference of potential and the current is, of course, equal to the work developed in the arc; and this, divided by the work expended in driving the machine, may be considered as the efficiency of the whole combination. It is a very easy matter to measure these quantities. The difference of potential on the two sides of the arc may be measured by the method given by the author in his previous paper, by an electrometer, or in other ways. The current may be measured by an Obach's galvanometer, by a suitable electro-dynamometer, or best of all, in the author's opinion, by passing the whole current, or its way to the arc, through a very small known resistance, which may be regarded as a shunt for a galvanometer of very high resistance, or to the circuit of which a very high resistance has been added.

It appears that with the ordinary carbons and at ordinary atmospheric pressure no arc can exist with a less difference of potential than about 20 volts; and that in ordinary work, with an arc about 4 in. long, the difference of potential is from 30 to 50 volts. Assuming the former result, about 29 volts, for the difference of potential, the use of the curve of electromotive forces may be illustrated by determining the lowest speed at which a given machine can run, and yet be capable of producing a short arc. Taking O as the origin of co-ordinates, Fig. 5, set off upon



the axis of ordinates the distance O A equal to 29 volts; draw A B to intersect at B the negative prolongation of the axis of abscissæ, so that the ratio $\frac{O A}{O B}$ may represent the necessary metallic re-

distance of the circuit. Through the point B, the

EDISONIA.

It is an undoubted fact that those connected with Mr. Edison believe in will overcome all difficulties mentioned by critics, and ultimately succeed in producing a cheap and simple electric lamp. In that as it may, the history of the electric light is incomplete without the criticisms that have been urged against his system.

The editors of the *Scientific American* have handed a lamp to Dr. H. Morton, Dr. A. M. Mayer, and B. F. Thurston, M.A., for investigation, with the following result:—The first object, on receiving the lamp, was to determine roughly what amount and character of electric current would be needed to operate it efficiently. With this view a number of cells of a small Grove battery were set up, having each an active zinc surface of twenty square inches, and a platinum surface of eighteen square inches. The lamp being placed in the situation usually occupied by the standard burner in a Bunsen photometer, the battery was, cell by cell, thrown into circuit. When ten cells had been introduced the incandescent wound a dull red, with fifteen cells a bright red, with thirty-four cells the light of one candle was given, with forty cells the light of 45 candles, and with forty-five cells the light of 95 candles, and with *forty-eight* cells 16 candles. Having thus determined what amount of electric current would be required for experiments, arrangements were made to measure accurately the resistance of horseshoe while in actual use and emitting different amounts of light. The resistance of the carbon thread at the ordinary temperature had been already determined as 122 ohms in the usual way, but it was presumed, as had been shown by Matthiessen (*Phil. Mag.*, xvi., 1858, pp. 230, 221), that this resistance would diminish with rise of temperature.

To measure the resistance under these circumstances the apparatus was arranged as follows:—The current from the battery was divided into two branches, which traversed, in opposite directions, the two equal coils of a differential galvanometer. One branch then traversed the lamp, while the other passed through a set of adjustable resistances composed of German silver wires stretched in the free air of the laboratory, to avoid heating. Careful tests of those resistances showed that no sensible heating occurred under these circumstances. Matters being thus arranged, the resistances were adjusted until the galvanometer showed no deflection when the candle power of the lamp was taken especially in the photometer, and the amount of resistance was noted. These measurements were several times repeated, shifting the coils of the galvanometer, and reversing the direction of the current. The results so obtained were as follows:—

Resistances.	Condition of Loop.
121 ohms	Cold.
84 "	Orange light.
80·3 "	$\frac{1}{2}$ candle.
79·6 "	"
75 "	16 "

The photometric measurements was in all these cases taken with the carbon loop at right angles to the axis of the photometer, which was, of course, much in favour of the electric lamp. On turning the lamp round so as to bring the carbon loop with its plane parallel with the axis of the photometer, *i.e.*, the edge of the loop turned toward the photometer disc, the light was greatly diminished, so that it was reduced to almost one-third of what it was with the loop sideways to the photometer disc. Having thus determined the resistance of the lamp when in actual use, it was next desirable to measure the quantity of the current flowing under the same conditions. To do this the current from fifty cells of battery was passed through a tangent galvanometer as a mere check or indicator of variations, and then through a copper voltameter, *i.e.*, a jar containing solution of cupric sulphates with copper electrodes immersed, and then through the lamp placed in the photometer.

Under these conditions it was found that during an hour the light gradually varied from about 16 candles at the beginning to about 14 candles at the end, making an average of about 15 candles, measured with side loop toward disc. The galvanometer during this time only showed a fall of half a degree in the deflection of the needle. Carefully drying and weighing the copper electrodes, it was found that one hall lost 1·0624 grammes. Now, it is well known that a current of one weber takes up 0·00326 gramme of copper per second, which would make 1·1736 grammes in an hour; therefore the current in the present case must have been on the average $\frac{1\cdot0624}{1\cdot1736}$ = 0·905 webers, or a little less than one weber.

Having thus obtained the resistance of the lamp when emitting a light of 15 candles, namely, 75 ohms, and the amount of current passing under the same conditions—namely, 0·905 weber, we have all the experimental data required for the determination of the energy transformed or expended in the lamp expressed in foot-pounds. For this we multiply together the square of the current, the resistance, the constant 0·737305—which expresses the function of a foot-pound involved in a current of one weber traversing a resistance of one ohm for one second—and the number of seconds in a minute. Thus in the present case we have 0·905² = 0·8193, and 0·8193 × 76 × 0·737305 × 60 = 2752·70 foot-pounds. Dividing these foot-pounds per minute by the number of foot-pounds per minute in a horse-power, that is, 33,000, we have 0·08, that is, about eight one-hundredths or one-twelfth of a horse-power as the energy expended in each lamp. It would thus appear that with such lamps as this one horse-power of energy in the current would operate twelve lamps of the same resistance with an average candle power of 16 candles each,* or 192 candles in the aggregate.

Assuming that a Siemens or Brush machine were employed to generate the electric current, such a current would be obtained, as has been shown by numerous experiments, with a loss of about 40 per cent. of the mechanical energy applied to the driving pulley of the machine. To operate these twelve lamps, therefore, we should have to apply more than 1 horse-power to the pulley of the machine, so that when this loss in transformation had been encountered there should be 1 horse-power of electric energy produced. This would call for 13 horse-power applied to the pulley of the dynamo-electric machine by the steam engine. To produce 1 horse-power in a steam engine of the best construction about 2lb. of coal per hour must be burned, and therefore for 13 horse-power 26lb. of coal must be burned. On the other hand, 1lb. of gas coal will produce 5 cubic feet of gas, and will leave besides a large part of its weight in coke, to say nothing of other "residuals," which will represent practically about the difference in value between "steam making" and "gas making coal," so that it will not be unfair to take 5lb. of gas coal as the equivalent of 52lb. of steam coal.

Three 52lb. of gas coal will then yield 260 cubic feet of gas, which, if burned in five gas burners of the best construction, will give from 20 to 22 candles each, or 100 to 110 candles in the aggregate. We have, then, the twelve Edison lamps producing 120 candles and the five gas burners producing 100 to 110 candles, with an equivalent expenditure of fuel.

If such apparatus and system could be worked with equal facility and economy, this world of course show something in favour of the electric light; but when, in fact, everything is this regard is against the electric light, which demands vastly more machinery, and that of a more delicate kind, requires more skilful management, shows more liability to disarrangement and waste, and presents an utter lack of the storage capacity which secures such a vast efficiency, convenience, and economy in gas, then we see that this relatively trifling economy disappears or ceases to have any controlling importance in the practical relations of the subject.

(Additions and corrections to above.)

In reading the above article in print we notice some errors which require correction, and some points calling for a more full explanation. It is said that the law of weight in one of the electrodes was 1·0624 grammes. This was, in fact, the amount gained by the cathode, the loss of the anode being a trifle greater. The gain of weight was, of course, what it was intended to take, so that the error was only in the expression, and not in the process or result. In the next place, in the last note, it is simply stated that the average of the maximum and minimum lights in minutiæ at right angles and in the plane of the loop was taken as the average luminous power of the lamp. Our reason for this, however, was not mentioned, but was, in fact, that we found by measuring the light at every azimuth varying by ten degrees between 0° and 180°, that this was approximately the true expression for the total amount of light emitted. We see from the article of Professors Rowland and Barker, in the *American Journal of Science*, that they, assuming certain conditions and discussing the same in a mathematical manner, have reached a different result; but as experiment shows this result not to be attained in fact, it is evident that the assumptions on which the mathematical reasoning is based do not include all the conditions present in the experiment.

Two other sets of experiments made since those given in our paper of April 17, in which the candle-power of the loop was in its best position, 17·6 and 19·8 candles, corresponding to averages of 11·7 and 13·2 candles respectively, showed a consumption of energy of 0·101 and 0·100 horse-power per lamp, or 9·6 and 9·1 lamps per horse-power. This would give 112 candles and 123 candles respectively per horse-power of electric energy consumed or transformed in the lamp.* These results certainly

* The candle-power being 15 candles in the best position, and 5 candles at right angles to this, the average or general illuminating power of the lamp is 10 candles

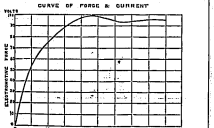
draw a tangent to the curve, touching it at C, and cutting O A in D. Then the speed of the machine, corresponding to the particular curve employed, must be diminished in the ratio $\frac{OD}{OA}$ in order that an exceedingly small arc may be just possible.

The curve may also be employed to put into a somewhat different form the explanation given by Dr. Siemens at the Royal Society, respecting the occasional instability of the electric light as produced by ordinary dynamo-electric machines. The operation of all ordinary regulators is to part the carbons when the current is greater than a certain amount, and to close them when it is less; initially the carbons are in contact. Through the origin O, Fig. 5, draw the straight line O A, inclined at the angle representing the resistances of the circuit other than the arc, and meeting the curve at A. The abscissa of the point A represents the current which will pass if the lamp be prevented from operating. Let O N represent the current to which the lamp is adjusted; then if the abscissa of A be greater than O N, the carbons will part. Through N draw the ordinate B N, meeting the curve in the point B; and parallel to O A draw a tangent E D, touching the curve at D. If the point B is to the right of D, or further from the origin, the arc will persist; but if B is to the left of D, or nearer to the origin, the carbons will go on parting, till the current suddenly fails and the light goes out. If B, although to the right of D, is very near to it, a very small reduction in the speed of the machine will suffice to extinguish the light. Dr. Siemens gives greater stability to the light by exciting the electro-magnets of the machine by a shunt circuit, instead of by the whole current.

The success of burning more than one regulating lamp in series depends on the use in the regulator of an electro-magnet, excited by a high-resistance wire connecting the two adjacent carbons. The force of this magnet will depend upon the difference of potential in the arc, instead of depending, as in the ordinary lamp, upon the current passing. Such a shunt magnet has been employed in a variety of ways. The author has arranged it as an attachment to an ordinary regulator; the shunt magnet actuates a key, which short-circuits the magnet of the lamp when the carbons are too far parted, and so causes them to close.

In conclusion, the author ventures to remind engineers of the following rule for determining the efficiency of any system of electric lighting in which the electric arc is used, the arc being neither exceptionally long nor exceptionally short. Measure the difference of potential of the arc, and also the current passing through it in volts and webers respectively, then the product of these quantities divided by 746 is the horse-power developed in that arc. It is then known that the difference between the horse-power developed in the arc and the horse-power expended to drive the machine must be absolutely wasted, and has been expended in heating either the iron of the machine or the copper conducting wires.

Messrs. Crompton, Preece, and Shoolbred took part in the discussion upon this paper, which, however, unfortunately was commenced at a late hour, when many had left the room. Mr.



Shoolbred exhibited the above diagram, showing the results of experiments at Silvertown, carried out on the A Gramme machine by Mr. K. Gray.

ELECTRIC LIGHTING. 1880

To the Editors of Engineering.

Sir,—The letter of Mr. C. F. Varley, which appeared in your issue of last week, is certainly a curious production. Even your ingenious correspondent, however, has not succeeded in finding any grievance which you are pleased to style a "calumny" against Mr. Varley, but I must still protest against your accusation of "calumny" against Mr. Cornelius Varley's name instead of Mr. C. F. Varley's. You say that Mr. C. F. Varley's letter to the Royal Society in 1867 is conclusive evidence. How can a letter to the Royal Society in 1867 be conclusive evidence as to a patent in 1866? I will now refer solely to the only patent taken out in 1866 for the dynamo-electric machine (No. 3384, dated 27 December 31, 1866) stands in the name of Cornelius and Samuel Alfred Varley. Mr. C. F. Varley's letter to the Royal Society, dated February 28, 1867, merely describes some experiments made on one of Mr. Siemens' dynamo machines. As the date of the latter he states: "In 1860 I established a few machines of two machines I had constructed, and in 1865 or 1866 Dr. Siemens and Mr. Wheatstone exhibited machines for yielding mechanical force from electric electricity without friction. A machine similar in principle to mine, but little different in construction has been exhibited recently under the name of Holtz. One of my machines bears to that machine precisely the same relation that Siemens' and Wheatstone's does to Wilde's."

By no process of reasoning can I see in these lines any claim in the invention of the dynamo machine, or principle on which it is founded; and I am sure Mr. C. F. Varley really claimed such a priority of invention, for in not the

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least is he reminded silent at the various discussions on the subject, that have taken place, and in which his brother, S. A. Varley, has continually insisted on his own claim to priority of the invention over Siemens and Wheatstone, on account of the patent standing in his own name and that of Cornelius Varley, and which was alluded to by

Yours obediently,

F. C. Webb.

Engineering 4 June

Progress of Science.

The Brush electric light has been introduced into the South Kensington Museum, in London, and the results are very satisfactory. The experiment has been tried in the hall containing the new fresco by Sir Frederick Leighton, P. R. A. There are eight lamps, three suspended on each side and two in the central line, so that the light is equally diffused. The use of the electric light is spreading. The Victoria docks and Holyhead harbor are to be lighted by electricity. The Royal Navy is adopting Brush's light. Siemens's light has been introduced into the Siam Discovery, Bangkok, as a gift to Jahlechoff's. The arrival of summer has to begin with it a discontinuance of the Siemens light in the reading-room of the British Museum until next autumn. The authorities regard it as a good success.

The Electric Light.—A very successful application of the electric light has been accomplished in the lighting of the Orient steamship Chimborazo, which left Gravesend on the 11th for Australia. The installation consists of a Gramme machine generating the current, by which seven incandescent lamps using Lane carbons are worked. Four of these are fixed in the main saloon, and the remainder in the cabins, the wires being led from the deck to the saloon. The lamps are placed in series, but a resistance coil and automatic switch renders each independent from its neighbour. Several spare lamps are carried which can be worked from the same machine. The whole current can also be switched on to a Crompton arc lamp, which is contained in a special lantern fitted with a reflector. This lamp is intended for the purpose of signalling purposes. The actual illuminating power of the large lamp is 4000 candles, while each of the small incandescent lights is about 75. The whole of the arrangements have been carried out under the superintendence of Mr. Killingworth Hedges, the incandescent lamps and Gramme machine being supplied by the British Electric Light Company. The results of the lighting by the other ports of the ship will be completed on her return.

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"To resume, my lamp contains several novel points; it lights and relights as often as required; it requires only one circuit for all the neighbouring; it requires automatically those candles candles; it replaces automatically those candles which have burnt out, with entirely new carbons; it does not employ any insulating material of a nature to change the colour of the flames, nor any preliminary preparation of the carbons, this preliminary preparation of the carbons, this preliminary preparation the expense. If we consideredly eliminates the expense. If we consideredly eliminates the source, like all others, variations in the sensing; it does not to a defect in the brilliancy, this will be due, not to a defect in the lamp itself but to a defect in the carbons; these lamp itself but to a defect in the carbons; these variations have disappeared since, thanks to M. Carel, the necessary homogeneity has been given to the carbons. It remains, then, to say how much light can be obtained with a given amount of work, what is the quality of the light and of the heat produced, and to what distance can it be conducted.

"I have employed in these researches a Gramme machine; it was driven by an Otto gas-engine, with which it is possible at any instant to measure the work consumed, which is exactly proportional to the number of explosions; it is sufficient to count them. It is well known that the Gramme machine is composed of two distinct parts; the light machine, is composed of two distinct parts; the light machine, formed by electro-magnets turning rapidly in a ring of iron wound with inducing wires, and an exciter of iron wound with inducing wires, and an exciter with continuous currents, which serves to magnetize the electro-magnets. It only does the preparatory work.

"The current which is produced increases rapidly with the velocity. However small the machine be, the necessary magnetization can always be attained, but one is obliged to expend a considerable amount of power, limited by the heating of the machine. I have succeeded, by theoretical considerations, and have succeeded, by theoretical considerations, and by my latest distribution of the wire, in reducing the heat to a quarter and the expense to a third, producing, at the same time, the same effect.

	First machine.	Improved machine.
Expenditure of horse-power ...	1·394	0·51
Current strength	·78	·76
Velocity	1·447	1·433

"The expenditure of work, reduced to half a horse-power, is insignificant.

"Different types of Gramme machines have been constructed for electric lighting; the large and constructed for electric lighting; the large ones more costly ones will light 24 candles of 1604 mm. size; the smaller ones are capable of working 4 size; the smaller ones are capable of working 4 candles. I have noticed that these last machines are so feeble that they cannot be employed with advantage. When a low velocity is given them, they take little force to drive them; when this speed is increased to 2,500 turns, they absorb about 1/2 horse-power, and, as this work is transformed into heat in the circuits, it is evident that one ought to be able to light a number of lights, and obtain a larger amount of light in proportion, as the velocity is greater.

"However, this is not found to be the case, because the heat developed in the machine is such, that the insulation of its wires becomes destroyed. It was very easy to remedy this defect by diminishing the resistance of the machine and increasing that of the circuit; this has been done with complete success, and allows of 24 lights being obtained with an 8 horse-power engine.

"I will simply give here the results of one of a number of experiments:—

VELOCITY: 1,530.

Number of lamps.	Intensity. Of each lamp.	Total.	Horse-power expended. Total.	Each candle.
1	134	134	2·81	2·81 =
2	113	226	3·60	1·79 =
3	107	321	4·07	1·36 =
4	105	420	4·43	1·11 =
5	95	475	4·70	0·94 =
6	96	576	4·91	0·82 =
7	93	651	5·04	0·72 =
8	92	736	5·11	0·64 =
9	86	774	5·09	0·57 =
10	74	740	5·07	0·51 =
11	70	771	5·04	0·46 =
12	60	720	5·01	0·42 =
13	56	728	4·89	0·37 =
14	50	700	4·60	0·32 =

"It may be remarked that the expenditure of horse-power and amount of light obtained augments up to 9 lamps, after which these two quantities diminish. It is clear that, if we wish to have a greater total amount of light, we must not go beyond this maximum, but if we wish to have a greater number of lights, more feeble, we must exceed it; thus, when we have 14 candles of 0·03 mm. size, a third of a horse-power each only will be required. But it would be better to stop 2 candles of half a horse-power; they are finer and less unsteady, in proportion as the carbons are improved the limit may be overstepped.

"With regard to the light from each lamp, it diminishes with their number; a single lamp with a velocity of 1,500 turns will give a light equal to 134 Carcels, 7 to reduces each to 113, and when the 134 Carcels, 7 to reduces each to 113, and when the number becomes increased to 14, the light from each is diminished to 50; this is the division of a sum total, with a decreasing quotient.

"It may be remarked that this quantity of light is greater than with the ordinary candles; the cause is due to the carbons, which burn with upwards instead of downwards. In one case the light is thrown upwards and is lost; in the other case it is thrown downwards, which is what is required. On the other hand, the flame of the arc, which tends always to rise, leaves the points and does not heat them when they are directed upwards; on the contrary, it envelopes them, and surrounds them with an atmosphere at an enormous temperature when they are turned downwards; this notably increases the amount of light given out. A photometric comparison of two identical candles in the same circuit has shown that the light from the turned down points is five times as great as that obtained with the points turned down. Although their temperature is enormous, the quantity of heat is not great, because the heat focus is small. I have compared in this heat with that of a Carcel, by placing successively this lamp and an electric burner in the same calorimeter. The lights being equal, the combustion of the oil developed 43 times as much heat as did the electric arc.

"It remains for me to speak of the distance to which the light can be conveyed; it is greater in proportion as the velocity of the machine is greater; with 1,500 turns it is possible to introduce in the circuit 1 kilometre of copper wire 002 millimetres in diameter without sensibly diminishing the light; with 2,000 turns 4 kilometres of this wire, or 16 kilometres of wire 001 millimetres in diameter, can be introduced with a similar result. It is thus possible to conceive that a large town can be lighted from a single source.

"The experiments and numerous trials which I have been able to make with the motors and the machines have been a great use upon my resources; I have, therefore, been very fortunate in having been assisted in every way by M. Durrieu, President of the Société du Crédit Industriel et Commercial. I am also equally indebted to the indefatigable exertions of M. Denayrouze, private tutor at the Ecole Polytechnique. I have also to thank MM. Mennesson and Ecouchkoff for having so skilfully assisted me in taking the measurements."

THE JAMIN ELECTRIC LIGHT SYSTEM.

Memoir presented by M. [illegible] to the Academy of Sciences, May 31st, 1880.

[illegible] July 6, 1880.

"I HAD the honour to submit to the Academy, during its meeting of the 17th March, 1879, the principle of a new electric burner. I have since constructed it rests on a slate base which can be fixed in globes quired, and which supports near the base a grooved copper horseshoe, H, H, H, which is bronzed, but, at the same time, sufficiently thick to avoid shadows being cast; at the top of the horseshoe is a hollow soft iron piece, G, whose function is to magnetize and attract a movable armature, E, F. . . . This armature, which is also of soft iron, passes first through a thin copper wire, wound three or four times round in the hollow of the horseshoe piece, H, H; this constitutes the circuit director. It is in the middle of this frame-work that is arranged, as with it that the electric candles, or carbon couples, are placed, between which the arc is formed. There are three of these candles shown, but a greater number can be used if necessary. Each carbon is introduced in a tubular support of copper, so that they are held vertically, being clipped by a spring. The operation of fixing does not present any difficulties. There is no insulating material between the carbons. Those to the right, B, A, ... are fixed and vertical; those to the left a, ... hang freely on joints, b, b', b'', ... the ends of their supports are held by a bar, c, c', which presses them all to one side; the armature, E, F, is connected by a lever, e, b, to this bar, which is pressed to the left by its weight; this causes the carbons to approach and touch against their fixed neighbours. It may be remarked that the contact

[illegible] Mr. Upton, in the columns of the *Scientific American*, relies upon the report of Messrs. Brackett and Young to prove that Edison's dynamo machine is better than the Siemens. *Nous verrons.* [illegible]

[illegible] carbon light is [illegible] The glow, and besides that [illegible] Carbon Company, [illegible] light than produced [illegible] ordinary gas-light, but the ordinary gas brackets and pendants will not do for the purpose.—*Nature.*

—The Revenue Institute professors continue an elaborate paper to run *Northrop's Magazine* [illegible] Mr. T. A. Edison, [illegible] Mr. Upton, [illegible] "When we remember that with [illegible] from 1200 to 1800 candle-power [illegible] applied to the generator, it is evident that [illegible] made, does not escape the enormous loss which has [illegible] encountered by all forms of incandescent lamps." The economic result [illegible] in their experiments show that the lamp developed 1200 candle-power per horse-power of electric energy, which would be equivalent to about 72 [illegible] candle of the electric generator.

47th Meeting for Electricians and Users of Electric Lighting, &c.

A Meeting—Dear Sir [illegible] *Electrical Review*, [illegible] *presented with*] [illegible] This relates to the [illegible] arrangement of three others [illegible] by the first pair before lighting or after [illegible] by the first pair before lighting or after [illegible] by the second pair before lighting or after [illegible] by the second pair before lighting or after [illegible] by the first

LA NOUVELLE BOUGIE ÉLECTRIQUE

DE M. JAMIN

Un appareil, si simple qu'il soit, n'arrive pas toujours immédiatement dans la pratique; nous n'en prendrons pour preuve que le dernier modèle de la bougie Jamin. Nous en parlerons aujourd'hui à nos lecteurs pour compléter l'historique d'un appareil qui, après un an d'études et de perfectionnements, ne répond pas encore, il faut bien l'avouer, aux espérances qu'il avait fait naître. Nul expérimentateur n'était mieux préparé à ces travaux que M. Jamin; par sa haute position scientifique et les travaux qu'il avait pu mener de près, en qualité d'ingénieur-conseil de la Société Alibichoff, le savant académicien possédait à fond cette partie si intéressante de la science électrique.

La première bougie de M. Jamin, présentée à l'Académie des sciences le 28 avril 1870, a été décrite dans le numéro de la *Nature* du 10 mai de la même année. Dans une lettre adressée à notre directeur et publiée dans le numéro du 24 septembre 1870, M. Jamin a décrit un second système, déjà très différent du premier. Enfin, l'appareil présenté à l'Académie le 31 mai 1880 et expérimenté le 5 juin dans le laboratoire de la Compagnie générale d'éclairage électrique, est un troisième modèle de la bougie Jamin, qui, tout en constituant un progrès sensible sur l'appareil primitif, ne répond cependant que très médiocrement aux séduisantes promesses du programme.

Nos lecteurs sont assez familiarisés avec les différents procédés d'éclairage électrique pour comprendre sans figure en quoi consistent les perfectionnements nouveaux de l'appareil.

La nouvelle bougie Jamin se compose d'un cadre directeur formé de quarante spires de fil de cuivre isolé, à l'intérieur duquel sont placées trois bougies de 25 centimètres de longueur environ et devant fournir, par leur allumage successif, un éclairage total de six heures. Ces trois bougies, formées chacune de deux charbons de 4 millimètres de diamètre, sont disposées parallèlement, et la tête en bas, dans le plan du cadre directeur; les charbons du gauche de chaque bougie sont immobiles, les charbons de droite sont fixés sur un support mobile. Au repos, ils sont légèrement inclinés sur les charbons fixes et les touchent par leurs pointes. La partie supérieure du cadre directeur est embrassée par une lame de fer dans rencontrée en U : le passage du courant la transforme en électro-aimant, elle attire une palette qui, par une combinaison de leviers, fait basculer légèrement les trois charbons de droite fixés sur le même support. Le courant traverse le cadre directeur, les bougies fixes, les extrémités en contact, les bougies mobiles, et retourne à la machine ou à la lampe suivante.

Au moment de l'allumage, le courant passe par les trois bougies à la fois, mais il n'y allume qu'une seule, la moins résistante; l'électro-aimant produit l'écartement et maintient les bougies parallèlement. Si le courant cesse de passer, l'électro-aimant devient inerte, lâche son armature; les bougies mobiles s'inclinent, viennent toucher les bougies fixes et l'appareil est prêt pour un nouveau rallumage.

Lorsqu'une des bougies est usée, l'arc voltaïque brûle un petit crochet de laiton qui maintenait en place le charbon mobile : ce charbon, sollicité par un ressort, oscille autour d'un axe horizontal placé à l'extrémité du support; l'éloignement du charbon mobile éteint l'arc, l'électro-aimant devient inerte, les bougies restant en contact, et il se produit l'allumage automatique d'une autre bougie.

Quand toutes les bougies sont brûlées ou qu'il survient un accident à l'une des lampes, un appareil que M. Jamin ne décrit pas, et qu'il nous a été impossible de voir, permet de supprimer la lampe malade ou usée et de la remplacer par une résistance égale. C'est un *parachute ou appareil de sûreté*.

Nous cherchons en vain les nouveautés de cette lampe, sans réserve du cadre directeur, dont nous parlerons tout à l'heure.

MM. Wilde et Ingersoll ont fait, bien avant M. Jamin, une bougie à allumage et rallumage automatique. On trouvera une description complète de la bougie Wilde dans le numéro de la *Nature* du 9 août 1879, et en la comparant, il sera facile de constater l'identité des deux procédés. Nous avons vu fonctionner la bougie Wilde à Londres, un moment même où nous l'avons décrite, tête en bas, comme la bougie Jamin. Le fonctionnement en était aussi bon, mais les charbons s'usaient seulement un peu plus vite que dans la position normale, tête en l'air. A ce moment, sur le fil des comptes rendus, nous avions indiqué l'allumage possible du cadre directeur de la bougie Jamin et de l'allumage automatique de M. Wilde, mais les *expériences* du 5 juin nous ont convaincu de l'inutilité du cadre directeur, qui constitue la seule nouveauté, la seule *personnalité* de la bougie Jamin.

En admettant même que le cadre directeur maintienne l'arc aux pointes au lieu de le laisser se produire entre les pointes mêmes, cet avantage est plus que compensé par l'effet disgracieux qu'il produit et la bande d'ombre qu'il projette tout autour de lui : l'économie de lumière en bas disparaît donc en partie, puisque le point lumineux n'est pas complétement dégagé ; ce cadre directeur introduit aussi dans le circuit une résistance électrique trop importante pour être sans influence sur le rendement.

Le parachute a déjà été réalisé, dès 1878, par M. Rapieff, sous le nom de *safety-apparatus*, par M. Siemens, vers la même époque, et plus récemment par M. Reynier, pour ses lampes à incandescence.

Le système de petit crochet de laiton brûlé par l'arc a déjà été essayé sans succès et ne donnera pas, dans la pratique, les résultats qu'on en attend. En effet, si l'on veut faire avec cet appareil un éclairage des rues, le mécanisme, même très simplifié, serait encore trop compliqué et trop difficile. L'ajustage de ces petits crochets, qui doit se faire *sur place*, en haut d'un candélabre, constitue une difficulté sérieuse; le parallélisme des charbons dépend de cet ajustage, qui doit être assez précis.

Si on veut appliquer l'appareil à l'éclairage domestique, laissons la parole à M. Jamin, qui signalera lui-même, mieux que nous ne saurions le faire, l'inconvénient de son procédé :

« ... C'est ce charbon *désagrégé*, reposant par le cir-

bro de glicerina.

Correspondencia del Diario de la Marina

Nueva York, 22 de julio.

EL FERROCARRIL ELÉCTRICO DE EDISON.

Al espíritu emprendedor de dos distinguidos capitalistas de la Habana deberá muy pronto la pintoresca villa de Marianao el honor de ser la primera en ver instalados dos de los más grandes descubrimientos de este siglo, debidos á la fértil inventiva de Thomas Alva Edison, comunmente apellidado "el brujo de Menlo Park."

En cuanto los Sres. D. Leopoldo Carvajal y D. Juan Conill se cercioraron de la practicabilidad del ferrocarril eléctrico, pensaron en dotar al pueblo de Marianao de ese adelanto, para comodidad de los bañistas que diariamente visitan aquella pintoresca playa. Una tranvía ó ferrocarril de sangre podría tal vez llenar ese objeto; pero el espíritu de empresa de esos entusiastas patricios se rebelaba contra la idea de adoptar un sistema ya viejo, cuando el progreso acaba de proclamar la aplicacion de la electricidad como fuerza locomotriz. Quisieron, pues, que Marianao, que está destinada á ser el Newport de la isla de Cuba, tuviese lo más adelantado y lo más reciente en materia de locomocion, y ¿qué puede haber más adelantado ni más reciente que el ferrocarril eléctrico sistema de Edison, si este todavía no ha dado á conocer al público la última y más prodigiosa de sus invenciones? Se dirá que la aplicacion de la electricidad á la traccion ferrocarrilera es yá un hecho conocido, y que en Berlin se ha construido un ferrocarril elevado cuya fuerza locomóvil es la electricidad; pero esto no destruye el argumento de que Edison ha perfeccionado esa invencion con un sistema más reciente y más adelantado.

Pocos son los que tienen noticia de la nueva invencion de Edison, y ménos todavía los que han tenido ocasion de verla puesta en práctica. Con una actividad que cuadra perfectamente con el apodo de "brujo" que el vulgo le ha dado, Mr. Edison ha construido en sus terrenos de Menlo Park un ferrocarril para el ensayo de su nueva locomotora. El dia que la prensa eche á los vientos de la publicidad la noticia del nuevo prodigio que Mr. Edison tiene en sus terrenos, el villorio ó caserío de Menlo Park volverá á convertirse en otra Meca; á donde irán en peregrinacion millares de curiosos, creyentes y no creyentes. Hoy por hoy son contados los que han visto funcionar la nueva locomotora, y entre ellos se cuenta el Sr. D. Leopoldo Carvajal que ha hecho varias visitas al laboratorio de Mr. Edison. En una de ellas tuvo el honor de acompañarle el corresponsal del DIARIO, deseoso de recoger y comunicar á sus lectores algunos datos referentes á una invencion tan importante, y el resultado de esa visita sirve hoy de tema principal á esta carta.

Encontramos á Mr. Edison en el taller de maquinaria dirigiendo el trazado de unos planos, y nos acogió con esa afabilidad y *sans façon*, que constituye uno de los rasgos principales de su carácter.

El Sr. Carvajal le consultó acerca de un teléfono que tiene puesto en su oficina de la Habana y que la pone en comunicacion con sus dos fábricas de tabaco y su vivienda en el Cerro, y Mr. Edison, para ilustrar su explicacion, cogió lápiz y papel, trazó en este cuatro cuadraditos á cierta distancia unos de otros, y luego al lado de uno escribió en castellano la palabra *casa*, al lado de otro *oficina* y al lado de los restantes *fábrica*. No quiere esto decir que Mr. Edison posea á fondo el castellano; pero entiende y conoce algunas palabras y demuestra tener mucha aficion á nuestro idioma.

Pasamos luégo á ver el ferrocarril eléctrico, cuya estacion de partida, si tan pomposo nombre puede aplicarse á un pequeño y tosco tinglado de madera que bastaba únicamente á resguardar del sol y de la lluvia á la locomotora y un carrito que componian el tren, está detrás y á poca distancia del taller de maquinaria donde están situadas las máquinas electro-dinámicas. Tanto la locomotora como el carrito á que estaba unida, son de forma que podemos llamar primitiva, pues están construidos provisionalmente y á guisa de ensayo, sin atender á la belleza ni á los detalles de ornamentacion. Inmediato al "paradero" habia un coche en vias de construccion destinado á reemplazar el carrito ántes citado, y en ese ya se veia una mejora notable sobre aquel. El carrito está enteramente abierto por los cuatro costados y cubierto por un toldo sostenido por barras de hierro: un banco con tres asientos á cada lado está puesto en el centro y á lo largo, de modo que se tocan las espaldas de los pasajeros. El coche, por el contrario, está cerrado y tiene los bancos laterales, sentándose de frente los pasajeros, como en los coches de las tranvías.

Pero no era por cierto, ni el coche ni el carrito lo que más llamaba la atencion, sino la máquina que habia de arrastrarlos y que está destinada á causar una revolucion en el ramo de caminos de hierro. No pretendo hacer una descripcion técnica de esa nueva locomotora, ni siquiera dar una idea exacta de su figura, bastará que el lector imagine una caja en forma de cruz, puesta entre cuatro ruedas, cuyos ejes giran merced á unas correas puestas en movimiento por árboles que parten de la caja donde va encerrada una magneta. En las aspas de esa cruz van dos asientos: el de la izquierda es para el maquinista que pone en movimiento ó para la locomotora, y el de la derecha lo ocupa el conductor ó auxiliar que toca la campana de aviso. Al extremo posterior de la caja hay un timbre que suena tirando de un cordon, y este cordon lo tenia asido Mr. Edison, el cual se sentó en el primer asiento del banco de la izquierda.

—¡*All aboard!* gritó Mr. Edison, y los que debíamos hacer el viaje de prueba nos sentamos en el carrito. El maquinista y el auxiliar estaban yá en sus puestos.

Mr. Edison tiró el cordon, sonó el timbre, el maquinista apretó un manubrio que salia de la caja generadora y levantó con una palanca un rodillo que oprimia la correa de cuero, y empezó á andar la locomotora al principio lentamente y aumentando por grados el *momentum* hasta adquirir una gran velocidad.

—¿Cuál es el *maximum* de velocidad que puede llevar esta locomotora? preguntó á Mr. Edison.

—Cuarenta millas por hora, y aun más si se desea; me contestó.

El trayecto que ha hecho construir Mr. Edison, y en el cual ha trabajado él mismo como si fuese un simple operario, tiene varias curvas de diferentes radios, algunos sumamente cortos, así como pendientes de mayor ó menor inclinacion, con el objeto de demostrar que los accidentes del terreno no son obstáculos para el ferrocarril eléctico, y que por este *sistema* se hace mucho más económica la construccion de la vía.

Por esas curvas y por esas pendientes anduvo el tren eléctrico sin disminuir la velocidad, hasta el punto de hacernos á los no iniciados asir fuertemente la barra de hierro, al ver que íbamos á doblar una curva muy curva ó á bajar una pendiente muy pendiente, con una velocidad de treinta millas por hora. Un golpe en el timbre del Mr. Edison, dos movimientos del maquinista y una vuelta á la retranca bastaron para hacer parar el tren en unos cinco segundos. Con la misma facilidad que habia avanzado retrocedió la locomotora, y llegamos al paradero completamente satisfechos de tan notable excursion. Saltamos del carrito, ocuparon nuestro lugar unas señoras vecinas de Mr. Edison, una de las cuales llevaba un niño de pecho, y con tan delicada carga repitió Mr. Edison el experimento sin la menor novedad.

Durante este segundo viaje tuve ocasion de examinar el paradero, y observé que del taller de maquinaria donde está la máquina generadora venian dos alambres á parar á los *rails* de la vía, despues de pasar por la pared del paradero, donde dos llaves permitian abrir ó cerrar el circuito. Las juntas de los *rails* estaban unidas con tiras de plancha remachadas, de manera que, no habiendo solucion de continuidad, sirven los *rails* de conductores, contribuyendo á formar el circuito por medio de las ruedas de la locomotora que se comunican por alambres con la magneta motriz que aquella lleva en su seno.

Segun tengo entendido, á cada diez millas se requiere una máquina generadora; pero así y todo, el costo de instalacion del ferrocarril eléctrico, por cada milla, inclusas locomotoras y generadoras, es mucho más económico que el de un ferrocarril movido por vapor, siendo tambien mucho menores los gastos de operacion y conservacion de línea. Si á esto se agregan otras ventajas en favor de los pasajeros, siendo la principal la carencia absoluta de humo y de polvo de carbon, y se tiene en cuenta la imposibilidad de pegar fuego á los sembrados contiguos á la vía, y la facilidad de construir un trayecto en cualquier terreno por accidentado que sea, bien puede predecirse que no tardará el ferrocarril eléctrico en ser adoptado con preferencia á todo otro, donde no sean muy largas las distancias, ni el tráfico muy excesivo.

El otro invento reciente á que me referí al principio de esta carta, es la luz eléctrica de corriente divisible, que el Sr. Carvajal desea instalar en su quinta de los Quemados de Marianao. Hubiera ya llevado consigo, en el vapor *Saratoga* que hoy lo conduce á esa, una máquina para veinticinco luces, á tenerlas yá completas Mr. Edison; pero hasta el mes de octubre no estarán listas las máquinas y lámparas que ha perfeccionado, y á esta dilacion deberá Marianao el no ver instalada la luz eléctrica de Edison este verano.

trasitos habrán y otro espíritu emprende-
dor construirá allí algunos lindos cottages
chalets con sus jardincillos, folletos anun-
ciando á las familias que los alquilan para toda la temporada. ¿Porqué no ha de tutar la isla de Cuba en Newport, como los Estados Unidos, en Brighton, como Inglaterra, en Biarritz, como Francia y en San Sebastian, como España?

Al espíritu de empresa toca contestar á estas preguntas. Todo podrá ser si los señores D. Leopoldo Carvajal y D. Juan Conill encuentran émulos é imitadores. A dichos señores faltaría por las proyectadas mejoras que piensan introducir en Marianao, y deseo que el ferrocarril eléctrico que allí construyan obtenga el buen resultado que marcho.

Si el espíritu de empresa ha sido la varita mágica que en pocos años ha trasformado el arenal de Coney Island en un palacio de hoteles-palacios que atrae gente de todas partes de los Estados Unidos, porqué no ha de poder el mismo talismán cambiar la faz de la playa de Marianao, trasformarlo allí atractivos veraniegos que llamen á los viajeros de la isla de Cuba que van á embarcarse en la Habana para dirigirse á puntos balnearios del extranjero? ¿Es acaso imposible que donde se proyecta introducir la luz eléctrica y el ferrocarril eléctrico y se intenta hacer una ensenadada para impedir que los tiburones se acerquen á la orilla, se construya también un cómodo y espacioso hotel á estilo americano, con un parque donde haya ruleta, todas las noches? Y si ahí no se

DIRECCION: ZULUETA 73. — Director propietario: Francisco Cepeda. — [illegible]TRACION: ZULUETA 73.

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SUMARIO

El alumbrado por la electricidad.—Cuento que pica en historia.—Se confirman las paluchas de Ruperta.—Estadística azucarera de los Estados-Unidos. III.—A la Junta Provincial de Libertos.—Tú, que no puedes, llévame á cuestas.—Más sobre el Banco del Comercio.—...Ya lo comereis ciculo!.—El perro del hortelano.—Las ranas pidiendo rey.—Tratado entre el Perú y España.—*Anche io sono reporterini.*—Variedades.

APÉNDICE.

Documentos de la Comision informativa para las reformas económicas y sociales de Cuba. Páginas 7 y 8.

EL ALUMBRADO POR LA ELECTRICIDAD.

Siendo de suma importancia cuanto se refiere al alumbrado público ó privado, y muy palpitante la cuestion que se viene agitando en todos los centros científicos, acerca de las ventajas del alumbrado eléctrico sobre el alumbrado por gas, ó vice-versa, creemos hacer un servicio á nuestros lectores poniéndolos al corriente de los diferentes aspectos que viene presentando esta cuestion desde hace algun tiempo; trasmitiendo con exacta imparcialidad cuantos juicios se emitan en la region elevada de la ciencia y el cálculo, ya en favor del uno ó del otro sistema, sin perjuicio de emitir nuestra opinion siempre que lo creamos conducente á la mejor inteligencia, ó al esclarecimiento ó rectificacion de los hechos.

El *English Mechanic* ha iniciado una interesante polémica, en la que examina algunas declaraciones importantes hechas por el eminente electricista William Thomson sobre el alumbrado eléctrico, en la informacion parlamentaria que está llevando á cabo un Comité de la Cámara de los Comunes. El *Mechanic* trata de atenuar la importancia que dicho señor asigna á la economía de combustible en el alumbrado eléctrico respecto del alumbrado de gas, teniendo en cuenta la potencia luminosa en uno y otro caso.

He aquí las principales declaraciones de Thomson que sirven de base á la crítica del *English Mechanic*.

«Invitado por el Comité para que emitiese su autorizada opinion acerca de la energía mecánica desarrollada para la produccion de un arco voltáico, en comparacion con la empleada ó representada en un mechero de gas, dijo: «La fuerza empleada actualmente para la produccion de la luz eléctrica por medio de las máquinas de induccion, está calculada en un caballo de vapor para un arco de la intensidad de 2,400 bujías, y á veces de mayor intensidad, segun las dimensiones y otras circunstancias del arco eléctrico; es decir, que basta una fuerza constante de un caballo para comunicar al éter luminoso la suficiente vibracion en la superficie de los carbones y entre sus puntas, y producir una luz constante de 2,400 bujías de intensidad. En tanto que una cantidad igual de fuerza consumida en combustion de gas, sólo produce una luz de 12 bujías de intensidad.»

Invitado á que explanase su idea, manifestó que, habiendo demostrado la práctica que un caballo mecánico producia una luz eléctrica de intensidad de 1,200 bujías, y calculando él que la mitad de la fuerza solamente está representada en la luz, y la otra mitad en el caldeo de las diferentes partes de la máquina, deducia que un caballo de vapor producia 2,400 bujías, fórmula de su contestacion.

Respecto del gas manifestó que habia calculado en cuatro bujías el pié cúbico de gas por hora. Segun sus cálculos, el poder calorífico del gas es de 12,000 unidades centesimales por grano. Que, apreciando la densidad del gas del alumbrado en la mitad de la del aire, habia asimismo calculado en consecuencia, que en relacion al calor desarrollado por la combustion del gas, tomando por tipo el correspondiente á un segundo de tiempo [illegible] el resultado que más arriba indicamos, es decir, que un caballo consumido en calentar el aire y producir la vibracion del éter luminoso en la llama de un mechero de gas, producia sólo una luz de 12 bujías.

El Comité hizo observar á esta declaracion que habia una apreciable diferencia de opinion entre los resultados ó testimonios científicos y los prácticos.

«En efecto, dice el *English Mechanic*, las conclusiones de Sir Thomson son realmente exactas; pero están dispuestas de manera que constituyen una série completa de alegatos especiales, y producen una impresion absolutamente falsa acerca de lo que los hechos mismos significan realmente. Las conclusiones son *ciertas en lo que respecta á la fuerza ó energía desarrollada en las luces.* La impresion que producen es *falsa en lo que respecta á la energía ó fuerza necesaria para producir las luces.*»

«La energía, como otras muchas cosas, puede considerarse de dos maneras. Existe la energía *potencial* ó teórica de un combustible dado, es decir, el calor desarrollado ó que puede desarrollar por la combustion al aire libre ó en union con el oxígeno. Esta energía potencial del carbon de piedra, por ejemplo, es aproximadamente de 13,000 unidades centígradas de calor por libra. En lenguaje comercial diríamos que ésta es la energía *bruta* del carbon de piedra. Existe además la energía *práctica* del combustible, como funcion de las resistencias, calderas, máquinas, etc. Por ejemplo, el promedio de las máquinas de vapor da un caballo por cada 7 libras de carbon de piedra por hora. Esto, en lenguaje comercial, puede llamarse la energía *neta* del carbon de piedra.

«Ahora bien; lo que Sir William Thomson ha hecho es precisamente esto: cargar al gas la fuerza bruta y á la electricidad la fuerza neta, como lo evidencia lo escrito en bastardilla. Y el público que no comprende esto, así como los escritores de la prensa periódica, creen que estos datos presentados con tal seriedad son rigorosamente exactos. Pero veamos cuál seria la verdadera y justa comparacion, utilizando hasta donde sea posible, los mismos datos ó fórmulas del Sr. W. Thomson. Un caballo dinámico de 75 kilográmetros da 33,000 pié-libras por minuto, ó 1,980,000 [illegible] expresado en unidades térmicas de 1 libr[illegible] centesimal, que equivale á 1,390 pié-libr[illegible] [illegible]allo por hora es igual á 1,424.5 unidades, [illegible] pues la potencia de 4 piés cúbicos de gas, [illegible] 2 bujías de luz.

«Para colo[illegible] caballo de energía en el arco eléctrico, se nece[illegible] otro caballo en el tránsito, y debe cargars[illegible] puesto que el gas, comparado con el es[illegible] [illegible]ntado por el gasto total necesario, ó sea su[illegible] [illegible]. Mas para producir un caballo en una [illegible] de vapor, se necesita un gasto de carbon q[illegible] [illegible] 2.5 libras por hora en las máquinas m[illegible] [illegible]onadas, y de mayor rendimiento conocidas hoy[illegible] y á veces 10 libras en las máquinas comun[illegible] [illegible]; pues, tomemos 4 libras como tipo muy ven[illegible] [illegible] máquina de vapor, y tendrémos 8 libr[illegible] [illegible] de carbon para producir las mencionadas [illegible] bujías. Y, siendo el promedio de la energía [illegible] de una libra de carbon ordinaria 13,000 [illegible] térmicas, el correspondiente á 8 libras será 1[illegible]

«En vez [illegible] poner para cada bujía:

$$\text{Gas } \frac{1,424.5}{12} = 118.7.$$

$$\text{Electricidad } \frac{1,424.5}{2,400} = 0.594,$$

como debiera ser [illegible]gun da á entender el Sr. William Thomson, nosotr[illegible] creemos más exacta esta comparacion:

$$\text{Gas } \frac{1,424.5}{12} = 118.7.$$

$$\text{Electricidad } \frac{104,000}{2,400} = 43.3$$

«Aunque [illegible] omitido (añade el *English Mechanic*) un elemento importante [illegible] de gas no necesita maquinaria, capital [illegible] inteligente vigilancia [illegible] todas estas cosas, y aun cuando ellas no deban constituir un factor para el cálculo especulativo ó científico de la energía potencial desenvuelta en los dos casos, entran por mucho como factores para el cálculo práctico del costo. [illegible] las diferencias entre la opinion práctica y la llamada científica, notadas en la informacion parlamentaria del Comité.

«Las comparaciones hechas, son, sin embargo, esencialmente erróneas, puesto que han sido establecidas entre la electricidad en las mejores condiciones y en gran escala, y el gas en las peores condiciones, y en pequeña escala, y ya sabemos que, en todas las cosas la pequeña escala es mucho más costosa que la grande, ya se considere el gasto en dinero, ó en energía. Pero además de [illegible] principio general, la comparacion no se ha hecho [illegible]mente con un arco de un caballo de energía ga[illegible] en él, sino que ha sido deducida de una luz que [illegible] 3 ó 4 caballos dinámicos; por es-

THE LARGE ELECTRIC WORKS OF PARIS.

THE STORES OF THE LOUVRE—THE HIPPODROME.

If we desire to obtain some idea of the progress made by the electric light during the last few years, we shall have to go down into the sub-cellars under the stores of the Louvre, and also pay a visit to the magnificent electrical works of the Hippodrome. These two great establishments have adopted systems of electrical lighting under special and very different conditions; and, in describing them, we shall show within what limits the electric light, when properly applied and managed, may prove serviceable; and we shall see, too, whether or not it is capable of advantageously replacing the other methods of artificial lighting that are known.

LIGHTING OF THE STORES OF THE LOUVRE.

It is to the stores of the Louvre that belong the honor of having begun the first experiments made with the Jablochkoff candle. This enterprise, which was modestly begun with a few candles and one Alliance machine, now embraces eighty-four lamps. M. Honoré, the engineer in charge of the establishment, found himself involved at first in many difficulties, but succeeded very ably in overcoming them. It was not convenient, in fact, to locate the boilers, steam engines, and the electrical machines necessary for the production of the electrical current in a sub-cellar and within a very limited space. M. Honoré has adopted the Belleville inexplosive boiler, which answers the purposes required of it very well. Two of these boilers of forty horse-power each supply two Corliss engines. Division Gramme machines are used, three twenty-candle machines and one twenty-four-candle furnishing the current for the eighty-four globes distributed among the stores and the hotel of the Louvre. In this establishment the electric light exhibits all those advantages that are inherent to its very nature—that is, it produces no perceptible* heat; it gives out no products injurious to respiration or detrimental to the delicate colors of fabrics; and, finally, it does not affect shades of color, the minutest differences between these being readily perceived. Accidental extinctions of the lights, which, at first, were quite frequent, are becoming more and more rare, and will eventually cease altogether. As to the steadiness of the light, it is much superior to that of the Avenue de l'Opéra, because the apparatus not being exposed to all the variations of the atmosphere are able to work under much better conditions. To sum up, the electric lighting of the Louvre is giving very satisfactory results, a sufficient proof of which is found in the extension that it has successively undergone.

THE LIGHTING OF THE HIPPODROME.

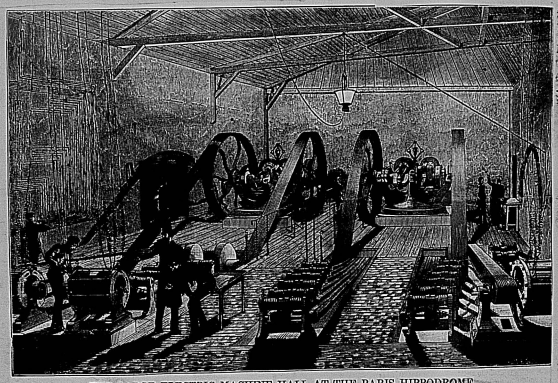
No one can doubt the value of the electric light when there is a question of illuminating large spaces, so in the Hippodrome, with its gigantic dimensions, we find a field of application which taxes it to its utmost. As in the case of the Louvre, the first arrangements made, although they were of quite extensive proportions, were soon found inadequate, and hence it became necessary to begin entirely anew. The accompanying cut represents the new machinery hall. The electric lighting of the Hippodrome includes at present one hundred and twenty Jablochkoff candles and twenty-one Serrin regulators, which, when all are in operation, require an expenditure of one hundred and twenty horse-power. The electric works of the Palais de l'Industrie will supply three hundred and sixty-five lamps at the opening of the next "salon," but these lamps are distributed in varying numbers among a number of small rooms. At the Hippodrome the hall is lighted by one hundred electric candles and twenty regulators, making the grandest and most powerful illumination that has thus far been effected. The use of two different systems—candles and regulators—necessitates the use of two different styles of machines, both of which were invented by M. Gramme. The one hundred and twenty candles are supplied by three alternate current machines and by one sixty candle machine; the latter (only a part of which can be seen to the right of the engraving) is the largest division machine that has been constructed up to the present time, but differs from the others only in its dimensions and power. The regulators are each supplied by a continuous current Gramme machine. Each continuous current machine can supply only one regulator at a time, but by means of a commutator it is possible to send the current in several directions so as to light up different parts of the hall, according to the requirements of the exhibition taking place. During the chariot races and equestrian performances the regulators around the circumference of the hall are lighted; during performances in the ring the machines supply the regulators that are arranged to light the center; and for aerial performances still another arrangement is adopted. All these changes are effected with remarkable facility and celerity. We must mention one other arrangement which has features of economy about it. The regulator machines have no return wire to complete the circuit, the return being effected through the framework of the building, which being entirely of iron serves as a conductor and completes the circuit.

* The lights being equal, the voltaic arc gives out two hundred times less heat than a gas jet burning 100 liters per Carcel burner.

The engraving shows how motion is communicated to the machines arranged *en escalier*. This arrangement has the advantage of rendering the speed of each machine independent of that of the others, and, consequently, of proportioning it to the distance that separates the lamp from the electric generator. To effect this it is only necessary to properly vary the diameter of the pulley of each machine. The division machines are the alternate current ones of the Gramme system. The coils are arranged in four circuits, each of which supplies five candles. These machines make six hundred and sixty revolutions. Their inductors are supplied by a Gramme machine of the same type as that of the Serrin regulators. These exciting machines make six hundred revolutions per minute. The sixty-candle machine supplies twelve circuits of five candles each, and makes only five hundred and fifty revolutions. While the three twenty-candle machines absorb a power of sixty horses, M. Geoffroy, the engineer-in-chief, estimates that the sixty-candle machine absorbs a power of no more than fifty. Here again is seen the advantage that is presented by the use of powerful rather than small machines. The motive power is furnished by two steam engines of the type styled "compound," of one hundred and twenty horse power each. Two pulleys 2·0 meters in diameter put in motion two intermediate shafts by means of rubber belting 40 centimeters wide. The intermediate shaft carries a drum over which pass the horse-hair belts which put the electric machines in motion. There is no scene more animated and interesting than that presented by these electrical works when everything is in operation and each man at his post. Extinctions, which were so frequent at first, are becoming now rarer and rarer, owing to the care of M. Geoffroy.

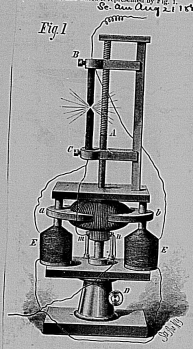
In conclusion, it only remains for us to add a few words on the question of economy, which here plays so great a role.

The electric lighting of the Hippodrome costs, all expenses included, from 250 to 200 francs per evening. To light it by gas a few years ago cost 1,100 to 1,200 francs, and produced a pretty mean effect. Here, then, is an application of considerable importance, where the electric light shows its superiority in an indisputable manner, from every standpoint. Let us remark, however, that this considerable difference in price will not occur where the electric lighting takes place on a small scale. In such cases, gas will undoubtedly assert its advantages. Very soon, on the occasion of the opening of the "salon," we shall finish this article by giving some information as to the lighting of the Palais de l'Industrie, at which the electric light is to figure to a still greater extent than it did last year. Whatever be the results obtained on this occasion, the fact is none the less established that the electric light has definitely earned a place for itself at night. But that its success be not compromised, it will be well to act with prudence and to extend the field of its applications only in proportion as improvements are made in it. Gas and electricity will then, without placing themselves in the position of competitors or rivals, be able, on the contrary, to lend each other mutual aid by the choice of a field of applications which, leaving their inconveniences in the shade, will put their respective advantages in the best light.



THE LARGE ELECTRIC MACHINE HALL AT THE PARIS HIPPODROME

W. Tchikoleff, the head of the electric lighting department of the Russian artillery, has described, in *La Lumière Electrique*, a new lamp, the design of which was lately brought before the physical section of the Moscow Society of Naturalists, and which is represented by Fig. 1.



TCHIKOLEFF'S ELECTRIC LAMP.

E E' are electro-magnets disposed like those on the other systems, and having poles, a b, spread out in circular form as in the Gramme machine. K is a Gramme or Siemens ring, the rotary motion of which causes the carbons to move through the intermediary of a double thread screw, A, and two nuts, B C, which carry the carbons. Lastly, D is a regulating screw, for the purpose of raising or lowering the luminous focus.

The current passes from the positive pole of the generator to the negative pole by three derivations, one of which includes the arc and traverses the ring by means of the contact pieces, m n, while a second, also including the arc, excites the electro-magnet, E (or both electro-magnets in a given direction); and a third which, without passing by the arc, influences the high resistance magnet, F (or both magnets in contrary directions), so that the action of this magnet upon the ring shall be in a reverse direction to that of E.

In consequence of this arrangement the action of the electro-magnets upon the ring, K, is, among all, when the arc possesses its normal resistance; but when the resistance of the arc augments, the action of the electro-magnet, E, becomes weakened, allowing F, to preponderate, and the ring, K, will rotate so as to bring the carbons into closer proximity. The contrary effect, will, of course, be produced if the resistance of the arc should diminish.

Experience has shown that with such a lamp it is possible to obtain, with regularity and safety, a good electric light with twenty-four Bunsen cells, and at first with even twenty cells. Some of these lamps have been in use in the Russian artillery since 1877. This lamp may also be constructed on the principle of the Wheatstone balance.

The form of this lamp intended for public lighting is represented by Fig. 2. The rod, A, with the upper carbon holder, works by the effect of its own weight. When the current traverses the lamp the distance between the two carbons is maintained by the aid of helical coils, but these coils and the toothed wheel which controls the movements are worked, as in the former case, on the principle of derivation. When the current is interrupted, the carbons come into contact by the effect of the weight of the rod, A.

Certain details of construction have been omitted in this description, but enough has been given to make the principle clear.

To sum up, the advantages of this lamp may be enumerated as follows:

1. Its construction is extremely simple; it is free from clockwork mechanism, springs, and electrical contacts.

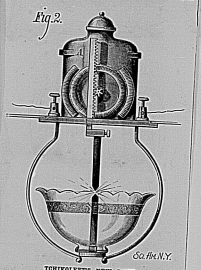
2. It does not require preliminary regulation nor any manipulation before or during its working.

3. Several of these lamps may be arranged in series in a circuit, and they are always in due relation with the intensity and the tension of the current which is to act upon them.

4. The lamp can work with comparatively weak currents, and also produce a very powerful light when the power of the current is augmented.

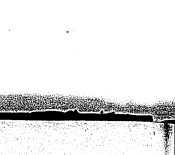
The inventor is convinced that the problem of the divisibility of the electric light by means of lamps having a voltaic arc can be solved only with the lamps based on the principle of the derivation of the current, which he discovered prior to Messrs. Lontin and Siemens.

Lamps with movable cartons, offering a certain resistance between their polar extremities, are, moreover, far preferable, from the point of view of divisibility, to lamps with fixed carbons, which may offer great variations in the resistance of the arc, in consequence of impurities, the action of the wind, etc. These variations may, in fact, be greatly reduced in the former description of lamp, and it is not necessary with them to employ currents of such high tension, or, if such currents be employed, additional lamps may be inserted in the circuit.



TCHIKOLEFF'S NEW LAMP.

THE ELECTRIC LIGHT IN PARIS FOR THE 24TH OF JUNE.—On this occasion nearly all the inventors of apparatus and the companies for electric lighting were represented. About forty Jablochkoff candles were arranged in groups at the Bois de Boulogne; the great lamps of M. Lontin were placed on the July column at the Place de la Bastille, and six more on the boulevard Montparnasse; the Serrin lamp was conspicuous on the Place de la République, and at the *Mairie du Temple*, whilst the modification of this lamp by M. Suisse was to be seen burning in the open air at the rue Saint-Sébastien. M. Jamin lamps figured at the *Magazins réunis*, and others were observed in Belleville; Messrs. Siemens Brothers had fourteen of their differential lamps at the *Palais Royal*, and four on the *place de la Bourse*; the *loggia* of the Opera was illuminated by six Dubosco regulators; the Compagnie Meritens and the


The Jamin Electric Light.
Lately one of the electric light companies of Paris made recent trials of the electric light, and the Jamin lamp was used. Singular, however, to say, the inventor of the lamp, one of the French delegates at the celebrated Electrical Congress at Paris, the object being to test the efficiency of the various electric lamps, and the distinguished gathering of ministers and notabilities connected with science, industry and public works were present on the occasion. At 10 o'clock a method of working, the number of lights to be used, by various experiments, the trial proceeded to the use of the Jamin lamp. The result was the following results could be obtained: The whole of the lamps placed on the same circuit could be lighted and extinguished at once, each formed by two rods of carbon 12-100 in. thick, one of which, were to be pressed back by a brass clip, would the electric current which forms the arc. When the candle has burnt to the end, the current consumes the brass clip, the carbon rods are separated by the spring, and the arc is transmitted to the adjoining candles. By this method the light can be kept up for an almost unlimited time. The lighting or re-lighting of the lamps is effected instantaneously by means of automatic mechanism, and if one of these should by any accident become extinguished, the others are not in any way affected thereby, but continue to burn with undiminished brilliancy. The light, which is well divided, is capable of being regulated at will from the soft light of a number lamps, to that of the full power of 300 lamps. The electric current is conducted to a distance of 24 miles from the electric source by means of a copper wire, differing in thickness according to circumstances, by a wire double that thickness. The experiments made at the last trial served to satisfactorily prove the steadiness of the light obtainable with the Jamin lamp. With respect to the cost of working, it was stated by the inventor that each lamp, which is equal to only one-half the power of a Jablochkoff candle, consumes, the electric candles are used, as at the Place de l'Opera in the Place du Theater Français, in Paris, and careful experiments have demonstrated that the system is capable of effecting a saving of one-third, or at least a quarter, as compared with coal gas, or at least a fifth of gas. The results of the illumination by means of electricity, as exhibited at the trial, were declared to be satisfactory, and it was proposed to promote at once the important position of forming a vast cheap and manageable method of illuminating suitable for factories and other large establishments and towns.

IMPROVEMENT IN THE EDISON LAMP.—A Mr. J. H. Guest, of Brooklyn, has been highly successful in making the "Edison lamp" perfect. He thought the principal trouble would be the entrance of air around the wires at the point of fusion in the glass, and to remedy this encloses the joints in small globes formed on the ends of the glass where the wires pass through into the vacuum globe. These globes are partially filled with mercury in order to ensure an air-tight joint. We see no reason why the cheaper material, water, should not be used instead of mercury, but we may also point out that this does not prevent the disintegration of the carbon, which is *the* weak point in the lamp.

THE ELECTRIC LIGHT IN BOMBAY.—The *Bombay Gazette*, one contemporary, the *Bombay Gazette*, is now constantly lighted by electricity. When the preliminary trial was made, says the *Gazette*, the result was found to be so satisfactory that we determined to use this beautiful light in the composing and machine rooms, and steps were taken to procure the additional motive power necessary. To drive the printing machines of the office an ordinary three or four horse-power engine was sufficient, and no engine of the same capacity would have been sufficient to drive the Gramme magneto-electric machine. It was deemed better to get an engine able to drive both at once, and with plenty of power to spare, so as to allow of future developments. One of Robey's semi-portable engines of eight horse-power was selected. The engine up, M. Verne, the chief engineer of the Indian Electric Light Company (*Limited*), a branch of the Société Generale d'Electricité of Paris, put up one of Gramme's eight-light magneto-electric machines, and made the connections with two lights in the composing room, one in the machine room, and one at the entrance. This leaves a reserve of four lights, which may be used hereafter if required. The connections made and steam up, the turning of a handle flooded the composing room, the machine room, and the entrance in the brightest and purest light, each lamp having the photometric value of fifty ordinary gas-jets. Every evening since the light was first used it has been turned on and used in the same way without trouble. There is abundance and superabundance of light, and the heat and vitiation of the atmosphere inseparable from the use of all other systems of illumination are entirely done away with. The Jablochkoff candles are used for the conversion of the electricity into light. The Société Generale is at present making arrangements with the Maharajah of Cashmere to light Jummoo with electricity. As a preliminary, His Highness's palace will be lighted up, and if all goes well the city, or at least its principal quarters, will be lighted. The light is in use at Rangoon in several rice mills, and in the private house of one gentleman. The company was employed by Sir Richard Temple to light the bridge-makers at Jhelum and elsewhere at night on the Candahar line.

DISTRIBUTING CURRENTS FOR ELECTRIC LIGHTS.—Among the many recently-introduced improvements calculated to make electric illumination permanently practicable, says the *Mining Journal*, is one by the Société Générale d'Electricité, of Paris, which is specially worthy of attention; it is a disconnecting and commutating apparatus for distributing currents to the lamps, and is so arranged that if one of a number of lamps or groups of lamps should by accident become extinguished, or should its carbons break or be consumed, this lamp is automatically thrown out of circuit, and the next in order is brought into circuit. When the lamp is of the Jablochkoff kind there is attached to the clamp that holds the candle a strip made of two metals having unequal degrees of expansion. The strip is bent in U form inverted, and is attached by one of its limbs, presenting its bend near the lower end of candle. When the candle is burnt down to this point, the heat of the voltaic arc acting on the bent strip causes it to partially unbend, so that its free limb comes against a contact screw, and thus establishes a circuit of less resistance by which the electricity passes, without continuing to pass through the residuary carbons of the candle. The free end of the bent strip may have attached to it a spring, which is usually held in a bent position by butting against a stop, until by the change of shape of the strip it is released from the stop, whereupon it springs against the contact screw and short circuits the current. The commutator whereby the candles are brought successively into circuit consists of a vessel of ebonite or other non-conducting material, divided into a number of parallel compartments, each containing mercury, connected by wire with one of the lamps or candles. Above this vessel is mounted a shaft which extends over all the compartments; it has on it a metallic disc which dips into the mercury of the first compartment, and at intervals along it, corresponding to the distance of each compartment from the next, it has a number of metallic pins projecting from it, these pins being arranged helically on the shaft, so that when the shaft is turned round, as one pin is leaving the mercury in one of the compartments the next pin in order is entering the mercury in the next compartment. On the shaft is an escapement which, worked by an anchor on the armature of an electro-magnet. The armature of a second electro-magnet is attached to a lever, which carries at its end two metal pins immediately over two cups containing mercury. Usually while one lamp of a series is in action the electric current for the lamp passes through the coil of this second electro-magnet, which by attracting its armature, keeps the metal pins out of the mercury. When, however, from any cause the lamp becomes extinguished, the second electro-magnet, no longer excited by an electric current passing through its coil, ceases to attract its armature; the armature lever thereupon moves so that its pins dip into the mercury cups, giving passage for the electric current to the first electro-magnet, the armature of which, moving the anchor, turns the escapement wheel and its shaft partly round. By this movement of the shaft the one of its pins which was in the mercury of one compartment, closing the circuit of the lamp that was in action, is withdrawn from the mercury, so that this lamp becomes excluded from the circuit, and the next pin on the shaft being now immersed in the mercury of the next compartment, closes the circuit for the next lamp in order. Immediately on that lamp coming into action the electric current again passes through the coil of the second electro-magnet, which, attracting its armature, withdraws the pins thereof from the mercury cups in which they were immersed, and so causes the first electro-magnet to be excluded from the circuit until it is again brought into circuit by the extinction of the active lamp or candle. Thus, as lamp after lamp comes to act the lamps are brought successively into circuit. It is convenient to number these lamps consecutively, and to fix on the shaft an index which, as it is moved by the shaft over a dial marked with numbers corresponding to those of the lamps, indicates at any time which of the lamps is in action.

THE ELECTRIC LIGHT AT ST. ENOCH STATION.

To the Editor of Engineering.

Sir,—With reference to your article on the Electric Light at St. Enoch Station, Glasgow, I should like to remark that the length of lantern is necessarily determined by the length of what they are constructed to enclose; length in this case is of little importance in the lantern itself, whilst it does not influence the illuminating effect at all.

Kindly allow me to remark that the British Electric Light Company, Ltd., as your article might lead one to suppose, have up to the present used a lamp exclusively; the company are not specially interested in any one lamp, which is a guarantee that the method best adapted to any particular work will in each case be used by them. The fact, however, that I selected Mr. Crompton's lamp for work as important as the illumination of St. Enoch Station speaks more for the lamp than if the company were specially interested in it.

Your obedient servant,

H. Hedgeffe Wade,

Engineer to the British Electric Co., Ld.

41, Parliament-street, Westminster, July 28, 1880.

Notes.

ELECTRICITY ON BOARD SHIP.—A steamer named the *Columbia*, which has just been completed at Chester, Pennsylvania, for the Oregon Railway and Navigation Company, has several novel and interesting applications. Thus, the Edison electric light is adopted throughout the ship. We learn from the *Scientific American* that the lamps are 120 in number. The lights of the state-rooms are under control of the steward on the out-side. The state-rooms on the upper and lower decks are on separate circuits, and so are the saloons. The lamp-fixtures are of the same form as those used for oil lamps, and by an ingenious contrivance they are adapted to either the electric or oil light, so that should the former fail in any way, the latter may be at once substituted. The electric lamp globes are frosted lightly by dipping in hydrofluoric acid. The desirability of electric lighting on shipboard, where fire risk elements are necessarily small, is obvious. The *Columbia* has further an electric hand light, consisting of a Maxim electric light. All the rooms are fitted up with electric calls, and the officers, smoking-room, &c., are provided with telephones, the smoking-room being in connection with the steward's room, and the captain's with the chief engineer's, purser's, and steward. An electric call-bell on the bridge enables the captain to tell, by simply ringing a button, whether the engine is going ahead or astern, and at what speed. The steering gear has connection with the foreign hoister, but with self-acting steadiness. The elevator for discharging cargo are new in design, and the running engines at the posts are arranged so that a loaded truck runs from the lower hold into the deck entirely by steam. The arrangement of berths is similar to that in a Pullman palace car, and when the berths are not in use they are folded out of the way. The system of water-supply for fire, &c., is very complete; and a new kind of still is used which is capable of supplying 1,000 gallons of pure fresh water daily. The *Columbia* is 324ft. length, 38ft. beam, 23ft. depth of hold, and 3,200 tons measurement.

THE printing offices of the *Neue Freie Presse* at Vienna are now lighted with Siemens' divided electric lamps.

CURIOUS MAGNETIC EXPERIMENT IN MAGNETISM.—M. Ohaikal has described a curious magnetic experiment to the French Academy. Two magnetic needles are suspended over water in a vessel by fine threads attached to needles poles. Their poles are opposite, and are distant from each other by an amount a little greater than the sum of their radii of mutual attraction. The water is gradually brought up over them by means of the tube of caoutchouc connected with the vessel and wound on a drum. When immersion commences, the needles approach each other by their immersed parts, and when the immersion has reached the third or fourth of the needles' length, they touch together. The explanation seems to be, that when hindered the orientation of the needles was their own weight; and the forces of gravity being weakened by the immersion, the magnetic forces become manifest. If the needles are suspended by their poles of the same name, a corresponding though opposite phenomena is ob-

Engineering Journal

THE JAMIN ELECTRIC LIGHT.

June 15/1880

On Friday, June 4th, some trials of the Jamin Electric Light were made in the laboratory of the Compagnie Générale d'Eclairage Electrique, 27, Avenue de Moine. A large concourse of scientific notabilities was present, including M. Gambetta, M. Durrieu, the Minister of Public Instruction, Members of the Institute, Perpetual Secretary of the Academy of Sciences; Vaucorbeil, Bergnet, Renier, Hervé-Mangon, Director of the Conservatoire des Arts et Métiers; Antonin Proust; Admiral Mouchez, Director of the Observatory; Desain, Professor of Physic at the Sorbonne; Freisy, Director of the Museum; Daubrée, Director of the School of Mines; Hébrard, senator, Director of the *Temps*; Gailly, senator; Debesh, Martial

MACHINES DYNAMO-ÉLECTRIQUES

Et régulateur à courants continus Jules Richard

DE MM. SIEMENS ET HEFNER-ALTENECK

La machine et le régulateur que nous allons décrire aujourd'hui s'emploient en Angleterre et en Allemagne comme on emploie en France la machine Gramme et le régulateur Serrin. Nous devions donc signaler ces deux appareils aux lecteurs de *la Nature* pour compléter ce que nous avons déjà dit à diverses reprises sur l'éclairage électrique, et les tenir au courant de l'état actuel de la question.

La machine de M. Hefner-Alteneck, construite par M. Siemens, est une machine dynamo-électrique à courant continu analogue, quant au principe du fonctionnement, à la machine de M. Gramme. Elle en diffère par la forme des inducteurs et surtout par la manière dont le fil est enroulé sur l'anneau mobile.

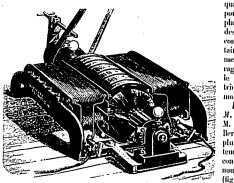


Fig. 1. Machine dynamo-électrique de M. Siemens (moyen modèle).

Les inducteurs sont formés de deux électro-aimants à pôles consécutifs composés de barres de fer doux réunies au bâtis de fonte de l'appareil, qui forme enfin la culasse extérieure.

La forme aryuée des pôles répartit mieux le champ magnétique, le rapproche des bobines, ce qui est une condition favorable à la production de courants puissants. Les inducteurs, dans les machines de grande et de moyenne puissance, sont disposés *horizontalement*, ce qui donne de la stabilité à l'appareil. Dans les machines du plus petit modèle, employées plus spécialement pour exciter les inducteurs des machines à courants alternatifs, et représentées précédemment dans *la Nature*, les inducteurs sont verticaux, pour ne pas trop rapprocher la bobine du sol.

La bobine induite présente une assez grande longueur et se compose d'une série de bobines partielles reliées à un collecteur Gramme. Le fil induit ne recouvre que la partie extérieure de la carcasse en fer sur laquelle les bobines sont enfilées. On utilise ainsi beaucoup mieux l'inducteur, l'enroulement des bobines est très simplifié et les difficultés que présente le rentrage de l'anneau Gramme disparaissent complétement.

Dans les premières machines construites en 1875, l'anneau en fer était fixé dans l'espace et placé à l'intérieur de la bobine tournante, mais dans les modèles plus récents de 1875 et de 1876, on a remarqué à cette disposition compliquée pour recevoir à un anneau tournant avec la bobine, ce qui fait remonter la machine Siemens dans le système Gramme, à laquelle elle a emprunté d'ailleurs les collecteurs et les balais.

Suivant les dimensions de la machine, on peut alimenter des lampes donnant de 200 à 800 becs Carcel en un seul foyer, dépensant de 2 à 5 chevaux de force motrice.

En changeant la nature du fil des inducteurs et des induits, on peut, pour une machine donnée, augmenter la quantité et diminuer la tension, ou inversement, suivant que le courant doit avoir de la quantité, comme pour la galvanoplastie et l'incandescence, ou, au contraire, une certaine tension, comme pour l'éclairage électrique et le transport électrique de la force motrice à distance.

Régulateur de M. Siemens. — M. Siemens, de Berlin, a construit plusieurs régulateurs à courant continu. Celui que nous reproduisons (fig. 2), imaginé par M. Hefner von Alteneck, ingénieur de la maison Siemens, est le dernier modèle adopté par les constructeurs en 1876.

La lampe que nous avons décrite dans *la Nature* est destinée plus spécialement aux courants *alternatifs* et à la division de la lumière; celle-ci est *monophote*, c'est-à-dire qu'elle ne permet de disposer qu'*une seule lampe* sur le circuit des machines qui l'alimentent. Le mécanisme reste le même pour les trois types de machines employées; les dimensions seules varient, suivant que l'appareil est appliqué aux phares, à la guerre, à la marine, à l'industrie, etc., et que l'on a besoin de foyers plus ou moins puissants.

Dans ce régulateur à courant continu, le mouvement d'approche des charbons est produit par le poids du porte-charbon positif, qui sert de moteur. Le mouvement d'écartement, au contraire, se produit par un appareil qui n'est autre chose qu'un petit moteur électrique, et dont nous allons examiner maintenant le fonctionnement.

Les organes principaux du régulateur Siemens sont : les deux porte-charbons A et B, un mouvement d'horlogerie animant par le poids du porte-charbon A et dont le dernier mobile est une roue à rochet dont la vitesse de rotation est modérée par une roue à ailettes I.

Le courant de la machine arrive par la borne G, traverse un électro-aimant E, dont on n'a représenté qu'un des noyaux, arrive par le rhéostat R à la lampe au porte-charbon positif A, traverse l'arc et revient à la machine par le porte-charbon B, en garniture isolée, et la borne Z, reliée au pôle négatif.

Au moment où l'on envoie le courant dans la lampe, les charbons sont en contact; le courant est très intense; il attire son armature cylindrique, fixée à un grand levier vertical pivotant autour de Y. Ce levier bascule de droite à gauche autour de Y, et un cliquet Q, fixé à son extrémité, fait tourner la roue I d'une dent en sens inverse du mouvement du charbon, mais à ce moment il se produit un contact en X; le courant traverse alors directement la dérivation de faible résistance produite par ce contact, et l'électro-aimant devient inerte. Sous l'action du ressort P, réglé par la vis B, le levier reprend sa position première; mais alors le contact en X est rompu, l'aimant est actionné de nouveau ; il attire son armature, et le tout se donne de nouveau d'une dent dans le sens favorable à l'écartement des charbons. Il se produit donc ainsi une succession rapide de mouvements, comme dans le tremblement des sonneries électriques, qui ont pour effet d'écarter les charbons très rapidement jusqu'à une distance normale, pour laquelle l'appareil est réglé. Lorsque cette distance est atteinte, le cliquet Q produit l'embrayage et maintient, le cliquet Q produit l'embrayage et maintient le levier en cet état. Alors très près du tient l'écartement. Le levier est alors très près du contact X, et si l'appareil est bien réglé, on sent, en mettant le doigt en N, une sorte de *frémissement* dû à la rupture et au rétablissement du courant, qui est l'indice le plus certain de ce bon réglage. Si l'arc s'allonge, l'armature tend à s'écarter de E et produit le déclenchement de la roue I, ce qui permet le rapprochement des charbons.

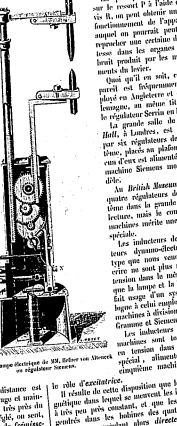


Fig. 2. Lampe électrique de MM. Hefner von Alteneck et régulateur Siemens.

On dispose dans cet appareil de trois moyens de réglage :

1° La tension du ressort P ;

2° La distance de l'armature à l'électro-aimant E, distance que l'on règle à l'aide d'une vis K ;

3° Le contact X, réglé une fois pour toutes par le constructeur d'après la course du levier et la longueur des dents du rochet.

En pratique, en agissant sur le ressort P à l'aide de la vis B, on peut obtenir un bon fonctionnement de l'appareil, auquel on pourrait peut-être reprocher une certaine délicatesse dans les organes et le bruit produit par les mouvements du levier.

Quoi qu'il en soit, cet appareil est fréquemment employé en Angleterre et en Allemagne, au même titre que le régulateur Serrin en France.

La grande salle du *Albert Hall*, à Londres, est éclairée par six régulateurs de ce système, placés au plafond; chacun d'eux est alimenté par une machine Siemens moyen modèle.

Au *British Museum*, il y a quatre régulateurs de ce système dans la grande salle de lecture, mais le couplage des machines mérite une mention spéciale.

Les inducteurs des générateurs dynamo-électriques de type que nous venons de décrire ne sont plus montés en série dans la même circuit tension dans la même circuit que la lampe et le balast, ou bien suivant le système adopté à celui employé dans les machines à division de Lontin, Gramme et Siemens.

Les inducteurs des quatre machines sont donc disposés en tension dans un circuit spécial, alimenté par une cinquième machine qui joue le rôle d'*excitatrice*.

Il résulte de cette disposition que le champ magnétique dans lequel se meuvent les inducteurs est à très peu près constant, et que les courants ne sont pas influencés dans les bobines des quatre autres machines, correspondant alors aux inducteurs, sont entièrement indépendants les uns des autres, sont même beaucoup plus constants que si chaque machine avait son inducteur dans son circuit propre. Les machines fonctionnent alors comme de véritables

24 July 1880

LANTERNE DE DIFFUSION

POUR LA LUMIÈRE ÉLECTRIQUE

Nous avons assisté récemment à de très intéressantes expériences d'éclairage électrique, et nous avons remarqué les excellents effets produits par la lanterne de *diffusion* représentée ci-dessous ; M. l'ingénieur Clémandot, qui l'a inventée, a bien voulu nous écrire sur notre demande la lettre suivante, que nous sommes heureux de publier.

G. T.

Paris, le 9 juillet 1880.

Monsieur,

Je me préoccupe depuis longtemps déjà des moyens à employer pour obtenir une bonne diffusion de la lumière électrique, c'est-à-dire d'utiliser cette lumière qui est tellement intense, si elle n'est pas répartie uniformément, tamisée, *diffusée*, c'est le mot, qu'elle ne donne que des résultats très imparfaits et hors de proportion avec les dépenses faites pour la produire, comme avec son intensité toute particulière.

Les globes opaques employés ont rendu à n'en pas douter de grands services, mais ce n'est pas, on peut dire, par diffusion qu'ils opèrent ; ils deviennent *lumineux eux-mêmes*, et comme ils sont employés sous un gros volume, ils deviennent nécessairement éclairants. Il y a bien, dans ce cas, une certaine quantité de lumière tamisée, mais eu égard à la lumière produite, il n'y en a pour ainsi dire que la moitié d'utilisée, et les expériences photométriques ont prouvé qu'il y avait environ 45 pour 100 de la lumière produite absorbée. La lumière électrique, si coûteuse à produire, est donc à moitié détruite par un accessoire indépendant de la lumière elle-même.

Le principe qui a servi de base à mes recherches, est celui qui préside à la répartition, à la diffusion de la lumière solaire. En examinant cette question, n'avez-vous pas à remarquer que ce sont les nuages placés entre nous et le soleil qui se chargent le mieux de nous répartir sa lumière, de ménager nos yeux, en peut dire, et cela est si vrai, que quand il s'agit de photographie, par exemple, c'est par un temps relativement couvert, c'est-à-dire par la lumière blanche, la lumière diffusée, que cette opération, dans laquelle le soleil se charge d'être notre dessinateur, réussit le mieux.

Le problème à résoudre était donc celui-ci : envelopper la lumière électrique d'une vapeur remplissant le rôle de nuages, c'est-à-dire nous tamisant, nous diffusant cette lumière. J'ai donc enveloppé la lumière, l'arc voltaïque, d'une double enveloppe, dans laquelle j'ai introduit une matière solide, il est vrai, mais tellement fine, tellement ténue, que c'est une substance solide pour ainsi dire vaporeuse. C'est du verre filé par des procédés particuliers qui donnent pour résultats des fils d'une finesse telle que chacun d'eux mesure 6 à 8 millièmes de millimètre, fils qui sont 175 fois plus fins qu'un cheveu et 45 fois plus fins que le plus ténu fil de soie.

Lanterne de M. Clémandot pour l'éclairage électrique.

Les premiers essais de mes procédés de diffusion ont été faits dans les grands magasins du Louvre, grâce à l'obligeance et à la libéralité de leurs propriétaires. J'avais imité un nuage, pour ne pas sortir des habitudes ordinaires, dans des globes en verre de 40 centimètres de diamètre ; mais la pratique de ce mode d'emploi ne tarda pas à me signaler des inconvénients qui ont dû me faire renoncer à cette disposition ; le bain de verre se tassait sur elle-même, et l'introduction de la poussière, se faisant par des interstices, ne tardait pas à la salir. J'ai alors eu recours à cet inconvénient en construisant des lanternes dont les parois sont composées de tubes de 4 à 5 centièmes de diamètre, tubes dans lesquels la laine se place très facilement, et qui, obturés des deux bouts, ne laissent aucune issue à la poussière. La laine une fois mise placée, conserve sa position première et remplit toutes les conditions désirées.

Les avantages de mon procédé sont nombreux ; ils présentent une économie de lumière de plus de 30 pour 100 sur les globes opaques employés ordinairement. L'opacité peut être variée à volonté, puisqu'elle dépend de la quantité de matière introduite, quantité qui peut varier selon les cas. On peut, en colorant les tubes en toute nuance, modifier, absorber à volonté les rayons nuisibles de la lumière électrique. La disposition est en outre très économique.

Vous avez dû tenir des expériences faites par mes procédés, et j'ai pensé qu'il pourrait vous être agréable d'avoir quelques détails, auxquels je joins des photographies de ma lanterne. Cette photographie (voir la gravure ci-dessus) représente une lanterne très élevée, parce qu'elle doit être appliquée aux brûleurs Siemens, qui se placent au haut de l'appareil, au-dessus de l'arc voltaïque. Je n'ai pas besoin de vous dire qu'elle peut être modifiée et adaptée à tous les systèmes producteurs de l'électricité.

Recevez, etc.

L. CLÉMANDOT.

Alternative Electric Light Experiments.

We learn from the *Paper World*, published at Holyoke, Mass., that Mr. H. C. Spaulding, of Boston, who was at first going to put his plans into effect in that city, has gone to Holyoke on account of the cheap power, and has made arrangements with the Water Power Company to put a wheel into their new pit expressly for his use. To make the experiment which he will attempt will require 150 horse power, enough to run a paper mill. A tower about 175 feet high will be built and surmounted by an immense lantern of such power, says the enthusiastic editor, as to put all former electric lights completely into the shade. Mr. Spaulding will put up this tower and apparatus at his own expense, but he hopes to succeed so well that the city will adopt his system. His idea is that by filling the atmosphere above the city with light from several such electric towers he will get the same effect that we do from the sun and its reflected light, and that the shadows will be no darker than those made by the sun. His idea is to fill the stratum of atmosphere just above the city so completely with light that it will permeate spaces which no direct rays reach, just as the sun's light does immediately after the sun has set.

The light which he expects to throw out from one lantern will be equal to 300,000 candles, while the largest electric light yet attempted by any one else has been of but 10,000 candle power. The estimated cost of the apparatus is $15,000, irrespective of any investment for power, but after the system is once in operation the cost of running it, aside from the power, will be small. —*Sci. Am.*

The electric lighting of some portions of the South Kensington Museum during the past few days by way of experiment has been made with it in 160 Swan and in One Hundred Lilmer does not appear to have been very successful. Wilde's machine and lights were tried in the Asphalt Gallery and in one of the Shoeshanks Rooms; and the noise emitted by the lamps was very objectionable, and they had to be discontinued on that account. The Werdermann lamp was the one selected for trial in the Library, worked by a Gramme and afterwards by a Siemens machine, the motive power in each case being a gas-engine; but the results were not satisfactory to Mr. Werdermann, and he therefore suspended the trials until he could get a better arrangement for producing the current. The Werdermann light gave every satisfaction as regards steadiness and colour, but the expense of working, including carbons, was about three times as much as the cost of the gas lighting previously employed. It is said, however—but with what reason we know not—that in the reading-room the cost of gas will be much greater, while

Since Communicated to Patent Office

OUGHT FROM JERSEY.

Mr. Edison was recently called to the fact that New Jersey's great investor is seeking a site on which to locate one of the largest manufacturing establishments in the country. Several localities are offering inducements to him in choosing a place. Dr. Edison will take into consideration the facilities for shipping to all parts of the world, and the probability of securing all the workmen at home—that is, without going to adjacent neighborhoods, as it is desirable to have the employes at all times within easy call. We are told that the number to whom employment will be given will range from 500 to 2,000. Not only the home market but the European will must be supplied from the new factory, the investor having reserved to himself the exclusive right to manufacture the lamps recently patented by him.

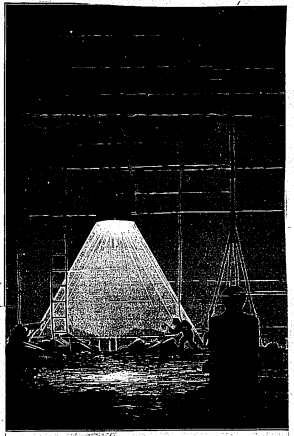
The question for our people to determine is, whether it would be to our interest to at least make an effort to include Dr. Edison to locate his works within our city limits. Our city certainly possesses all the advantages the great investor requires. Even now in his little settlement at Menlo he gives employment to more than a hundred people, but none of these have to find homes elsewhere. The city of Elizabeth is anxious to secure the prize, but we are confident the preference would be given our town if we would show a more liberal spirit. There are several excellent sites near the railroad and canal which would no doubt answer for the purpose. And then it should be remembered that our steamboat company furnishes a cheap and safe means of reaching the New York market, an advantage which manufacturers well understand.

SUBMARINE OBSERVATORY AND ELECTRIC LIGHT.

The accompanying engraving, taken from the *Leipziger Illustrirte Zeitung*, illustrates Bazin's submarine observatory and electric light, which has been found to be of the greatest service in examining wrecks, submarine foundations, etc. It was used for the first time in examining the wreck of the Confederate steamer Alabama, which was sunk off the French coast at Cherbourg. The electric light is contained in a heavy cylinder, about 6½ feet high and about 4 feet in diameter, and provided with a heavy plate glass bottom. The lower part of the cylinder contains alum water to counteract the pressure of the sea water, which increases very rapidly as the apparatus is lowered. The upper part of the cylinder contains a powerful electric lamp, the light rays of which pass through the alum water and the plate glass bottom, and lights up the bottom of the sea for a space about 100 feet in diameter.

Bazin's observatory, shown in the right hand corner of the engraving, is about 9 feet high and 2 feet in diameter. It is provided with two bull's-eye windows through which the person in the observatory can watch the divers that are at work on the wreck. As the water is an excellent conductor of sound the superintendent can converse with the divers very conveniently.

A person can remain in this observatory for about three quarters of an hour, and if any parts should break or leak he can enter the upper helmet and remain in the same from eight to ten minutes, thus allowing ample time to raise the entire apparatus to the surface.



SUBMARINE OBSERVATORY AND ELECTRIC LIGHT.

Electric Light.

We have not recently said much in regard to this subject in our columns, for the reason that for a considerable time very little that is new, or calculated to be new, has been brought to the public notice. Notwithstanding this fact, we are in position to affirm that much activity prevails among inventors of this class of devices.

Although there is an apparent pause in the advance of electric lighting, it is not to be denied that it has already made very substantial progress. The Fuller Electrical Company in Brooklyn is, we are told, working its manufactory to the very utmost of its capacity in the manufacture of lamps, dynamo-electric machines and other appliances for electric lighting. This is, we believe, the present state of affairs in nearly all establishments of this class.

A new machine has been invented by a Newark, N. J., inventor, from which we have heard very glowing reports. We have not as yet seen the machine in operation.

A very large increase in the use of electric lighting has been made this season at the American watering-places. By the aid of these lights bathing is continued during the evening as well as the day-time, wherever the state of the tide permits. The bathing establishments have found their incomes substantially increased by the employment of this new system of illumination.

Abroad, the Jablochkoff candle appears to have reached the highest success. A new electric lamp has been produced by M. Jamin. The Brush light, well known in this country, has been introduced into England, and its use is rapidly extending there.

The Jamin lamp is described as consisting of three electric candles placed side by side, each candle being formed of two parallel pencils, placed in vertical position, and burning from the bottom upwards. The candles are covered by very fine copper wire, which conducts the electric current, and is so arranged that the arc is maintained at the lower end of the pencils. When one candle is burned out, the next is automatically lighted. Each candle is stated to last two hours, and the cost of carbon consumed is about one cent per hour. The Gramme machine, consuming eight horse power and running at 1,500 revolutions per minute, supplies twelve Jamin lights, each of thirty-two candle power.

The Jablochkoff system has been now in use for eighteen months by the Metropolitan Board of Works in London for illuminating the Thames embankment, and it has not missed a single night. This is considered a remarkable success. A twenty horse power engine has sustained as many as eighty of these lights between Blackfriars and Westminster, a distance of over two and a half miles. Only fifty lights are, however, actually used. The expense of this light has been greatly reduced, and a contract has been made for the next twelve months at the rate of five cents per hour for each light, the illuminating power of which is guaranteed to be equal to that of three hundred and seventy-eight sperm candles. The glass globes used with these lights reduce the above named illuminating power to that of two hundred and sixty-five sperm candles. These lights are employed for a period of six hours each night, but this can be extended to eight hours, if desired. The difficulties at first met with in the use of the Jablochkoff light appear to have been entirely surmounted. Large companies are forming in different parts of the world to introduce it, the most notable of which is, perhaps, a Russian Company with a capital of four million dollars.

The Wenderamun light has had its capacity greatly increased by the recent improvements in the Gramme machine. It is capable of greater subdivision than any other known electric light, and is coming into considerable use in Paris for domestic purposes, the supply of electricity being generated at a central point, from which wires lead to the different localities where the light is required. This light produces an illuminating power equal to three hundred sperm candles by the use of only one-half horse power. Thirty lights, equivalent in power to three hundred sperm candles, are maintained by a twelve horse power engine.

It will thus be seen that in the question of economy, as compared with ordinary illuminating materials, a very great advance has been made; not so much in the introduction of new devices, as by a more skillful application of those already known.

The Edison light, which made so great a stir in this country a short time ago, has ceased to be much talked about. The opinion generally prevails that Mr. Edison has failed in his attempts to make any marked improvement in this field.

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EXTENSIVE ELECTRIC LIGHT EXPERIMENTS.—We learn from the *Paper World*, published at Holyoke, Mass., that Mr. H. C. Spaulding, of Boston, who was at first going to put his plant into effect in that city, has gone to Holyoke, especially on account of the cheap power, and has made arrangements with the Water Power Company to put a plant into effect over all expenses for the season. He make the experiment, which he will attempt, will require 450 horse power, enough to run a paper mill. A tower about — 175 feet high will be built and surmounted by an immense lantern of such power, says the enthusiastic editor, as to put all former electric lights completely into the shade. Mr. Spaulding will put up this tower and apparatus at his own expense, but he hopes to succeed so well that the city will adopt the system. His idea is that by lighting the atmosphere above the city with light from several such electric towers he will get the same effect that we do from the sun and its reflected light, and that all shadows will be no darker than are those made by the sun. His idea is to fill the stratum of atmosphere above the city so completely with light that it will penetrate spaces which no direct rays reach, just as the sun's light does overhead after the sun has left us. The light which he expects to throw out from one lantern will be equal to 200,000 candles, while the largest electric light yet attempted by any one else has been of but 10,000 candle-power. The estimated cost of the apparatus is 15,000 dols., irrespective of any investment for power, but after the system is once in operation the cost of running it, aside from the power, will be small. The expense of lighting Holyoke at present, public and private, is estimated at 100,000 dols. a year, and for about this amount the seven towers which are proposed could be set up and the lights put into operation.—*Scientific American.*

It is not likely that the suggestion for lighting Chestnut street by electricity will be adopted at once, but it is worth while to consider the subject. There can be no doubt that electricity will supersede gas for general illumination, especially in the open air, and that before many years. Perhaps about the time that the Gas Trust expires by limitation and the gas works revert to the control of the city the use of gas will begin to diminish; but, however that may be, the city ought to have the best as well as the most convenient street lights that science can supply. Chestnut street now is very badly lighted; it hardly can be said to be lighted at all, except where private enterprise has furnished it the means, and the only square in which the illumination is at all satisfactory is that between Eighth and Ninth streets, which is well lighted by two electric lamps, one at each end of the square. We should say that one lamp at the centre hung over the centre of the streets at each intersection would do the work now feebly attempted by a dozen sickly gas lamps, and it is probable that the cost would not be greater. There are a great many details, however, that would have to be considered, and we should need to consult the experience of foreign cities, where the subject has already received a good deal of attention. Mr. King's resolution will lead to a profitable public inquiry, and the matter certainly is worthy of a careful report.

Progress of the Electric Light Abroad.

The fact that much more publicity is given in England and on the Continent than here to the results attained by the promoters of the electric light has given rise to the impression idea that little is being done here. Such is not the case, however. The applications of the light to the illumination, not alone of large spaces and of places of amusement, but also of factories and mills, are becoming more numerous. It is even rumored that Edison, of whom the public has lost sight entirely, has nearly completed works to test his light on a large scale in this city. The development in this country is steady and encouraging, because it is divested of all attempts to catch public attention by sensational reports.

Abroad inventors are active and capitalists confident. The *Times* announces progress there in an able manner, but falls into the error of underrating the strength of the movement here. M. Gramme, who has done so much to aid the progress of electric lighting, is adapting his well-known dynamo-electric machines to the requirements of the Jablochkoff, the Werdermann, the Dagieff, and other forms of the light. M. Jamin has come forward with a new light, and the Siemens light is said to be more than maintaining its reputation. The Brush light has been introduced into England from this country, and its use is extending. The Jamin light consists of three candles placed side by side, each candle being formed by two parallel carbon pencils held in a vertical position, so as to burn from the bottom. A bank of fine copper wire surrounds the candle and conducts the electric current, and is so arranged that the luminous arc is always kept at the lower end of the pencils. When one candle is burned out the next is kindled automatically. Each candle burns two hours, and the cost of the carbon consumed is but a trifle over a cent an hour. A single lamp would thus burn six hours without requiring any attention, at an expense of not more than 7 cents for material consumed, to which, of course, must be added the cost of generating the current. A Gramme machine, driven by an 8-horse engine at the rate of 1500 revolutions per minute, sustained twelve Jamin lights, each equal to thirty-two candles. It was found that with a machine making 1500 revolutions per minute, and a wire 1-20th of an inch in diameter, six lights could be sustained on a circuit of five-eighths of a mile. By doubling the size of the wire and increasing the revolutions to 2000 per minute, a circuit of ten miles can be operated. This light is in the hands of a French company with a capital of 8,000,000 francs, and one of its founders and directors is a man who is proprietor of about sixty gas works.

The most conspicuous success thus far has been won by the Jablochkoff system. For eighteen months the Societe Generale d'Electricite, in connection with the Metropolitan Board of Works, have maintained the light on the Thames Embankment without missing a single night. The light was recently suspended for a few days for the purpose of cleaning the engines which has been resumed. It was found that a single 25-horse power engine under the Charing Cross bridge could maintain as many as 80 lights between Blackfriars and Westminster, something over 2½ miles. The number of lights in actual use, however, is but 50, extending the whole length of the Victoria Embankment.

Experiments undertaken with a view to reducing the expense of this light have been attended with very gratifying results. The terms of the contract for the next twelve months are at the rate of 5 cents per hour for each light, and the illuminating power of each is equal to 378 sperm candles, but this is reduced by the general glare from 252. The lights burn about 4 hours, but can be burned eight.

The Jablochkoff light has been successfully used for long distances, and on a large scale, the Paris Salon having been lighted by it with 400 lights for two months. A Russian company has been formed, with a capital of $4,000,000, to perfect and apply this system.

A steam engine is being erected in the South Kensington Museum for use in connection with the Brush light. A large court, formerly lighted by 1700 gas jets, is now lighted by eight Brush lights, at a cost of 10d. per hour, a saving of 10s. per hour as compared with gas at the London price of 80 cents per thousand feet. Here, as well as at the British Museum, the great advantage of the electric light over gas consists in the fact that it perfectly harmless and void of danger, while the combustion of gas is destructive to paintings, decorative work, and book bindings. In a large biscuit factory at Bermondsey the light is found to possess the positive advantageage of enabling the workmen to distinguish the most delicate shades of color, a matter of necessity in that business. Brush's brewery is to have the Brush light, and the company are about to erect works in the heart of London, intending to supply the light from a central point over a circuit 10 miles wide.

The Siemens light has been permanently adopted at the British Museum, and is in use on a large scale at the Victoria Docks. The improvements recently made in the Gramme machine have increased the power of the Werdermann light, and its capability of subdivision—in which respect it is said to surpass all other lights—has led to its application to domestic uses on a considerable scale in Paris. The supply of electricity is generated at a central point, and the light is held on by wires wherever required with as much ease as gas. A Werdermann light equal to 300 candles requires the use of only one-half horse power, and a 12-horse power engine will maintain 30 lights, each equal to 300 candles. A notable feature in the progress made by all these lights is in the reduction of operating expenses.

In conclusion, we may add that for therapeutic gas compounds the electric light is losing much of its terrors, not because of a conviction that its competition need not be feared, but because gas manufacturers are becoming sufficiently alive to the fact that there is ample room both for the electric light and for gas. "*M. Jamin has made efforts to convince a number of representatives of the gas interest at Paris of the absence of any danger to its future growth and prosperity.* From the language of one of their number, M. Jordan, it appears that they are beginning to take this view.—*Iron Age.*

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THE MAGNET.

One of the difficulties experienced in bringing the electric light into use is the finding of a suitable shade or globe, which, while diffusing the light, will not absorb more than a slight per centage of the illuminating power. The opal and ground glass globes, with which we have become familiar, absorb from 20 to 50 per cent. of the light produced by the electric arc—a serious loss, which has been tolerated in order to obtain the necessary diffusiveness. M. Clemendot claims to have hit upon a method which supplies the diffusive power with the minimum of loss. He takes his lantern of a number of tubes of clear glass, united at the sides. These are filled with glass wool, which is given in a state of extremely fine threads. The surfaces of these threads reflect the light in all directions, and the tubes, being clear, the absorption of light is reduced to 15 per cent. The opacity can, however, be increased by putting a larger quantity of the glass wool into the tubes, and, what is perhaps more important still, as the new lamp entirely removes the objection to the "lineness" of the light, for either the tubes or the glass wool can be stained so as to yield light of any desired color. //

Sept 15, 1880 //

THE MAGNET.

Before the American Association for the Advancement of Science, on the 31st ult., Mr. E. B. Elliott, of Washington, read a paper on electric lighting, applied to large spaces. He instituted a comparison between the relative cost of the lighting of large areas by illuminating gas and by electric processes, deciding in favor of the latter. He then compared the relative efficiency of the several processes of electric lighting, showing the greater economy of the Jablochkoff candle and of Wilde, the electric arc processes being, in the lighting of large areas, by far the most economical, and the former for the purposes mentioned beyond question. The electric arc and the incandescent processes, however, are not to be considered in the light of rivals, the former being specially adapted for lighting of large areas, while the latter, so far as successful, is designed for interiors, as for domestic and like purposes. He then treated the relative economy of large and small electric lights, showing that the economy of large electric light greatly transcends that of small ones. He discussed the mutual action of electric currents, a knowledge of the law of which has at the very foundation of a mastery of the subject of electric lighting.

Sept 15, 1880 //

THE MAGNET.

A PERSON asks contemptuously in the *Morning Post*, "What has women invented," to which "A Man" replies: "Well, women did not invent herself, the creation of her was reserved for the greatest inventor of all, and she is the most beautiful invention of costly and intricate machinery and mysterious powers, known or unknown. Less fastidious may, but, while man has been doing these things, she has invented the happy home wherein he can rest after his toil, invented the spirit of cheerfulness in that home, a desire to help him over all the rough spots of life; and when worn out with sickness and pain, she has invented that wonderful magic of a woman's touch whereby our pains are relieved, and we are led to bless the day when mankind was given that wonderful and blessed invention, woman." //

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THE MAGNET.

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INTERESTING TELEGRAPHIC ITEMS.

The pneumatic tube system of letter telegrams in Paris now operates fifty miles of piping, from six central stations, where motive power is produced by steam-engines of 153 horse-power. About 400,000 dispatches are sent per month, the average charge being less than ten cents.

Sept 15, 1880

SCIENTIFIC NOTES.

M. THOUVE has been exhibiting his electrical polyscope at the annual meeting of the Physical Society of Paris. It was placed in the stomach of a fish, which suffered no inconvenience, and the electric light rendered its body semi-transparent.

It is well known that if a long dry tube, open at both ends, be held over a jet of burning hydrogen, a musical sound is produced, the pitch and quality of which vary with the length, thickness, and diameter of the tube. It has been proposed to adapt such a tube to a safety lamp underground, in mines, and to place it near a telephone in communication with another in the manager's office on the surface. The alteration of the sound due to a greater or less admixture of gases with the air of the mine would warn the manager of the state of the atmosphere in the working.

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EDISON'S "PERFECT LAMP" PERFECTED.

(FROM OUR AMERICAN CORRESPONDENT.) Aug 31 1878

Another forecast in the matter of electric lighting has been made public, to the effect that Edison has "perfected his perfect lamp" and that he is now about to proceed to secure the actual lighting of New York—or rather a portion of it, "after a) experiment—with his new lamp. Further, he claims that he can furnish the electricity for lighting and supplying electric power less than one-fifth the cost of that used in the light way, and thus at once consign gas companies to the things of the past, to rest upon the shelf in company with the linkboy's torch. Of course we have lately been canvassing the lower business portion of New York, with the object of ascertaining whether the overplussed and citizens would agree to the adoption of motive power and lighting purposes, if Edison were to establish the central station, and the matter seems to be very well settled with the result of the canvass, and satisfactorily, that a sufficient number of persons have pledged themselves to use his system as to warrant the erection of suitable works, and thus the necessary data can be secured. Edison's experiments have been carried on with great secrecy, even, if saving to the gas companies the knowledge of what he is doing, it should be termed to supply electricity for lighting purposes at cost to the people.

When such statements as these appear in the daily papers on your side of the Atlantic, as they sometimes will, you are apt—I should say gas engineers—are very apt to take alarm. I therefore take this early opportunity of writing to put before your readers an account of the so-called invention of Mr. Edison's lamp, which are exciting so much comment here, and I will not be surprised to see how much cause there is for any uneasiness on the part of gas engineers.

The improvements in the lamp are three in number. First, the brancelled, only needed for conducting the carbon incandescence in vacuo of glass, while the "perfect lamp" may clear; second, the globe is a little more than the diameter apart, third, the carbon of the horseshoe is sure of the same thickness as within. Let us consider these in the order named.

First. As to the necessity of a vacuum, or incandescence in vacuo, when compared with a gas flame, and consequently more dazzling to the eye, the light may be a little more trying to the eyes of those who look upon it—to the beholder when it is enclosed in a gas globe. On the contrary, the round glass will discount more light than the clear globe, and thus reduce the light to a degree, at least similar to that of the gas flame. Further the light is more "mellow," whereas the loss of light caused by a ground globe is usually placed at about 15 per cent., the inventor claims two reasons to account for this discrepancy. First, that the electric light being a pure white light the rays therefrom will pass through a ground glass globe in a more truthful tone, while the globe would greatly modify the yellow light), and, secondly, that the heat radiated by a gas flame is so much greater than that from the electric light, that the globe, being of a much smaller area—the light is concentrated by a smaller globe being so small—of reason, it must certainly so be. Now in regard to the first it before it leaves my sight this evening, when one of the great drawbacks to the use of large electric lights has been the necessity of constantly renewing the carbon points, or globes, and the consequent stoppage of the light during such renewal, and that owing to this fact much lighting power is lost. Of the second improvement, as to how that loss of the vacuum globe would also accounts for the diminished heat, I would ask, if the larger area of a gas flame is the larger amount of heat generated, and if the light obtained, the difference between the size of Edison's new globe and the ordinary gas globe is not sufficient to account for the loss of heat, for gas globes were 8 inches in diameter. Besides there is another thing to be noted in comparing the ground glass globe with the clear globe. In the former instance all the light has to pass through the globe, while in the latter case a good deal of the light which is reproduced by the globe, passes through the lamp itself, and thus the light is not lost. Again, the ground glass globe, a great gain, the light globe will be increased in power—as of great service.

The third improvement is of some value, if it does what the inventor claims for it, viz., that the carbon will not burn away. It will be remembered that in the carbons before forming the loop was of greater breadth than thickness, so the light was not lessened as the carbon burned away, but it was better to be forming a regular electricity for carbons have never stood to what figures the purveyors of the electric will not consume more than about a quarter of a mile square, but I suppose to chiefly with office-buildings, hotels, and the like. In the former instance the buildings stand, it used to run passenger-elevator engines and other various kinds of work, but chiefly for lighting purposes. The latter is chiefly with office-buildings, hotels, and the like. In the former instance the buildings stand, it used to run passenger-elevator engines and other various kinds of work, but chiefly for lighting purposes. The latter is chiefly with office-buildings, hotels, and the like. In the former instance the buildings stand, it used to run passenger-elevator engines and other various kinds of work, but chiefly for lighting purposes. So I do not think the new move will meet with a great deal of success, even if the attempt is made. However, the inventor's plans, as before intimated, is to supply the motive power, and the light, by the 16-candle lamps, and give the light as a part of the rent. It is stated that almost all the light used in the section—except that burned in the houses of which he makes no mention—is that used in the daytime, by dark editors, &c., as he would have to provide the power, to supply the engines of 50 horse power.

Of course all figures connected with the Menlo Park are almost valueless for purposes of comparison, as they are not to be taken alone. The smaller power of the new lamps is placed at 16 candles, an improvement, according to the inventor's own figures, of 4 candles in the new lamps. Edison's estimates for running the same will be sold at 25 cents. Edison's [illegible] will last with ordinary care about six months. The number of lamps mentioned per horse-power is given as 8, the plant necessary to supply 800 lights being as follows:—

	Dols.	C.
100 horse power engine with one large generator . . .	4000	00
Boiler, &c., &c.	1600	320
Total	5600	1120

The gas plant necessary to supply 800 lights is placed at from 7000 to 10,000 dols., and buildings are presumably left out in either case, while the cost of maintaining the gas plant is to the consumer—or perhaps better users—provides are to be offset by the gas companies meter.

In fact, Edison claims that where a gas company would spend 1,50.74 cents (Rs 2125), a gas company would have to pay 2 dols. (Rs.) Now had the inventor did not stretch it a cent, and make the former figure 1 dol. 72 cents?). Manifestly the cost of his plant is too low. I doubt very much that the plant mentioned could be procured for the amount mentioned. It is unnecessary to look to its author, as the apparatus would have to be in duplicate—amounting to 11,200 dols. (22,240), which, when compared with the inventor's highest estimate of 5600 dols., leaves a loss of 5600 dols. (11200). Then, does not show a very great saving in favour of the price of his plant. A little further consideration will show how much larger the capital of an electric lighting company must be over a gas company's, more even than intimated in the foregoing figures, because while the gas company will need to have works scattered all over the city, in many cases having two or three on different sides, the electric company can build where land is cheap, and at a distance from the centre of business, and thus save the enormous cost of gas-mains, as they would have to be of large size, and, of course, entered in pairs.

But it is a waste of time to attempt to form any comparison between which system of lighting would the cost of gas; and it is necessary, as the public at large are interested in the matter, that a public test should be made, or however great the saving effected by the electric light, however unsightly fixtures can possibly do with its light, that consumers are slow to lose. For, even where the electrical apparatus is to be had, the accident should occur in the machinery the lights would probably go out before the extra engine could be brought into action, which with gas there would be no danger. Then, again, as that if anything goes wrong in the works the light would be maintained. Again, as Edison proposes to make his profit from supplying the electricity, he would naturally run his conductors only where he could get a large number of customers for his engine; consequently it would only be a limited portion of each city where he could at all interfere with gas companies.

In truth the his latest move shows the utter weakness of his case; and here, fortunately, I take, as a matter of existing the price of the Edison Company's stock, or gas as a preparatory step to giving up all intentions of introducing his system in this city, and I am sorry for the gentleman. He is certainly very enthusiastic as to what is now accomplished in revolutionizing the railway system, through the supplanting of steam motive power by the introduction of his electrical engines; but it does not seem within my province to enter into details on this head, suffice it to say, I am sorry that locomotives will be placed aside, like gas companies, in a very few years.

THE ELECTRICIAN.

Electric Lighting at Glasgow.—The Exhibition of Gas and Electric Lighting Apparatus at Glasgow will be opened on September 28th, and continue till October 26th. Sir William Thomson's name appears on the list as a vice-chairman. Besides the manufacture of coal gas, oils, and candles, there will be a section devoted to electricity, its generation, and application to purposes of lighting, heating, telegraphy, and motive power, &c. Photometric apparatus for indicators, illuminated buoys, and many other miscellaneous articles will be displayed. It is to be hoped that makers of electric lighting apparatus will seize the occasion and make a good show of their productions. A side by side comparison of this kind is the best answer to the carping criticism of gas supporters on the merits of electric lights.

The Electric Light in Brussels.—The national *fête* at Brussels has been the occasion of a fine display of electric lighting in the Belgian capital. There are many boulevards and buildings in the little Paris permanently lighted with Jablochkoff's candles; but on the night of the special illuminations many thousand lamps were blazing. The magnificient theatre, which is believed to be the largest in the world, was splendid with the brilliant globes, and the front of the Gare du Nord in particular presented an enchanting spectacle. All the outlines of the architecture were picked out with ordinary gas jets, and between these on the windows, doors, and arches were placed a great number of globes of various colours enclosing electric candles. These paint-coloured globes, some green like emeralds, others deep red like rubies, and some of sapphire blue, glowed like Aladdin's gems, and made a rich effect. Even in Belgium fairs the enterprising mountebanks and hucksters-have adopted the electric light in preference to the naphtha vreuset. Is not this enough to make the Billingsgate fishmongers blush?

The Electric Light at the South Kensington Museum.—Major Russell, R.E., who is entrusted with the charge of the buildings of the South Kensington Museum, gives the following account of the experiments of last year with the electric light:—Arrangements were made in the early part of the year with the British Electric Lighting Company for trying a Wilde's machine and lights in the Raphael Gallery and one of the Sheepshanks rooms. The machine was worked by the gas engine purchased in the preceding year. The trials, however, were discontinued after a short time, on account of the buzzing noise emitted by the lamps, which was found to be very objectionable. The promotors expected to be able to overcome this difficulty, and it was intended to have some further trials when this should have been done; but before long the company was wound up,

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Lamps for the Electric Light.—M. L. Cimandot suggests the use of spun glass as an effective method of securing the diffusion of the light. He would surround with double glass globe, between which is placed the spun glass. Experiments have been successfully made at large warehouses of the Louvre at Paris.

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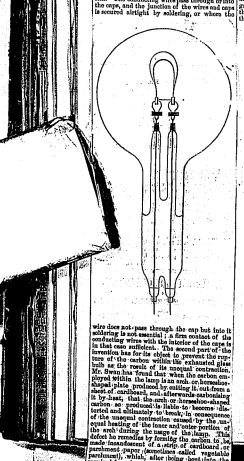
and no further trials were made. It was found from the trials that two lamps lighted one of the Sheepshanks rooms, in which the consumption of gas is 600 feet per hour; and that six lamps gave sufficient light for the Raphael Gallery, usually lighted by a consumption of 1,800 feet of gas per hour. Apart from the noise, the light was generally satisfactory, though the lamps required rather better adjustment to make them burn satisfactorily, and to enable six of them to be properly worked by the gas engine. This better adjustment could no doubt have been effected with care, but it was not thought advisable to continue the trials with this view as long as the great defect of the noise remained. As regards cost, the motive power and carbons for this light were found to cost 2s. 6d. an hour for the Raphael Gallery, against a cost of 6s. 6d. an hour for gas. No determination of the probable cost of wear and tear of the machinery, &c., could of course be arrived at from these limited trials, but the saving of 3s. 10d. an hour, or nearly £140 a year, would certainly be ample to cover this cost, as well as the interest on the outlay for the machinery. At a later period Mr. Werderman, the inventor of another form of electric lamp, lent some of his lamps for trial to the Art Library. They were worked by a Gramme machine hired for the occasion, and afterwards by the Siemens machine, the motive power in each case being the gas engine. Neither of these machines however, gave results satisfactory to Mr. Werderman, and at his request the trials were discontinued until he could get a machine made which he believed would answer his purpose better. He has not, however, resumed the trials as yet. The Reading Room was satisfactorily lighted by these lamps. The light was steady and of good colour, and the amount of heat given out by them being imperceptible, there was a favourable contrast to the gas lighting, which makes the room very hot. There were no signs of the evolution of any noxious vapours, but this is a point which will require further investigation. Eight of these lamps were used in the Art Library, but the best results were obtained when seven only were used at one time. They were placed at the same height above the tables, about five feet, as the gas lights, and the consumption of gas in the lights which they replaced is at the rate of about 6d. an hour. The gas consumed in the gas engine which worked the electric lights cost about 10d. an hour, and the carbons about 8d., so that these two items alone cost three times as much as the gas lighting. It must be remembered, however, that in the new Reading Room, which will be nearly 25 feet high, it will be necessary to have the gas lights more than five times as far above the readers' tables as they are in the present room. The consumption of gas in proportion to the number of readers will therefore be largely increased; but there will be no corresponding increase in the number of electric lamps, which may be as near to the tables as they were in the above-mentioned trials, and therefore the cost of gas, and of even the Werderman electric light will not be much greater than that of gas in this case, and in every other point the advantages will be with the electric light. Mr. Redman Green 9,224,000 cubic feet of gas were consumed, costing £941 10s. 1d.

English Mechanic Sept 10 1880

SWAN'S ELECTRIC LAMP.

THE annexed engraving we illustrate one of the electric lamps patented by Mr. Swan, of Newcastle-on-Tyne. It is a first view of his multiple carbon lamp, in which there are five lamps rendered incandescent by the passage of the current; but in the ordinary lamp there is only one carbon filend. The invention, it will be seen, resembles Edison's in principle, but the first part of Mr. Swan's has for its object the prevention of the cracking and leakage of the glass bulb or globe usually caused in consequence of the heating of the carbon filament or conducting wire, which when strongly heated melts the glass globe, causes it to crack and leak at or near the junction of the wires and glass. The means used is the employment of a pair or cups of platinum as an attachment to the lamp globe, or a tube proceeding from it at the place where the conducting wires enter the lamp inclosure. Each cup is attached by the fusion of the glass around its rim. The conducting wires pass through or into the cups, and the junction of the wires and cups is secured airtight by soldering, or when the



latticures, or an alloy of platinum and tellurm attached to the conducting wires, which pass through or into the cups. The third part of the invention has for its object the prevention of the evolution of gas occluded by the conducting wires within the lamp. Mr. Swan accomplishes that by coating the conducting wires within the lamp with glass or enamel. Mr. Swan claims as his invention the use of cups of platinum fixed to the glass of the lamps as a means of preventing the cracking of the glass by the heating of the conducting wires. Second, forming carbons for incandescent lamps, that is to the manner described, in which a strip of paper or card bent to the required form is carbonized by heat, and then it is held in a vessel containing charcoal or other form of carbon in powder. Third, forming the carbon for incandescent electric lamps by carbonising vegetable parchment of the required form, in the manner described. Fourth, employing several carbon anthes in each lamp, as described. Fifth, preventing the evolution of gas occluded by the conducting wires within the lamp, by coating the conducting wires within the lamp with glass or enamel.

Patentee Swan Sept 1 1880

IMPROVEMENTS IN THE PRODUCTION OF THE ELECTRIC LIGHT.

By F. H. VARLEY.

THE author describes how he has divided the electric light. In place of carbon points he uses tinuous columns of finely powdered graphite or carbon, continually renewed. One method—this powder falls from a platinum or iridium funnel like the sand in a sand-glass. The electricity passing in the direction of the falling particles. The falling stream of carbon is in a closed vessel in a vacuum or in carbonic acid atmosphere. By altering the carbon dust with lamp black, gravel, etc., the resistance may be varied. In production of the current an arrangement which seems somewhat like a Heimsholt's coil is employed. He also describes the use of a battery to work a magneto machine to drive a Holtz machine, and from this the supply of electricity is obtained.—*Society of Arts Journal*, Electrical Number.

Abstract of a paper read before the Royal Society of Edinburgh by James Blyth, M.A., F.R.S., on May 3 1880.

IRON Sept 10 1880.

THE JAMIN ELECTRIC LIGHT.

THE Jamin system of electric lighting, particulars of which have already been given by us, was recent meeting of the British Association at Swansea, by the Comptoire Générale d'Eclairage Electrique of Paris. In the pavilion in which the exhibition and soirees were held, and which is 180 feet long by 140 feet wide, were eighteen lamps suspended from the roof. These lamps were mounted in three different circuits of six lights each, and six more lamps, mounted in a fourth circuit, were distributed as follows:—Two lamps at Mr. Glenge Heand's saw yards, situated at a distance of about 200 yards from the pavilion; two lamps on the walls where the various appliances used in connection with the Jamin's system, and the lamp itself, were exhibited and demonstrated by Mr. J. A. Berly, C.E., the representative and engineer in the country of the Compagnie Générale d'Eclairage Electrique, and under whose immediate superintendence the whole of the plant for electric lighting was erected and fixed; one lamp over the principal entrance, and two lamps inside the pavilion, lighting the approaches leading to the main entrance. The electricity for the current was raised by two self-exciting Gramme dynamo-electric machines, capable of feeding from four to sixteen lights each, but arranged to feed twelve each. The Gramme machines were driven by the steam-engine of Mr. Heand's saw mill; and who kindly lent the steam-power for the occasion, and also the services of its foreman and staff. The engine is an horizontal single cylinder of 20 horse-power, and manufactured by Messrs. Charles Foote, of Millwall, London. The light attracted great attention and proved very successful as an illuminator.

Printed Telegram Sept 10 1880

Swan Electric Light for Light-Houses.

THE Light-House Board of the United States Light-House Board is valuable in containing some useful information respecting the comparative merits of the several forms of the electric light, and of the several appliances that have been devised for producing it. The report on this topic discusses, (1) the modes of producing electric illumination, (2) the instruments for producing electrical currents, and (3) the results of measurements of luminous intensity.

Respecting the first category, the report notices three modes of producing electric illumination; (a) by the electric arc, (b) by ignited conductors, and (c) by incandescent gases. Respecting the electric arc, the report commends upon several objections attending its use. It is unsteady; and the carbon poles wear away and are gradually consumed; and the point is made that while very ingenious regulators have been devised to overcome the troubles and inconveniences arising from these causes, they cannot control the accidental variations in the structure of the carbon poles, which causes them to wear away unequally, and by reason of which the arc shifts its position, giving rise to frequent and often considerable variations in the intensity of the light that it emits.

The report refers to certain observations on this point, from which it appears that variations in luminous intensity from this cause were noticed, within a few minutes, of from 400 to 2,000 candles. The remark, however, is appended, as a qualifying clause, that "since the great improvements recently made in the homogeneity of the carbon poles, and in the regulating machinery, and since the introduction of reflectors, the electric arc is no longer too unsteady for practical purposes."

On the production of the electric light from incandescent conductors, the report is decidedly unfavourable. It affirms that this method of producing electric illumination is open to the grave objections of great wastefulness of "energy (and consequent costliness) and the rapid destruction of the conductors by disintegration. A current, for example, that would furnish an electric arc of from 1,000 to 2,000 candle-power, would not generate a light of more than 50 to 100 candle-power with platinum wires, and the platinum soon becomes brittle and broke up. Better results were obtained with carbon rods placed in exhausted glass tubes, but the carbons soon disintegrated. The report is unfavorable to lamps of this class, and the fact is worthy of notice, that the experiments upon which the conclusions just stated were reached, antedate those of Mr. Edison which lately attracted so much attention.

Respecting the practicability of subdividing the electric current, which is one of the indispensable principles of any system of electric lighting adapted for domestic uses, the report gives some interesting and suggestive figures of the great loss of energy which such division necessitates. A current of given strength, for example, when concentrated on a single lamp, gave a light of 66 gas jets (of 16 candles each); when divided between two lamps, the light was reduced to 24 each; among three lamps, it gave 14 gas jets each; among four, 8 each; and among five, 4 each.

The report also describes and explains the action of 17 magneto-electric machines, and gives the results of a number of comparative tests of the economy and illuminating power of some of the best known of those machines and lamps.

GAS, CANDLE, AND ELECTRICITY.—It is not generally known that the first to find out the exceptional advantages of carbon cut from the retorts of a gasworks in producing the electric light was Mr. Golding Bird. In a letter to the *Philosophical Magazine* for January, 1838, describing his new induction coil, he expressly states that he gets the most brilliant sparks from electrodes of this material.

ELECTRICIAN, SEPTEMBER 11, 1880.

SWAN'S LAMP.—At the time Mr. Edison brought out his lamp, it was stated that Mr. Swan of Newcastle had long ago tried a similar plan, and found it a failure. He states, however, that he has now succeeded in devising a plan to keep the incandescent matter intact. It is to exhaust the containing vessel to a high degree, at the same time raising the carbon to as high or a higher temperature if possible than it is likely hereafter to be subjected. Whilst in this incandescent state the exhausted containing vessel is hermetically sealed. This operation is said to obviate the failure of the carbon by disintegration.

BURTON-ON-TRENT.—Messrs. Bass and Co. have introduced the electric light into their extensive premises at Burton-on-Trent. There are at present twenty-one lights, worked by a Brush dynamo-machine, the whole supplied by the Anglo-American Electric Light Company. The machine is driven by a 10 horse-power portable engine. Two rooms—the cask office and the square room—are fully lighted by electric lights, whilst other parts are only partially lighted. Hitherto the cask room has been lighted by thirty-five gas lights, and these are replaced by two electric lamps. Mr. Bass is reported to be fully satisfied with the experiment.

ELECTRICIAN, SEPTEMBER 11, 1880

ELECTRIC LAMPS.—Mr. Patrick Drew, of Brooklyn, has patented what he considers to be an improvement in the Edison lamp. He constructs his vacuum chamber and sealing tubes in such a manner that the tube is closed round the wire at the point best subject to expansion and contraction, and arranges that at the point of maximum expansion and contraction the wire is practically free without affecting the glass. Mr. Drew evidently does not understand the difficulties to be overcome before a vacuum lamp will become commercially possible. Let him devise a non-disintegrating material for the burner, and then perhaps his plans may be thoroughly considered.

Electric lighting has been having a trial along the harbor front of Montreal, and it is pronounced a success. The system in use is the Brush-dynamo electric machine, working a single circuit of 14,000 feet or 2½ miles in length, on which are arranged twenty-one lamps, any sixteen or lesser number of which may be used at once on such wharves as vessels desire to handle cargoes during the night, the remaining lamps being simply switched out as a pendulum may be turned off. The length of the district covered by the lamps is 1 1-32 miles, and the wharf frontage, including piers, is 9,100 lineal feet, or nearly one and three-fourth miles over which the light of the sixteen lamps may be distributed as desired.

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Gas and Water Notes.

ANSWERS TO CORRESPONDENTS.

C. A.—The price of the South Metropolitan Gas Company—p. per 1,000 cubic feet—is the interest on their debenture stock.

INQUIRER.—Messrs. Crosby, Lockwood, and Co., of Stationers' Hall-court, publish a work on Gas Meters.

The Jamin Electric Light.—This system of electric lighting, particulars of which have already been given in *The Metropolitan*, was exhibited for the first time in this country on the recent meeting of the British Association at Swansea, by the Compagnie Générale d'Eclairage Electriques of Paris, and, as was of course to be expected, much interest was evinced in the experiment. In the pavilion in which the exhibition not above were held, and which is also lit from top by 120 foot wide, eighteen lamps were suspended from the roof. These lamps were mounted in three different circuits of six lights each, and six more lamps, mounted in a fourth circuit, were distributed as follows:—Two lamps at a sawmills, situated at a distance of about 250 yards from the pavilion; two lamps on a mast, where the various appliances used in connection with the Jamin system, and the lamps itself, were exhibited and demonstrated by Mr. J. A. Berly, C.E., the representative of the company; the pavilion, lighting the approaches leading to the main entrance. The electric current was produced by two self-exciting Jamin dynamo-electric machines, capable of feeding from four to sixteen lights each, but running for twelve each. The Gramme machines were driven by the steam-engine at the saw-mills, the proprietor of which had kindly lent the steam-power for the occasion, as well as the use of his premises and staff. The engine employed was an horizontal single cylinder of 20-horse power, manufactured by Messrs. Charles Powis, of Millwall, London. Of the practical result of the trial we are not able to speak in very positive terms, not having been afforded an opportunity of judging at on the occasion, but we are assured by those who were, and whose opinions on such a subject we certainly consider worth having, that the success of the light as an illuminator was most decided. We are exceedingly pleased to hear that the exhibition proved so successful, and we trust that before long the metropolitan public will have an opportunity of judging for themselves of the merits and value of the system.

Electric Light.—If any one doubts the applicability of the electric light for trading purposes, let him visit the Coffee Palace Company's establishment under the Royal Exchange in the City, there he will see any day two or three hundred people dining, in what would otherwise be called a large vault, but properly decorated, and lighted by electricity, as as light as day, and perfectly free from heat or unpleasant smell.

Progress of the Electric Light Abroad.—The Mid-Kent Telephone Company has given its England and on the occasion there, how is the results attained by the promoters of the electric light, has given rise to the erroneous idea that little is being done here. Such is not the case, however. The applications of the light to the illumination of mines, to the spaces and of places of amusement, but also of factories and mills, are becoming more numerous. It is even rumored that Edison, of whom the public have lost sight entirely, has nearly completed work to test the light on a large scale in the city. The development in this country is steady and satisfactory, because it is divested of all attempts to catch public attention by sensational reports. Abroad inventors are active and industrious enough. The *Times* summarizes progress there in an able manner, but falls into the error of underrating the strength of the movement here. M. Gramme, who has done so much for all the progress of electric lighting, is adapting his well-known dynamo-electric machine to the requirements of the Jablochkoff, the Werdermann, the Rapieff and other forms of the light. M. Jamin has come forward with a new light, and the Edison light is said to be more than realizing its promises. The Brush light has been introduced into England from this country, and its use is extending. The Jamin light consists of three candles placed side by side, each candle like being 18 inches long. The carbon pencils held in a vertical position, so as to touch the bottom. A pair of fine copper wire surrounds the candle and conducts the electric current, and it is arranged that the junctions are always kept at the lower end of the pencils. When one candle is burned out, the next is kindled automatically. Each candle burns two hours, and the cost of the whole apparatus is but a trifle over a cent an hour. A single lamp would thus burn six hours without requiring any attention, at an expense of not more than seven cents for material consumed, to which, of course, must be added the cost of generating the current. A Gramme machine, driven by an eight-horse engine at the rate of 1,500 revolutions per minute, sustained 12 Jamin lights, each equal to 32 candles." It was found that with a machine making 1,200 revolutions per minute, and a wire one-twenty-sixth of an inch in diameter, the lights could be sustained on a circuit of five-eighths of a mile; by doubling the size of the wire and increasing the revolutions to 2,000 per minute, a circuit of 10 miles could be maintained with the same light. The Gramme is a French company with a capital of 8,000,000 francs, and the name of Gramme, the inventor is a man who is proprietor of about 60 gas works.

The employees exceeds than for has been won by the Brush machine during the 18 months for the Consolidated Electricite, in contract with the Metropolitan Board of Works, have maintained the lights on the Thames embankment without missing a night's light. The lighting was recently suspended for a few days for the purpose of cleaning the engine, which has been running. It was with a single horse-power engine under the Charing Cross bridge could maintain as many as 80 lights between Blackfriars and Westminster, something over 2½ miles. The number of lights in actual use, however, is but 50, extending the whole length of the Victoria Embankment. Experiments undertaken with a view to reducing the expenses of the light have been attended with very gratifying results. The terms of the contract for the next 15 months are at the rate of 5 cents per hour for each light. The actual power of each is equal to 978 sperm candles, but this is reduced by the ground glass globes to 750. The lights burn six hours, but can be burned eight. The Jablochkoff light has been successfully used for long distances and on a large scale, the Avenue Opéra having been lighted for 1½ mile with 400 lights for two months. Experiments have been made with Edison's system, and the results are highly satisfactory. The Edison light is said to be more than realizing its promises. The Brush light has been introduced into England from this country, and its use is extending. The Jamin light consists of three candles placed side by side, each candle like being 18 inches long. The carbon pencils held in a vertical position, so as to touch the bottom. A pair of fine copper wire surrounds the candle and conducts the electric current, and it is arranged that the junctions are always kept at the lower end of the pencils. When one candle is burned out, the next is kindled automatically. Each candle burns two hours, and the cost of the whole apparatus is but a trifle over a cent an hour. A single lamp would thus burn six hours without requiring any attention, at an expense of not more than seven cents for material consumed, to which, of course, must be added the cost of generating the current. A Gramme machine, driven by an eight-horse engine at the rate of 1,500 revolutions per minute, sustained 12 Jamin lights, each equal to 32 candles." It was found that with a machine making 1,200 revolutions per minute, and a wire one-twenty-sixth of an inch in diameter, the lights could be sustained on a circuit of five-eighths of a mile; by doubling the size of the wire and increasing the revolutions to 2,000 per minute, a circuit of 10 miles could be maintained with the same light. The Gramme is a French company with a capital of 8,000,000 francs, and the name of Gramme, the inventor is a man who is proprietor of about 60 gas works.

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months. The Anglo-American Company has been formed, with a capital of £1,000,000, to purchase and apply this system. On sixteen engines is being erected in the South Kensington museum for use in connection with the Brush light. A large court, now lighted by 1,700 gas jets, is now lighted by eight Brush lamps, at a cost of 1s. 8d. per hour, a saving of 10s. per hour as compared with gas at the London price of 60 cents per 1,000 feet. Here, as well as at the British museum, the great advantage of the electric light over gas consists in the fact that it is entirely odorless and void of danger, while the combustion of gas is destructive to paintings, decorative work and bookbindings. In a large biscuit factory at Bermondsey the light is found to possess the peculiar advantage of enabling the workmen to distinguish the most delicate shades of color, a matter of necessity in their business. Shoreditch is also to have a Brush light, and the contract is about to be let for the lighting of Leeds, intending to supply the light from a central point over a circuit of 10 miles with. The Siemens light has been permanently adopted by the British Museum, and is in use on a large scale at the Victoria docks. The improvements recently made in the Gramme machine have increased the power of the Werdermann light, and its capability of subdivision—in which respect it is said to surpass all other lights—has led to its application to domestic use on a considerable scale in Paris. The supply of electricity is generated at a central point, and the light is had on by wires wherever required with as much ease as gas. A Werdermann light equal to 300 candles, requires the use of only one-half horse power, and a four-horse engine will maintain 20 lights each, equal to 300 candles. A notable feature in the progress made by all these lights is in reduction of operating expenses.

In conclusion, we may add that for European gas companies the electric light is having much of its terror, not because of a conviction that its competition must be feared, but because gas manufacturers are becoming confident that there is ample room both for the electric light and for gas. M. Jamin has made efforts to ascertain the views of representatives of the gas interest at Paris of the absence of any fear of the electric light, and from the following language of one of its number, M. Jordan, it appears that they are inclined to take that view.—*Iron.*

Metropolitan Gas Meter Inspectorate.

Appointments to the Metropolitan Gas Meter Inspectorate are announced by the Salt Lake Tribune of the 12th inst. that the Walker Bros. of that city have contracted to construct the largest of the Brush electric light for one of the largest sand machines with 14 lights, with which they will illuminate their quartz mills at Walker-ville, Montana. The mills will be employed about the works as follows: seven will be used in the large mill, four in the small ore, one in the hoisting works, and two will be placed at the lights in the dumps. The motive power afforded by this number of lights will enable the men to work at night as well as in the daytime, while the expense will be less than that of the present lights. It will be the first instance of the employment of the electric light in America.

Electric Power for Domestic Lights.

A Frenchman, Gaulard, has devised a plan for reducing the glare of electric lights, which he claims to be much more economical than ground glass globes. He makes his lantern of glass tubes filled with finely spun glass threads or glass wool. By reflection from the glass threads the light is given the desired diffusion, with a loss of illuminating power not exceeding 10 per cent, against 30 or 40 per cent with opal or ground glass. The natural blueness of the electric light can be corrected by tinting the glass tubes or the inclosed wool.

Electric Lighting.

Mr. Thomas Parkinson, has devised a simple for obtaining a constant current of electricity, under the varying degrees of electric lights, which he claims to be much more economical than ground glass globes. He makes his lantern of glass tubes filled with finely spun glass threads or glass wool. By reflection from the glass threads the light is given the desired diffusion, with a loss of illuminating power not exceeding 10 per cent, against 30 or 40 per cent with opal or ground glass. The natural blueness of the electric light can be corrected by tinting the glass tubes or the inclosed wool

parties. Indeed the device acts as the regulator does on a steam engine. If the carbon feeds too fast it checks it; if too slow it hastens it. It is in constant[illegible] to have the machinery and light on at the[illegible]ition at the depot to-morrow evening from 7 to 8 o'clock, and possibly later, if practical assistance that may[illegible]ed to secure steam power to operate the generators. The Ralgate Theatre extension is to arrive here at 7, and remain until 7:45, and will be accompanied by a[illegible]ht car, which will be run over the depot the light that hour is very slight, within the depot the light will produce a strong glimmer on the rails, and will show[illegible]ower, or even to contend with daylight, and serve a very[illegible]ortunity to the reception of the excursionists.

Several of the Sacramento[illegible]ave already been ordered for use in hydraulic mines, and it would seem, therefore, from this very practical statement that Sacramento is indeed to enjoy the credit of the solution of the electric light problem.—*Sacramento (Cal.) Record-Union.*

Oct. 4, 1879.

THE METROPOLITAN.

Electric Lighting at the New Docks.—A most important and interesting trial of the electric light as a means of illuminating the open spaces and quarters of warehouses took place on Monday evening last at the Royal Albert Dock at Silvertown, which, it will be remembered, was formally opened by their Royal Highnesses the Duke and Duchess of Connaught in June last. Some short time since, we alluded at considerable length to the preparations that were then in progress for the employment of this mode of lighting at the new dock, and in view of the extensive scale on which it was evident from the first that the trial would be made, the first lighting up by this means was anticipated with very great interest. As a natural consequence, there was at Silvertown on Monday evening a large gathering of scientific and other gentlemen interested in the subject. The subjoined account of what was seen and learned by those who had an opportunity of being present on the occasion has been furnished to us, and we would direct the particular attention of our readers to what is therein stated. It is for such purposes as this of all others that the electric light is likely to be found most suitable, and we observe, with considerable pleasure, the success of the experiment.

It will be remembered that the Royal Albert Dock is an extension, and a gigantic one, too, of the Royal Victoria Dock at Canning Town, consists of an entrance lock at Galleons Reach, approached from the Thames by a new impounding basin. The entrance lock is 1,000 in length, and opens into a tidal basin, having a water area of 32 acres. The tidal basin is 1,400 long by 1,000 in width, and has a water area of 72 acres. Attached to the east side of the tidal basin, and on its southern side are two impounding docks, one 2,600, and the other 500, in length. The whole of the entrance area, which is about a mile and three-quarters in length, is now electrically lighted by **46 lamps on the Siemens system. To the Siemens are fixed** four generating stalkes of machinery-houses, two of which are placed on the north and south sides of the north basin, near its junction with the entrance basin, and two more in similar positions at the western end of the impounding basin. In each of these engine houses are placed two nominal horizontal steam engine, which, together with a boiler of the same power, are supplied by Messrs. Marshall, Sons, and Co., of Gainsborough. The generating apparatus at each station consists of seven Siemens machines, each of which is of 16 lights, each of which is of 2,000 candles power, so that the total light, and from which a very powerful light is emitted. Of these lights, two are placed at the pier-heads, two on either side of the entrance lock, three around the tidal basin, while in rows on either side and on the south side of the main basin and entrance are placed the remaining 36 lights. Additional lights will eventually be placed above a clock tower at the western end of the basin, which tower has yet to be erected. The lamps are so distributed as to secure the best illumination at the dock gates and entrance bridges, and to afford sufficient light for the guidance and carrying on of the traffic along the quays and on the dock pathways. The lamps are hung from the stations to the lights are partly carried on lattice-work poles and partly conveyed underground in the form of cables. As the distances between the lamps and the generators vary from 1,100 to 1,400 yards, and the thickness of the leads has been selected with a view to compensate as much as possible for this difference and thus to equalize the intensity of the light. The Siemens regulators are enclosed in lanterns, which have been expressly designed to protect them against the weather, and they carry carbons of sufficient length to allow for 10 hours' consumption. Arrangements are made to admit further extension of the light space, power being reserved for supplying a small number of lights from each station, or up to[illegible] all. Such, in general terms, are the arrangements of this most recent example of electric lighting, which, simply regarded as a mechanical[illegible], is, perhaps, the largest yet attempted. The visitors included the chairman of the Dock Company, Sir George Chetwynd, the director, Colonel Strahlenie, the general manager, and many others. They proceeded to the new Royal Victoria Eastern Railway from Liverpool-street, and on arriving in the Royal Albert Dock, soon after 9 o'clock, were conducted to one of the sheds on the north side of the dock, which was lighted by electricity in order to show what could be done in the way of internal electrical illumination. This shed, which is 300 ft. long by 120 ft. wide, was lighted by means of eight small lamps, worked by a single electro-current machine, which, with its exciter, was placed in No. 3 electric-light station, close by. The shed was simply lighted—perhaps a little too fully—and during the evening the lights were very steady. Alongside the quay outside this shed lay the *Calvados*, a vessel belonging to the Orient line of steamers, and which had arrived that evening, and was the first vessel docked by the aid of the electric light, her docking having been most successfully performed. In the shed were some of the passengers and their luggage, which was being removed. Besides the eight small lights in the shed, there were two lights in the electric-light station No. 3, worked from the same pair of machines. This station was the visitors next repaired to, and after having examined the engines and machinery they proceeded to the roof on the extreme north-western corner, where they had the benefit of seeing the excellent effect of the electric-light in commanding the whole view of the entrance. Returning down the tidal basin, they were conveyed in a steamer which was in attendance to convey them to the small wharf in the graving docks, the object being to observe the effect of the whole series of lights from the basin. Unfortunately this object was defeated, inasmuch as the whole of the lights were extinguished just as the steamer was leaving her moorings. The reason assigned for this unlooked-for extinction was that the water supply to the boilers had run short, it being then half-past ten o'clock, and the engines exhausting been started at 6 o'clock. However, sufficient had been witnessed to demonstrate the practical value and efficiency of the system of electric light for the docks. During the time the visitors were at work on the docks, while it continued the lights exhibited great penetrative power, although, of course, they fell much of their useful effect. Considerable, too, the newness of the system, was the economy, the lights burned very well and were steady throughout. Upon the steamer arriving at the landing place one of the electric lights close by was started, and how its effect will be to the visitors while disembarking and returning their train which landed them at Fenchurch-street station at midnight. L.

The Telephone in Coal Mines, 1850

Could have been anticipated the following upon this subject:—"There are difficulties connected with the application of electric lighting to coal mines, which, however, are not insurmountable. The first one to the use of the telephone as a means of communication between the miners and the upper world. In order to communicate with the outside ground. The advantages of the telephone would be manifold in the ordinary routine of the pit. In the only colliery in which, we believe, it is in use, the engineer above is able to satisfy himself as to the condition of the pumping machinery in the parts of the works the most difficult of access, by merely listening to the sounds given out by the valves, &c., independently of the advantage of sending immediate advice or instructions on an emergency; and it is evident that, in case of an explosion, were the wires properly protected, the communication they would afford with workmen suddenly entombed alive would be of the utmost importance. On this last account the establishment of means of instantaneous communication with those employed in mines has, we are informed, been already enforced by one of the Australian Legislatures." //

ELECTRICAL ILLUMINATION OF MONTE CARLO.—The *Elektrotechnische Zeitschrift* reports that the first experiments with the electric light on the Venetian railway took place recently under the direction of M. C. Molecchott and of the engineer Girolamo Taddei, who represents in Italy the firm of Siemens and Halske. Only fourteen differentiation lamps were used, being maintained in action by a dynamo machine of medium size giving alternating currents. //

One of the difficulties experienced in bringing the electric light into use is the production of a uniform shadow across from a slight perturbation of the travelling power. The equal and ground-glass globes, with which we have hitherto been concerned, remedy this to a great extent, but the light is then[illegible] by the electric arc—a serious loss in many difficult cases. In order to obtain the mean,

The city council of Akron, O., has unanimously adopted the report of its[illegible] committee in favor of electric light and has empowered[illegible] to proceed with[illegible] Two letters to it, by 40 inches.....

Cost of engine and boiler foundations	$1,500
Cost of engine and boiler[illegible]	2,000
Cost of 2 engines at[illegible]	1,600
Cost of 2 boilers at[illegible]	1,000
Cost for[illegible]	250
Electrical machines[illegible]	1,000
Total	$7,700

THE *Electrician* Oct. 1 1879

RESPONDS: ELECTRICAL ILLUMINATION OF THE OPERA HOUSE AT PARIS.—Writing on this subject, M. Hospitalier says:—We may assert that the electrical illumination of the Opera will be *eclectic*, whenever it may be carried into effect: it is easy to show that this must be the case. The *foyers*, the *loggie*, the entrance halls, &c., may, without inconvenience, be lit up by the Jablochkoff *bougie*, or any other; but this kind of light must be rigorously banished from the house and from the stage, for the Jablochkoff *bougie* and all the apparatus in which alternating currents are employed produce a certain sound which is more or less intense, but which is always undissimable in a place where a *religious* silence is occasionally in the highest degree requisite. A journalist has happily characterised this peculiar matting sound by comparing it to a *ballet of cockchafers*.

Electrician Oct. 1 1879

// THE ELECTRIC LIGHT AND LANTERNS.—A recent number of *Le Gaz* thus sums up the principal defects of the most renowned systems of electric lighting:—"Jablochkoff Candle: Too much scintillation; no arrangement for relighting autonomically in case of extinction; too deep shadows beneath the lamp. Werdermann Lamp: Absorption of a great portion of the lighting power by the upper carbons; too frequent changing of the incandescent carbon; too much shadow. Jamin Candle: Too much noise; light too unsteady. Regnitzen—Serrin, London, Brush, &c.: Too costly: too much shadow beneath; delicate manipulation." Therefore, remarks our French contemporary, "there is still no really practicable system of electric lighting extant except the Serrin or Brush regulators for lighthouses or large works." Beyond this important negative result, the experience of four years working of the electric light in Paris, although aided by large subsidies, much financial support, and a certain amount of public favour, has produced absolutely nothing. We are inclined to think our contemporary is a little behind the times, and that a little keen appreciation of the progress recently made by Brockie, Crompton, Siemens, &c., in England, would enable one to place a different construction upon the existing phase of electric lighting. //

THE ELECTRIC LIGHT AND LANTERNS.

A recent number of *Le Gaz* thus sums up the principal defects of the most renowned systems of electric lighting:—"Jablochkoff Candle: Too much scintillation; no arrangement for relighting automatically in case of extinction; too deep shadows beneath the lamp. Werdermann Lamp: Absorption of a great portion of the lighting power by the upper carbons; too frequent changing of the incandescent carbon; too much shadow. Jamin Candle: Too much noise; light too unsteady. Regnitzen—Serrin, London, Brush, &c.: Too costly: too much shadow beneath; delicate manipulation." Therefore, remarks our French contemporary, "there is still no really practicable system of electric lighting extant except the Serrin or Brush regulators for lighthouses or large works." Beyond this important negative result, the experience of four years working of the electric light in Paris, although aided by large subsidies, much financial support, and a certain amount of public favour, has produced absolutely nothing. We are inclined to think our contemporary is a little behind the times, and that a little keen appreciation of the progress recently made by Brockie, Crompton, Siemens, &c., in England, would enable one to place a different construction upon the existing phase of electric lighting. L.

ELECTRIC LIGHTING.—The *Staten Herald* gives the following account of an American experiment made on September 2nd:—" A number of[illegible] of powerful electric lights was made last evening in the vicinity of the Sea Pavement, Long Branch, and the[illegible] was witnessed by quite a[illegible] interested spectators. The Northern Electric Light Company have[illegible] a powerful engine and dynamo-electric machine of the type, and mounted upon each of these elevations a tower of 12 electric lights of the Weston patent, each light being estimated at 2,000-candle power. As the towers are but 100 feet apart and in a triangle, it will be seen that the light of 30,000 candles was concentrated within a limited territory. The design of the exhibition was to afford a model of the plan contemplated for lighting the entire beach overhead in vast areas, the estimate being that four towers to a square mile of area, each mounting lights aggregating 90,000-candle power, will suffice to flood the territory about with a light almost equal to midday. Last evening a motive power of 25 horses was used in generating the electricity from three Weston machines, and the lights, with one single slight flicker, burned steadily and brilliantly all the evening. The[illegible] of the towers was also greatly improved by the[illegible] of reflectors, which were sufficient to allow two base-ball nines to play at the centre of the field lighted a game of the[illegible], with a score of 45 to 16, but, on account of the uncertain light (resembling that of the moon at sea), the batting was weak and the catchers were poorly supported. A trip on the Nantasket Beach Road to Point Allerton, about a mile from the lights, showed that the rays were discernible even at that distance, though the intervening territory was but little affected beyond an eighth of a mile circuit. The lights appeared to illuminate a larger area on the water-side than on the land, the Sea View House and its surrounding[illegible] being but[illegible] affected, while[illegible] beyond the[illegible] of the[illegible]. The claim put forward by the company is for a saving in the matter of lighting rates and taxes by grouping and concentrating electric lights of any kind."[illegible]

The English Mechanic
AND
WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 1, 1880.

ARTICLES.

INDUSTRIAL USES OF THE ELECTRIC LIGHT.

IN an interesting pamphlet just issued Mr. R. E. Crompton, whose successful utilisation of the electric light is well known, reviews the question in its present aspect with a fair degree of impartiality, considering that to some extent he is naturally biased in favour of the "new" method of illuminating. Although experimentalists have not yet done with the light, for they recognise the possibility of further discoveries, it has left their hands in a practically perfect shape, and it is for the mechanical engineer to utilise the principles now well understood. Referring to the books on the electric light, issued within recent years, Mr. Crompton justly says that though bulky they contain little information of practical use, and are mainly histories of early invention with a sufficiency of newspaper cuttings describing recent ones, most of which have failed to stand the test of actual use. The accounts of working cost, too, are in many cases misleading, as the reports of engineers more or less interested in the success of the apparatus to which they refer, and too frequently they are treated confidentially with authors and with known facts. Mr. Crompton also condemns as dangerous generalisations the use of a number of useful facts which may be found of value by those who are engaged in introducing the electric light into new districts, and he indebtedness to Dr. Monsel, Dargaye, Latimer Clark, Hearder, Hopkinson, Muirhead, Preece, and Stocks-magines, in describing the various carbons, &c., he likewise mentions, rather superficially, that he regards lamps in modestly confesses that he has been engaged in perfecting the very device during the past two years, he judges himself to be peculiarly unfitted to the exclusion of others. He divides the systems of electric lighting into two classes:—

1. The incandescent, the most notable of which are those of Swan, Edison, Sawyer-Man, Edison, and Werdermann; 2. those using alternating currents, either with regulators or candles, as the Holmes, the Siemens, the Jablochkoff, Siemens, Wilde, and Lontin; and 3, those using continuous current machines with are regulators, which the principal are those of the Gramme, Siemens, Brush, Burgin, Crompton, and Weston, and the most used forms those of Serrin, Siemens-Siemens, Brush-Burgin-Crompton, and Weston. He adds the following definitive purposes of the Dubosq and Pournier patterns. Having thus classified the various systems into groups, Mr. Crompton discusses the first two as unsuitable for practical work, mainly for the following reasons:—The incandescent system, he says, promises well, but it must be always wasteful of energy, and consequently of horse-power, until some substance is discovered which is sufficiently refractory and stable at the intense temperature at which the incandescent system would be theoretically equal in economy to the are. Some of the modified incandescent systems, such as those of Hegnier, Andrez, and Werdermann have, he admits, attained a high degree of commercial success, especially for work on board ship; but he points out that the applications have been few, and in view of the uncertainty of the incandescent as to the best form of their apparatus, he considers that the whole subject has not yet passed out of the experimental stage. It must be confessed that the definition is just; but probably the main reason for the apparent neglect of the incandescent system is the fact that most of the inventors are endeavouring to perfect arrangements which will adapt the electric light for use in houses and public buildings, where a number of lamps of comparatively low illuminating power are required, rather than one or two brilliant, not to say overpowering, centres of light. That is confessedly Edison's main object, and other inventors are travelling on the same lines. Even supposing machines giving alternating currents, Mr. Crompton doubts the possibility of their competing on even terms with machines giving continuous currents, and he advises for the latter 35 per cent. more useful effect at the arc than can be obtained with the former. He also points out that as the object is nine times out of ten to illuminate a certain floor-area, and not waste light on the walls and ceiling, the space lost by the positive carbon is a natural advantage in favour of the continuous current system. The alternating current, on the contrary, has the two carbons equally consumed. As a consequence, the light is thrown in all directions above and below the horizontal plane passing through the arc, necessitating a large proportion of it being lost downwards as a long way is forcible to a dozen men. Four instances in an hour, with the light blazing full up or movement of the carbons, announced by a flicker of an inch, has a vastly greater effect than if the are were 1-8th of an inch, and with very rapid are the flicker is a tendency of the negative carbon to take a sort of mushroom shape from accretions received from the positive pencil. These are of course accessible to such an extent as to build up the are sufficiently to break and spoil their invariably-coarse hissing and unpleasant fluctuations. Crompton has been a standard as internal resistance of one ohm for his machines maintaining the arc of 5lm., with a pure white light. Brush, on the contrary, uses external resistance, some of his machines maintaining a resistance of one ohm for the arc of 10lm. Crompton, these high-tension are are unsteady, and the fluctuations. Crompton therefore thinks that if Brush had cemented himself with four lamps, four low-tension arcs would have obtained good results. He alludes to the lights at South Kensington and Liverpool-street station as bearing out his argument. Crompton's machines for the latter will be inclined, we imagine, to agree that the system there adopted is really very successful. Referring to the rather absurd statements which have been made with regard to the are, he agrees with Mr. Preece that instead of comparing the electric light with the candle-power used for gas, it should be with the illuminating power which a certain floor-area to a certain standard, and he gives a useful table for which several of the best known machines are thus compared. Omitting the machines from a merchant's point of view, he includes only those which are to the Siemens, and the Burgin, which, he says, "generally will give a little better than either. As to regulators, Mr. Crompton naturally considers them the best, and if we may judge from the ever-lessening number received, it is the best in the market. The inventor's great point is delicacy of adjustment, and he establishes that all the good machines rival one another so closely in economy of working that it is for secondary importance for the intending user to look at other points. The interior mechanism of the machine itself; the firmness and durability of the construction are particularly considered, and the probable wear and tear and risks of damage in working. As to resistance, the machines of Siemens and Burgin give, as a rule, the lowest tension currents, *i.e.*, have the lowest internal resistance; only one are can be burned in circuit, but the light is beautifully soft and steady. They have low windings and consequently small waste of heating from 1 to 2 are in the circuit, and the Brush machine gives a current of sufficient tension to burn 10 are in series. In comparing the Siemens, Crompton says that as we increase the tension and diminish the quantity of current we gain the power of burning more than one light in series, but the outlay is out and about $100,000), but it gives by the glowing of the carbons a much whiter light, which is often unpleasantly coloured purple, blue, or greenish; moreover the use of the arc is no longer confined to that point where the two carbons touch, but the whole current need nearly, but large enough, thus the light is of unequal brilliancy when viewed from different directions, and unsteadiness are clearly perceptible. If then the object is to light large spaces where the lamps can be placed at a considerable height, and where good colour and steadiness are desirable, Mr. Crompton advises the use of low-tension currents and single lights; but he does not think that for some scale are will ever supersede Siemens has done throughout, and Gramme in his larger machines. For purely mechanical reasons currents of very low tension are objectionable, and there is a long way in favour of a dozen are

LITERATURE.

Electrician Oct 16 1880

The Electric Light for Industrial Purposes. By H. E. Crompton [Manchester: Palmer & Co.]

Mr. Crompton has collected in a pamphlet of some forty odd pages a large amount of information which he, in his capacity of engineer and contractor, has felt to be wanted. He commences by referring to the systems of electric lighting in use, grouping them in classes, and pointing out that practically the incandescent past the experimental stage, or to have been commercially successful when tried. The greatest advance has been made with the system employing direct currents; of such machines we are told there are upwards of 2,000 in Europe and America. With regard to the motive power there is little or no difficulty. Mr. Crompton says first-class engines can be had from fifty different builders, and speaks in high terms of the engines supplied by Marshalls of Gainsborough, and Ransome of Ipswich. A good deal of information is given about accumulators, and the experiments made with them are carefully criticised. The author lamps per horse power, viz., the ground area lighted to a certain standard. The labels given observe careful consideration. In speaking of lamps, Mr. Crompton admits a bias towards his own lamp, which discussion on carbons. These produced by the electric light know how important it is to have good carbons and how difficult it is to obtain them. Mr. Crompton states the defects carbons are and he gives a list of prices which will enable the reader to obtain a fair idea of the cost of such lights for a variety of purposes.

The Electric Light for the Merv Expedition.—We understand that the Jablochkoff Electric Company in Russia have just completed, under the personal supervision of Professor Jablochkoff himself, the machines specially designed for use at Kamyschlar, where Colonel Alikhanoff and Skobeleff intends making use of the electric light during the impending debarcation of Caucasus troops from the Volga for the Turkomans campaign. The three machines, with 2,200 candles, leave St. Petersburg this week for the Caspian.—*Globe.*

Scotsman Journal Oct 16 1880

Sir William Thomson's Lecture.—Lecture on Saturday afternoon. Professor Geikie, having sketched briefly, the geology of Edinburgh, first and the Salisbury crags, and called special attention to the existence of the Edinburgh coal-field. The geological features of Princes's Street, the new premises of Mr. D. Nicolson, where they were entertained to tea and other refreshments. Mr. Nicolson's factory, which has few, if indeed any, equals in the country, was visited and greatly admired. Mr. Nicolson's residence and its grounds. Mr. Nicolson has apart, connected by means of the telephone, and arrangements had been made for the lecturer and friends to observe the working of the exhibition. [illegible] privilege that was eagerly taken advantage of.

Dr. Bikmore, on Health, said:—"It is not, perhaps, alphabetical in the case of the electric light, but the question of the effect the light may make a considerable change in the conditions of some kinds of labour. The influence of light on vital powers is one of these. It does not always favourable, and that is in this country still reading by men from the sun, and not aware of any the Arctic Circle; but we can have prolonged daylight of bearing on animal life from Siemens' interesting experiments on the effect of the electric light on the vegetation [illegible] as Darwin pointed out, the 'sensitiveness' of the eye is also their highest vigour or perfection of vision, side, or under similar conditions."—*Scotsman*, August 11th, 1880.

Mechanical World Oct 16 1880

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After a few preliminary remarks in reference to the general principles upon which the application of electricity to illumination depends, and while referring to the various modes and appliances for generating electric currents, the author takes advantage of the reference to voltaic batteries—which are now of so high absolute resources of illuminating currents—to point out that the voltaic cell is that modified form which is known as the secondary battery, and which was first introduced some twenty years ago by M. Planté, is likely to play a very important part in the development of electric lighting, not as a generator of electricity, but as a sort of reservoir for what may be called "storing up" electricity which has in the first instance been generated and rendered by a dynamo-electric machine. Without describing the secondary battery of M. Planté, the author here says our readers that it consists generally of two sheets of lead placed very close to one another, and immersed in a cell of diluted sulphuric acid. When these plates are respectively connected to the opposite poles of a voltaic battery or other generator, the oxidation of the surface of the one, and that the deoxidisation of the other so far alter their relative electric condition that for several hours after they have been disconnected from the exciting battery they are capable of giving out an electric current, and reassembling it through a circuit connecting their poles, and by forming a number of such secondary cells together, powerful currents of high electromotive force may be produced and rendered available for considerable time after they have been charged by the primary battery. In reference to the beauty of the author Mr. Swan pointed out that in the secondary battery a solution such as sound is the only products of working up a source of electricity by which electric lights may be sustained for considerable periods of time, and that without the stopping of the dynamo engine. The author then described the system of electric lighting of a successful means of keeping a number of lights of the same intensity independent of the variations of the prime generator and of the speed at which it was driven, and was shown how each lamp could be all automated in the think that the author had made a great step in the development of electric illumination when Mr. Swan few having so prominently drawn attention to the means by which it may be brought about.

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Electrician Oct 16 1880

THE ELECTRIC LIGHT IN ANTWERP.

Jamin's Electric Light.—We understand that instructions have been given to proceed with the lighting up of the Royal Panorama, Leicester-square, and adjuncts with thirty Jamin's electric lights. The directors and artists of the Panorama have carried out some extensive trials at the works in Paris, and were so satisfied that they have decided upon adopting this system. *Electrician Oct 16 1880*

The Electric Light in Paris.—M. Charles Garnier loudly demands the introduction of electricity, so as to preserve from destruction the works of art with which he has decorated the Paris Grand Opera. To descend from the sublime to the comic—from the Grand Opera to the Palais Royal—this latter theatre has been entirely redecorated, and in so remarkable a manner that it merits a few words of notice. M. Bayard has been entrusted with the work, and has painted on the walls of the *foyer*, or crush room, a biographical history of the theatre. On one side we have grouped representing all the ancient actors in their most celebrated parts—the Père Amant, Bontin, Rigaud, and Mlles. Perron, Nathalie, and Mars. To unite the past with the present there is an allegorical group of nymphs and satyrs, and then we find the portraits of all the celebrities who still entertain the gay audiences—Bressaut, Hyacinthe, Ravel, Scheneider, &c. But we are reminded that these new and elaborate decorations, which possess the double attraction of works of art and works of history, will be prematurely obliterated if they are exposed night after night to the blaze of innumerable gasburners. The Gymnase Theatre has also been redecorated, [illegible] *Oct 9 1880*

THE GAS AND ELECTRIC LIGHT EXHIBITION AT GLASGOW. *Oct 16 1880*

TO THE EDITOR OF THE ELECTRICIAN.

Sir,—Your correspondent describing the above is hard on us exhibitors of electric light apparatus, saying that we are always behindhand, and, when we do show, do not show at our best for some time. I think if you consider that we have to supply the entire plant for the production of the electric light, viz., engine, dynamo-electric machines, cables, connections, lamps and lanterns, wherever one exhibitor has the very exclusive use gas supplied to them from the mains laid on ready to their hands, and have only to hang up and attach a few lanterns and burners to make a very effective display you will see how to go far for the explanation. The exhibitor of gas apparatus had burners shown on the opening day, I do not think the gas of the exhibition would be quite so brilliant as at present, and I think it is just possible that they might be a few kitchen and sanitations of the light even among the gas exhibitors during the early days of the exhibition.

Speaking for myself, all my apparatus has been ready for showing the light for some days, but I had an engine to drive and dynamo-electric machines. This has arisen from an unfortunate misunderstanding regarding the supply of the steam power, which has made my engine late in arriving. I have no doubt others are in the same position.

I beg to correct your correspondent in some few mistakes he has fallen into regarding the exhibition.

The British Electric Light Company are not exhibiting at all. Messrs. De Clark, Reichhead and Co. are exhibiting the Lontin light, the Anglo-American Company are to exhibit the Lontin light, Strode and Company show the M'Kenzie and Dyer system, of gymnotus in my own name. I have not heard who is to show Hrochki's lamp. In a few days I believe that there will be a fine display, and your correspondent will have nothing to complain of the year's exhibition has taken place at the very busiest season of wondered at that many gas firms could not afford to send skilled operatives to remain with their stands for a month.—Yours, &c.,

H. E. Crompton.

Mansion House Buildings, London, Oct. 9.

well acquainted with the essential characteristics of both systems, we will pass over that portion of his lecture in which the author treated of lighting by the electric arc, and pass at once to his remarks with respect to that branch of the subject with which his name must more especially be associated. In speaking of lighting by incandescence, he expressed the belief that that is the branch of the subject that will yield the largest crop of fruit. "Electric lighting by incandescence," he said, "is just as simple as arc-lighting is difficult; all that is required is a material which is not a very good conductor of electricity, highly infusible, and which can be formed into a wire or lamina, and is either non-combustible in air, or, if combustible, does not undergo change in a vacuum. There are, so far as I know, just two substances that possess, in any sufficient degree for the purpose in question, the qualites I have specified, viz., platinum (or an alloy of platinum with iridium), and carbon." He then went on to compare the merits of the two substances, showing that while platino-iridium possesses the advantage over carbon in being incombustible in air, it is incomparably inferior to carbon in infusibility, the latter substance having resisted without fusion the very highest temperature to which it has been subjected. In consequence, however, of its destructibility by combustion either in air or in imperfect vacua, carbon has been put aside by most workers in favour of its metallic rival, and our readers are familiar with the published experiments of Mr. Edison, and with the many modifications of his platinum lamp,* in all of which provision had to be made for the protection of the platinum strip from destruction by fusion under the influence of an abnormally strong electric current. The readers of this journal (and more especially those of them who a few months ago were possessors of gas shares) are also aware that Mr. Edison has more recently produced an incandescent lamp,† in which a loop or horseshoe of carbonised paper was employed in the place of the platinum strip. This lamp, judging from accounts reaching us from the other side of the Atlantic, gave great promise of success; we have heard but little, however, of it since, and the obvious inference is that the apparatus has not fulfilled the promises taken by its sponsors at its birth.

It is an interesting fact, however, as bearing upon the history of the subject, that as far back as twenty years ago, Mr. Swan designed and constructed a lamp identical in principle, and very similar in appearance, to that of Mr. Edison, and in which an arch or horseshoe of carbonised paper was employed. This early lamp of Mr. Swan is shown in Figs. 1 and 2, which represent the front and side elevations respectively of the apparatus. In it the carbon was in the form of an arch, about 1 in. high and a ¼ in. wide, its ends being clamped in small square blocks of carbon; the whole was enclosed under a bell glass, which was fitted by an air-tight joint to a circular base-plate, and the air within the chamber so formed was exhausted by a common air-pump. When the battery was connected, the paper arch became incandescent, but Mr Swan observed that its inner edge was raised to a higher state of incandescence than the outer edge, and in consequence of this the carbon horseshoe, seen edgeways, began to bend towards one side, as shown at A, Fig. 3; on continuing the current the bending gradually increased, as shown at B, and at last the arch bent over as at C, until the top of the arch touched the base-plate, when it broke in half, and the lamp was destroyed.

The destruction of the incandescent carbon strips *in vacuo* has, until now, presented an insurmountable obstacle to the development of incandescent lamps founded on that principle, and the cause of this destruction has hitherto been attributed to a continual evaporation or sublimation of the carbon under the influence of the enormous heat to which it is subjected, and this view was supported by the fact that after a short time the glass became dimmed and obscured by the formation of a kind of black smoke depositing a species of soot over the internal parts of the lamp. More recent experiments of Mr. Swan have shown, however, that this phenomenon can be completely prevented by having a more perfect vacuum within the chamber, by heating the carbon to a high degree of incandescence during the process of expansion so as to drive out all the gaseous impurities occluded within it, and by having exceedingly good contacts between the carbon horseshoe and its supports. By the adoption of the Sprengel vacuum, by attending to the perfection of every detail of the construction, and, above all, by a special method of preparing his carbon, Mr. Swan has recently produced an incandescent lamp which is represented in Fig. 4, and which in our opinion appears to be the most important step that has yet been made in the economical application of electricity to the production of small lights. This little instrument—which at first sight reminds one of some of the

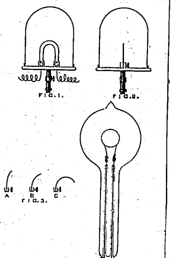


FIG. 1. FIG. 2.

A B C FIG. 3.

FIG. 4.

beautiful apparatus employed by Mr. Crookes in his researches upon radiant matter—consists of a bulb or envelope of glass, which contains a circular loop of what, for want of a better term, we must call carbon *wire*, the two ends of which are electro-plated and soldered to two platinum wires, passing through the lower part of the envelope and terminating in two loops shown in the figure. In order to prevent any possibility of air leaking into the envelope the platinum wires are coated with glass throughout their entire length, and this is fused to and therefore forms part of the envelope which, having been exhausted by attachment to a Sprengel pump, is hermetically sealed, and the instrument is complete.

What is, however, by far the most interesting feature of Mr. Swan's lamp, and it is that which more than anything else constitutes his discovery, is the production of a carbon so entirely altered in physical characteristics as to be to many intents and purposes a new substance altogether. The carbon loops, produced by a process which for very obvious reasons is not described in detail, are no thicker than a hair and are as hard and as elastic as a piece of watch-spring or tempered steel wire, and it is a curious fact that the longer and the hotter they are heated the harder do they become. This alteration of the physical nature of carbon will naturally recall to the memory of our readers the very beautiful experiments of Mr. Edison,* in which he was able to confer upon metals by a process of alternately heating and cooling *in vacuo* physical properties quite different to those appertaining to them in their normal condition. The carbon threads produced by Mr. Swan are perfectly homogeneous in structure, and within the lamp neither waste away nor deposit carbon on the envelope, nor does there appear to be in them any tendency to fracture.

We very much regret that want of space will not permit us on the present occasion to refer to the concluding remarks of Mr. Swan's lecture with the fulness they deserve, but we may briefly call attention to the fact that the author combatted the idea that there need be any loss whatever in the extensive subdivison of the electric light by means of incandescent lamps, quoting the authority of Faraday in support of his view, and stating that "the cost of raising to a certain degree of incandescence a longer or a shorter length of carbon, or of maintaining a ten candle light, or a hundred-candle light, will be exactly proportional to the light produced," and on this principle he said it is possible to contemplate the economical production of an electric light as small as a rushlight.

After making some interesting suggestions with respect to the method of arranging the circuits for the distribution of light from a central station over a large district, the author referred to the actual cost of lghting the lecture-room by gas and by twenty of his own lamps, which were in use during the latter part of the lecture. He stated that in order to produce the current by which the twenty lamps were rendered incandescent 120 cubic feet of gas per hour was being consumed in the gas engine driving the machines, but that the usual lighting of the room was effected by 70 gas jets consuming about 200 cubic feet per hour, so that even in so small an installation and with by no means an economical motor, more illuminating power was indirectly obtained from gas burnt in the engine than was obtained from the much larger quantity of gas consumed at the burners.

It would be impossible within the limits of one notice to do anything like justice to so interesting a subject as that which Mr. Swan so ably treated last week at Newcastle, but we hope before long to have something more to say with respect to his experiments and the development of his system, and while congratulating him on the success he has already achieved, we would express the hope that he will continue his most interesting experiments in the full anticipation of still more important results accruing therefrom.

London Oct 29th 1880

THE ENGINEER.

ELECTRIC LIGHTING.*

The first part of Mr. Swan's paper deals with general principles, and, as these must be tolerably well known to all who take any interest in the subject, may be mentioned very briefly.

The economical production of powerful electric currents occupies the foremost place in considering this subject. The dynamo-electric machine is the most economical generator of such currents. Recent progress towards perfecting these machines has been gradual, but on the whole the cost of producing electricity by mechanical means has been diminished. It is practicable to develope 1-horse power by the combustion of 2 lb. of coal per hour, and to produce with this amount of motive power a current of electricity sufficient to give a light of over 1000 standard candles. That is to say, we can maintain for one hour an electric light more than equal to 1000 standard candles, or sixty-six large gas burners, by the combustion of 2 lb. of coal. That is a much more economical result than can be obtained by the voltaic battery, or any other means of generating an electric current at present known. The voltaic battery, however, is likely to prove useful as an auxiliary to the dynamo-machine, especially for storage of electricity. M Planté was the first to use a battery for such a purpose, and it is known as Planté's secondary battery. This battery consists of plates of lead placed opposite each other, and very near together—but not touching. If these two plates are for a time connected by wires with a generator of electricity, no matter of what kind, one of the lead plates is changed on its surface—it becomes oxidised—and after undergoing this change, it is, when detached from the generator, in such a condition as to be able to give out at any future time a current of electricity on its own account, and when the charge has been expended the plates are like an empty gasometer—just in the same condition they were before receiving the charge, and ready to be charged afresh. The secondary battery is therefore an instrument of very great interest at the present moment, and it is much to be hoped that it may be improved, because, in the simple form described, it does not quite do all that would be required of a secondary battery, applied as a store of electricity on a large scale. The want of a means of storing electricity is a newly-felt want; as yet it cannot be said to have been quite fully supplied, but research is busy at work seeking its complete fulfilment. There can be no doubt that what is wanted will be found, and with the perfecting of the secondary battery, that great objection to electric lighting—that you cannot store the power which produces it as you can store gas—will be completely met. The author gave a short description of the thermopile, and then pointed out that there were practically in use only two systems of lighting by electricity—(1) that of lighting by the electric arc, and (2) lighting by incandescence.

The lamp used to illustrate the first system was that of Mr. Crompton, which was termed *par excellence* the electric light. Six of these lamps were stated to have replaced at the Alexandra Palace 2000 gaslights costing 25s. per hour, at a cost of only 6d. per hour. The lamp used to illustrate the second system was Mr. Swan's own, one which is said to have solved a problem, viz., the economical application of the electric light to household purposes.

Mr. Swan criticised the previous attempts to obtain an incandescent light from platinum wire, iridio-platinum, and carbon. He spoke of Mr. Edison as having come nearer making a useful platinum lamp than any experimenter in the same track who had gone before him. While Mr. Edison was experimenting with platinum, Mr. Swan was working with carbon. Nearly twenty years ago he had a number of pieces of paper and card, of various forms and sizes, buried in charcoal in a crucible, and heated white-hot in the pottery kiln of Mr. Wallace, of Forth Banks. A spiral of the carbon thus obtained was mounted in a small glass shade, and the air exhausted. The attempt to obtain a light at that time resulted in failure, because the current of the ten Callan's cells employed was too weak. The experiment was repeated with shorter carbon and a larger battery—forty or fifty cells—when the carbonised paper arch became red-hot, and it was evident only a stronger current was wanted to make it give out a brilliant light.† But the experimenter's battery power was exhausted, and he could only notice the action of the carbon arch till rupture occurred, and the experiment collapsed. The investigation was laid aside, till the introduction of dynamo-electric machines and the Sprengel air-pump brought the question of electric lighting out of the region of things scientifically interesting into that of things practically useful.

In all the various attempts to utilise the principle of the incandescence of carbon *in vacuo*, two great difficulties have stood in the way, and baffled every attempt to overcome them. One was the rapid wearing away, and consequent breaking, of the incandescent carbon, and the other the obscuration of the lamp by a kind of black smoke. So uniformly did these phenomena appear that the idea was propounded, and generally accepted, that the blackening of the lamp globes was due to the volatilisation of the carbon under the enormous heat to which it was subjected. "If this idea," said Mr. Swan, "of carbon were founded in fact, any further attempt to render incandescent carbon lamps durable by means of a vacuum were mere waste of time, and durable they must be if they are to be of any practical value. Fortunately I did not accept as conclusive the experiments which seemed to show that carbon was volatile, and that the blackening of globes of incandescent carbon lamps was an inevitable result of the carbon being very highly heated. I knew that the conditions under which, without exception, all previous experiments had been tried, were such as did not allow to be formed anything approaching a perfect vacuum within the lamp. Screw fittings had invariably been employed to close the mouth of the lamp, and the ordinary air-pump to exhaust the air. Under such circumstances it was certain that a considerable residuum of air would be contained within it, and also that it would leak. Then, there had never been any thought given to the gas occluded in the carbon itself, and which, when the carbon became hot by the passage of the current through it, would be evolved; nor had sufficient care been taken to make the resistance at the points of fixture of the carbon, less than in the carbon to be heated to incandescence. It was evident to me that before any definite conclusion could be arrived at as to the question of the volatility of carbon, the cause of the blackening of the globes, and the wearing away of the incandescent rods, we must first try

* Abstract of a paper by Mr. J. W. Swan, read at the Literary and Philosophical Society, Newcastle-on-Tyne, October 20th, 1880.

† It would be interesting to know if these experiments were made public at the time, or at any time previous to the publication of the records of Mr. Edison's attempts in this direction.—Ed. E.

the experiment of heating the carbon to a state of extreme incandescence in a thoroughly good vacuum—such as Mr. Cookes has taught us how so procure—and under more favourable conditions as to the contact between the incandescent carbon and the conductors supporting it than had hitherto obtained. Accordingly, in October, 1877, I sent to Mr. Stearn a number of carbons, made from carbonised cardboard, with the request that he would get them mounted for me in glass globes by a glass blower, and then exhaust the air as completely as possible. The delicate operation Mr. Stearn very kindly undertook, and very skilfully carried out. In order to produce a good vacuum it was found necessary to heat the carbon to a very high degree by means of the electric current during the process of exhaustion, so as to expel the gas occluded by the carbon in its cold state, for, otherwise, however good the vacuum was before the carbon was heated, immediately the current passed and made it white hot, the vacuum was destroyed by the out-rush of the gas pent up in the carbon in its cold state. In order to make a good contact between the carbon and the clips

supporting it, the ends of the carbon were thickened, and, in some of the early experiments, electrotyping and hard soldering of the ends of the carbons to platinum was resorted to. I will not weary you, however, with details, but simply say that the prescribed conditions having been rigorously complied with, it was found, after many troublesome experiments, that *when the vacuum within the lamp globe was good, and the contact between the carbon and the conductor which supported it sufficient, there was no blackening of the globes, and no appreciable wasting away of the carbons.* Thus was swept away a pernicious error, which, like a lying finger post, proclaiming 'No road this way,' tended to bar progress along a good thoroughfare. It only remained to perfect the details of the lamp, to find the best material from which to form the carbon, and to fix this material in the lamp in the best manner. These points, I think, I have now satisfactorily settled; and you see the result in the lamp before me on the table." The carbon in this lamp is a mere hair, quite homogeneous and almost flinty in hardness, and becomes harder by the use of the lamp; the longer and the hotter it is heated the harder it becomes. It is essential to economy in lighting by incandescence that the incandescent carbon should be very thin. The carbon used is not one-twentieth the thickness of the thinnest of the carbons formerly employed, and, therefore, one-twentieth of the current, costing one-twentieth the price, will produce in this thin carbon the same degree of luminosity as twenty times more current will produce in such carbons as were used in those ancient lamps. The work of Mr. Edison in connection with the carbon lamp was then mildly discussed, but subsequently his system of distribution was carefully considered, and shown to be inapplicable. The great purpose in view is to obtain a lamp applicable to the lighting of houses. In view of such application, two questions present themselves, one as to distribution, another as to cost. Can this light be divided, distributed, and measured as gas is divided, distributed, and divided? And at what cost? First, then, as to division and distribution, it has been asserted on very high authority that great loss necessarily attends the division of the electric light. To a certain extent this is true of lighting by the electric arc, but it is totally and absolutely erroneous of lighting by incandescence. There is no loss in dividing the electric light produced by this means. Faraday has stated the law of the case in these words:—"An electric current which will heat 1in. of wire white hot, will also heat to the same temperature 100in., or an infinite length of the same wire." For supplying large towns Mr. Edison proposes to distribute the light from centres by what is known as the divided arc system. This plan has the merit of simplicity, but is open to many and great objections. It is necessary that each lamp should have a high resistance, or there will be a large waste of current spent in heating the conducting wires. Instead of following this plan, Mr. Swan puts his lamps in series, 10, 50, or perhaps 100 lamps in one and the same line. A copper wire less than ¼in. thick would supply current for one such series of 10 to 100 lamps at five miles distance with a very small percentage of loss. The great difficulty in this system is that a break in any part of the line would extinguish all the lights in the series. To obviate this, it is proposed to use an automatic circuit closer, so that should any lamps go wrong the circuit is still unbroken. With regard to economy Mr. Swan said, "The economy of lighting by incandescence has not been exemplified by so many instances of actual practical use. One thing is, however, quite clear, and that is that electric lighting by incandescence is an economical process—it will be less costly than gas lighting. That is conclusively demonstrated by the fact that 1000ft. of gas employed in working a gas engine to develope an electric current, and used in my lamps, will yield more light than 1000ft. of gas consumed in the ordinary way in gas burners. This room is now lighted by twenty of my electric lamps, and to produce the current which feeds them 100 cubic feet of gas per hour are being burnt in a gas engine; before my lamps were kindled the room was lighted by seventy gas jets, consuming, I am told on good authority, 280ft. per hour. It is very evident that we have got more light out of the gas through the medium of electricity than was got from the larger quantity of gas which those burners consumed. From measurements carefully made, both of light produced and current required to produce it, I am warranted in saying that at least twice as much light will be produced by a certain quantity of gas used to generate an electric current employed in my lamps, than would be obtained from this quantity of gas burnt in gas burners in the usual manner. If that is so, then it is evident that when, instead of the motive power of gas, that of steam produced in the most economical manner is employed, this method of electric lighting will be very much less costly than gas lighting. I reckon that 40 lb. of coal employed in raising steam to generate electricity is capable of producing in my lamps the effect of 1000ft. of gas burnt in gas burners in the ordinary manner.

The Electrician Oct 30 188 London

GLASGOW.—ELECTRIC LIGHT EXHIBITION FOOTBALL MATCH.—The important match between players living north and south of the river took place at Burnbank on Monday night by aid of the electric light, which was supplied by the committee of the Philosophical Society's Gas Exhibition. The ground was illuminated by thirteen electric lights placed on elevated positions equi-distant, with extra powerful new patent reflectors, to diffuse the rays; one light alone, supplied by the Anglo-American Electric Light Company, was equal to 56,000 candles, and the general effect was very fine.

London Oct 29 1880

IRON.

ELECTRICITY IN COLLIERIES.

MR. W. H. PREECE, President of the Society of Telegraphic Engineers, has addressed the following important letter to *The Times* on this subject:—Sir,—Several correspondents recently advocated in *The Times* the employment of electricity for illumination in collieries. One suggests that portable lamps made of a battery and a vacuum tube should be employed. Such lamps have been tried frequently, but they have failed from want of permanence in the current and of intensity in the light. I have seen excellent lamps of this form, notably one made by Breguet, of Paris; but they proved much too feeble in illuminating power and practice. Others propose the use of the electric light on the assumption that such a light is safe. It cannot be too strongly insisted that the absolute safety of the electric light is a popular delusion. In the first place, the arc itself is the greatest source of heat which science possesses, and, in the second place, the wires conveying the electric currents that produce the arc may themselves be conveying energy in a form as insecure as a train of gunpowder. The danger of the electric arc is supposed to be removed by its insertion *in vacuo* in hermetically sealed glass bulbs; but what if these bulbs be broken, and what about the difficulty in maintaining the vacuum? Granting, however, that it be practicable to immure the light in a secure transparent vessel, what about the wires? The currents employed to generate the light are extremely powerful, in some cases many thousand times stronger than those employed to work telegraphs. Not long ago a poor musician in a theatre in Birmingham, and quite recently a poor Russian sailor on board the *Livadia*, were killed by incautiously seizing upon certain exposed parts of the conductors conveying these currents. The difficulty in maintaining currents in their proper path in telegraphy is very considerable. How much more difficult must it be to maintain those employed for electric lighting! Copper wires are carefully enclosed in indiarubber or gutta-percha coatings, but these insulating coatings are liable to injury; they are inflammable, and if a mere crack or pin-hole were to occur in such a coating, the currents would escape to earth, generating heat and producing fire. This view is not chimerical. Offices have been set on fire even by the currents employed in telegraphy. I know of two such cases; one in New York, and the other in Boston. It is not at all unlikely that the recent fire in Manchester arose from such a cause. The liability to such accidents is evidently much greater with electric lighting, and it is only technical knowledge and professional skill which can render such currents innocuous even in well-constructed buildings. In mines, however, the difficulty is much greater. There the wires must necessarily be suspended in narrow, frequented galleries close to the damp earth, and be liable to incessant injury, and they could be rendered comparatively safe only by costly cabling. It would be impossible to guarantee absolute security. To light a colliery by electricity would therefore be both costly and dangerous. The popular delusion as to the safety of the electric light is probably due to its being so frequently spoken of as a cold light, the word "cold" being used in its figurative sense of cheerless, the unscientific taking the word in its literal sense. There is reason to believe that electricity plays another important part in colliery accidents. Some months ago there was a terrible disaster in the Risca colliery in South Wales; over 70 human beings were hurried into eternity. An inquiry was held into the cause of the disaster, and the conclusion arrived at was very unsatisfactory. A well-known telegraphic engineer, Mr. Arthur Redcliffe, from evidence collected on the spot, arrived at the conclusion that the mine was discharged by a flash of lightning. He submitted his evidence to me, and I fully concurred with him. All the conditions for such a catastrophe were present. The flash of lightning was seen to strike the head-gear of the shaft immediately before the explosion. This machinery was connected with the bottom of the shaft by several continuous conducting masses. Iron rails, resting on poorly conducting matter, extended thence throughout the galleries. The gas was there, and it only wanted a break of continuity in the metallic masses conveying electricity, of which there were many, to produce sufficient heat to fire the charge. I have no doubt that lightning was the cause of the explosion. These facts were submitted to those who were concerned in the inquiry; but, probably, being incomprehensible to them, they were ridiculed and therefore ignored. Hence I advocate the employment of well-constructed lightning-conductors over the head-gear of shafts to keep electricity out of the colliery and to insure safety rather than the erection of conductors along the galleries to convey it in them for purposes of illumination and to court danger.

~~Iron~~ ~~London~~

OCCASIONAL NOTES.

Oct 29 1880

THE ELECTRIC LIGHT IN THE BRITISH MUSEUM.

THE electric light is slowly but surely making its way. When the practicability of using it in public libraries, museums, picture galleries, and other collections was first suggested, perhaps no one would have thought it likely that, of all our public institutions, the British Museum would be the first to admit the new light to a practical test. After a series of experiments it has at length been definitely admitted by the Museum authorities. The latter have hitherto resolutely, and very properly, we think, resisted the introduction of gas. It was a high testimony to their liberal views to permit the experiment; and they cannot be praised too much, now that experiment has proved successful, for introducing the light—the electric lamps finally adopted being those of the Siemens pattern. Having once broken with tradition as far as safety will permit, may we ask them to go yet a step further, and to enlarge the benefit already conferred by extending the hours of admission to the Reading-Room, if not to the whole Museum? A student who has to earn his daily bread during such hours as the Reading-Room is now open finds that under existing regulations the splendid library is almost closed to him. Now that it can safely be done, the gratefulness with which the opening of the library in the evening would be welcomed by that class of students who are able to use the great resources of the library only if they are willing to make great sacrifices can only be equalled by the great benefits with which such a lengthening of the hours of admission would be accompanied.

THE WESTINGHOUSE CONTINUOUS BRAKE.

One of the best managed of English railways has taken another step towards ensuring the safety of the human freight carried by it. The directors of that company have decided to apply the Westinghouse brake, in use on their lines, to the engine as well as to the carriages and tender of express trains. The company would have been saved heavy damages, and their passengers great and in many cases prolonged suffering, incident to recent disasters, if this precautionary measure had been adopted earlier. It is true that the uncertainty of all safeguards that human ingenuity is able to provide—however perfect they at first sight may appear—has been too often demonstrated. Yet their introduction will contribute much towards prevention, which, as we all know, is better than cure. If to this be added a more stringent adherence to regulations laid down for the guidance of railway servants, all that human foresight possibly can do has been done, and we shall in all probability in future hear less of railway accidents than hitherto. The Westinghouse brake is the best at present known for stopping trains within short distances and diminishing their speed. We hope the good example of the Midland Company will be speedily followed on all our principal lines.

London Oct 29 1880

IRON.

A NOVEL exhibition of powerful electric lights was made recently in the vicinity of the Sea Foam House, Nantucket Beach, the display being witnessed by quite a crowd of interested spectators. The Northern Electric Light Company had erected three wooden towers, each 100 feet high, and mounted upon each of these a circular row of twelve electric lights of the Weston patent, each light being estimated at 2500-candle power. As these towers are but 500 feet apart and in a triangle, it will be seen that the light of 90,000 candles was concentrated within a limited territory. The design of the exhibition was to afford a model of the plan contemplated for lighting cities from overhead in vast areas, the estimate being that four towers to a square mile of area, each mounting lights aggregating 90,000-candle power, will suffice to flood the territory about with a light almost equal to midday. A motive power of 36 horses was used in generating the electricity from three Weston machines, and the lights, with one single slight flicker, burned steadily and brilliantly all the evening.

London Oct 29 1880 Iron.

THE JABLOCHKOFF ELECTRIC LIGHT

A SHORT time since we stated that the Société Générale d'Electricité, of Paris, which was formed for the purpose of experimenting with, developing, and demonstrating the Jablochkoff electric system, was shortly to be superseded by, or absorbed into, a permanent working company. That contemplated change, we are informed, has now taken place, a company having been organised called the Electric and Magnetic Company (Limited), with a capital of £500,000. The object of the new company is to develop the application of electricity to lighting and other purposes, and, without binding themselves exclusively to any particular system, the directors express their confidence as to the system of M. Jablochkoff, which has stood the test of time, being the most suitable yet introduced for general application. They, however, state that they are prepared to adopt other systems that may appear desirable. To secure the advantages of the Jablochkoff patents, they have entered into an agreement with the Société Générale d'Electricité, who are the owners, by which they will obtain an interest in them on what appear to be very favourable terms. The Electric and Magnetic Company intend to enter into active operations at once, and it is expected that a great extension of the Jablochkoff system will follow so soon as the company are able to supply the light on a large scale. Our readers and the public generally are well aware of the successful application of this system in England on the Thames Embankment and Waterloo Bridge. We may now add that the District Railway, after having tried the Jablochkoff light at the Victoria Station for six months, are having two more stations fitted with it. That at Charing Cross will be ready for lighting in a few days. The directors of the Metropolitan Railway Company are also proposing to light most of their stations upon the same system. Messrs. Shoolbred, after two years' trial, have decided upon increasing the number of their electric lamps, and Messrs. Whiteley, of Westbourne Grove, following this example, are having part of their extensive premises fitted with the Jablochkoff light. The proprietors of the Stanners' Close Steel Works, at Wolsingham, are having Jablochkoff lamps put up in their converting house. On the Continent the light continues to progress. M. Schneider, of Creusot, after a two years' trial of the light at the iron bridge and steamship yard of Chalons-sur-Saone, is extending the system to the rolling mills of Creusot and the collieries of Devise. The Chemin de Fer de l'Etat Belge have, since our last notice, doubled the number of the lights at their Antwerp Basin station, and the Havre municipality have entered into a contract for ten years for lighting their harbour and docks. The last addition to this list is the yacht of H.I.M. the Emperor of Russia, the *Livadia*, the magnificent saloons of which are lighted exclusively by Jablochkoff lamps. It will thus be seen that the Jablochkoff system has made substantial practical progress, which augurs well for the success of the new company, the offices of which are at Palace Chambers, St. Stephen's, Westminster.

London Oct 30th 1880

THE METROPOLITAN.

The "Brush" System of electric lighting appears to be making very considerable progress. Almost every week we are able to chronicle fresh instances of its adoption for ordinary lighting purposes; and there can be no doubt that for large open spaces, workshops, and warehouses, this light has many decided advantages which cannot fail to secure for it due recognition. We now hear that this system has been introduced into the Royal Laboratory at Woolwich, and that with one engine of about 25-horse-power sixteen brilliant lights are supplied, any of which can be extinguished without interfering with the rest.

Edison's Electric Light is once again the subject of considerable discussion in the scientific world, and especially in gas circles. It appears that the Professor recently contributed an article to the *North American Review*, in which he recounted a number of further developments in the machinery for the production of the light, and argued for its soundness as a commercial speculation. We are bound to confess, however, that these new developments, so far as we understand them, do not appear likely to advance the success of the light very materially. At the same time it is quite evident that Edison continues with characteristic pertinacity to devote his attention to the subject; and at the head of a man who, in various branches of science has accomplished so much in the past, and is labouring with so much spirit and determination in a matter of immense interest and importance to the civilised world, we are not disposed to level that abuse and ridicule which a certain section of the gas world seem ever ready to shower upon those who directly or indirectly presume to threaten their position.

ELECTRIC LIGHTING.*

Almost two years ago I had the honour of delivering a lecture in this place on Electric Light. To-night I have undertaken to report the progress which has been made in the interval with the subject. All the enquiries whether or not gas lighting was greatly prejudiced by the electric light. It was generally admitted that a revolution-working discovery had been made, and you may remember, as a consequence, that the shares of gas companies suffer a while, when the electrical engineer was introduced and joined in the delight of scientific examination, demonstrations and lectures. Then the gas companies set to work to improve their gas in place of the lamp and burner, which at first took possession of the public mind, there is now, I think, a reasonable confidence in the possibility of electric lighting, but the universally prevailing that electric light is a substitute for gas, is after all a theory.

The following remarks on the *present position* are here given, and the description of the *present practice of producing electricity by mechanical means* has been added.

On the production of electricity.

It is practicable to develop a horse-power by the combustion of 25lb. of coal per hour, and to produce with that amount of motive power a current of electricity sufficient to give a light of several thousand candles; that is, 1,000 to 2,000 candles, or 6 large gas-burners, or 12 of the more than equal to 1 cubic foot of gas per hour, and consuming 5 cubic feet per hour. Of the voltaic battery, or any other means of converting an electric current of present known, there is only one means of converting an electric current of electricity was discovered as essential to the voltaic cell, and the question of electricity. Mr. Planté was, I believe, the discoverer in the secondary battery of it. Many have since experimented, and I have myself, in the idea of a secondary or charged plated opposite each other and very near together, but not touching one another, and separated by the space of about one-eighth inch, or *viz., lead* and in the presence of *dilute sulphuric acid*. Now, the action of the same metal, voltaic battery, inasmuch as the combination differs from an ordinary battery in the absolutely of the two metals employed. The ordinary battery is zinc and copper, or zinc and platinum, or some such metal in part constitute it. It is that zinc is the one metal employed with an electrolyte of dilute acid. Now, in the secondary battery, the two plates are alike, therefore of the same voltaic battery. But if these two plates are first charged with the ordinary way with a generator of electricity, a current will flow as one set of the (presumably) oxidised, and the other reduced. This kind of thing may be used plates is changed on its surface—it becomes (presumably) oxidised, one of the other reduced as well as upon the other, and the battery is ready for use. condition or is to be able to give out, at any future time, a current of electricity on its own account. The process of charging is to send a current into the plates are, in a way, opposite, just in the same condition they were before receiving the charge, and are ready to receive another charge. The secondary battery, therefore, is a means of storing electricity. The battery is transient, and it is useful to be hoped that it may be of interest at the present time, when the question which I have described is being much discussed, to have it explained how the secondary battery, applied as a store of electricity, will work large scale for accumulating electricity for lighting. I have here a small, but decided, makes a very great noise, and I am glad to see that all that could be was charged this morning; I have not touched it since. I will now ask how will join the plates together by this platinum wire? It was nearly burnt. I will disconnect and the wire will become cool. Now, I will charge it again. The want of a means of storing electricity is now (by the use, white hot) cannot be a question of the practicability of the secondary battery. It has been completed in actual practice, and research is still busy at work. It has be completely fulfilled. Research is still busy at work; but it is not to be found, and with the perfection of the secondary battery that great object in electric lighting—that you cannot only produce the power when you—like electricity was here lately refused to.]

All the various methods of producing electricity that can make any pretension to practical use are divisible into two classes, namely—

1st. Voltaic electricity.

2nd. Electricity by magneto-electricity.

In lighting by the electric arc, it is the break or gap in the circuit which has to be bridged over by a spark of electricity before flame. In lighting by incandescence there is no break or gap at all, but a continuous circuit of high resistance, and it is the heating of this by the current that produces the light. In lighting by incandescence, therefore, a continuous solid substance is there between the terminals which, and such a light, which is prepared for use. Now, to do it most perfectly and I am talking about, I will first speak of the voltaic battery, and then—incandescence—is found in the secondary battery. A secondary battery, produced by a steam engine and dynamo-electric machine, is charged, and these two pencils of carbon are brought into contact, whereupon there is a stream of flame, the carbon is consumed; by increase of the space a much expensive one much expensive one and the current is consequently diminished, and when the distance of about a quarter of an inch is reached the light is found to be of the best possible character. The carbons are also made to approach one another by clockwork, and the current is consequently light is found to be of the best possible character. The carbons are also made to approach one another by clockwork, and the current is consequently arranged that each of the carbons shall receive a certain limit of consumption before the carbons are made to approach one another by clockwork, and the current is consequently also reason.

A certain *amount* of difficulty or resistance must be offered to the passage of the current in order to get the most light, and to get the best effect the resistance to be neither too much nor too little.

When the points are made to touch there is no longer the resistance of the air-space to be overcome in the circuit, the light consequently goes out.

Observe the alternations in the light, and how they depend on the distance between the points. Now, as the production of steady light depends on the points should be maintained at a constant distance, it is clear that under the complicated conditions of every-day use the question of the distance of the points to each other is a matter of extreme difficulty.

I will now ask for the carbons to be turned on to a large lamp of light, in order that you may see how very nearly the difficulties of producing a steady are fulfilled in the incandescent lamp.

The particular lamp I am using for the purpose of my illustration is that which is employed in the Holborn Viaduct Station. Properly-applied it fends the points together almost continuously and with great precision.

That, then, settles and *finally disposes of the question of Electric Light*. That is the form of electric light that inventors have for the last forty years struggled and battled with difficulty upon difficulty to render serviceable to the wants of man.

From the nature of the electric arc light you will easily perceive that it is a kind of light not suited to the lighting of dwelling house, nor shops, nor streets.

It does not lend itself kindly to division, nor extensive distribution. It will give you either a great deal of light or none.

The incandescent principle used is excellent. If you want a very brilliant light, and one concentrated in one focus, for a lighthouse or signal, for example, or for illuminating a large factory station, or very large workshop, or open space, it is unquestionably the most economical and the best of all artificial lights.

It has already found for itself in England over 20 appreciable applications. Its use is continued and increased on the Thames embankment. It is used in the main room of the British Museum; in the Union Library, Liverpool; in a portion of the South Kensington Museum; at the Liverpool Exchange; in the Grosvenor Gallery; in the Newcastle Water Co.'s Reading Room, Blackburn; on the Promenade at Blackpool; and at the New Albert Dock, Leeds. In all these cases the electric lamps are used in conjunction with gas, and are lighted by ignition by day, and at a very moderate cost.

As an illustration of the economical lighting by means of the electric arc under conditions suited to its use, I instance the case of an installation which cost £2,000 and is lighted with a consumption of 70 cwts. of gas per week, or 3,640 cwts. of gas per annum, giving the worth of gas per annum of £1,820. The £2,000 was borrowed, at a cost of 5 per cent., and some interest was given for the economy of the electric arc light is greater by half in the case I have mentioned, and it is probable an effect of general illumination can be produced by the electric arc light at a cost of 25 per cent. less than overland as well as upon the Continent.

The interest which attaches to electric arc lighting is much less than it was. It is not now a novelty, and it is not likely to be extended. Whereas, the incandescent light, as a rule, wants the light of 1,000 candles all in one place. Now, it is not generally want in a number of small places, dispersed in different rooms, and in different parts of another direction. For electric light of this description we must employ a subdivision of the electric current.

I said that there is another way of producing electric light; namely by magneto-electricity.

Lighting by incandescence is a branch of the subject which has a special and its I believe to be the best which will yield the largest crop of light. Electric lighting by incandescence is a subject which is not a very good conductor of electricity, highly infusible, and which, when heated to a high degree, undergo change in a vacuum. There are, so far as I know, no other substances which possess all the qualities I have specified in the purpose in question.

The two substances are Platinum, or an alloy of platinum with iridium, and carbon.

Platinum has the advantage over carbon that it is not consumed by the heat, but it has the disadvantage of you make it why you make it why you make it why

Nature. PHYSICAL NOTES [illegible] 1880

Mr. J. E. H. Gordon has lately patented a method of producing light from electricity based upon Mr. Spottiswoode's suggestion to apply the alternating-current magneto-electric machine of De Meritens to the induction-coil. Mr. Gordon arranges small balls of platinum or iridium, or of an alloy of these metals, at the ends of fine platinum rods in pairs in the middle of a suitable globe, and causes to pass between them a rapid succession of sparks whereby they are raised to incandescence. There is no consumption of carbon or any other substance, and the lamps may be connected either in series or in parallel branch arcs. The principal remaining disadvantage is the noise attendant on the rapid sparks. A mechanical contrivance is added to keep the knobs near together when no current is passing in the primary coil. The induction-coils used are of comparatively small size.

The Brush Electric Light Company has twenty-two lamps on Broadway, in this city, between fourteenth and thirty-fourth streets. The lamps are supported by iron posts twenty feet high. The station from which the electric force is supplied is in west thirty-fourth street. The generating machines already in use, and here in number and will each give current enough to supply sixteen lamps of the standard power of two thousand candles. Each fifty ordinary gas burners each. Each of these generating machines is about four feet long, eighteen inches wide and two feet high. The armatures make about eight hundred revolutions a minute. Fourteen machines, in addition to half a dozen more station light machines, are now ready for use. Forty-eight machines which is now nearly ready for placement from Glenfield. The company have introduced a cheap and effective fuel under their boilers; they burn the screenings of coal yards mixed with bituminous coal in the ratio of ten tons of dust and screenings to one ton of coal. The mixture costs about one dollar a ton and gives an excellent fire.

Electrician Nov 13 1880

The Electric Light.—The British Electric Light Company (Limited), through Mr. H. Bury, their agent, in Manchester, have introduced into the print room of Messrs M'Laren and Neylson's warehouse in George-street, a system hitherto practically unknown in that neighbourhood. Under Mr. Bury's superintendence there have been fitted up at Messrs. M'Laren's premises seven small divided lights, on what is known as the André system. Depending from the ceiling in lamp form, the lights are protected by glass globes, and fitted with reflectors, and their brilliant illuminating power is strikingly evidenced by the manner in which the various colours in the prints are shown up. Each light is said to be equal in power to six ordinary gas jets, and the system is held to be specially adapted for warehouses, printworks, steamers, billiard tables, dining and drawing rooms, and, indeed, any place where many small lights are required. The system has been introduced by the company in London and elsewhere, but this is the first occasion on which it has been shown in Manchester.

The Anglo-American Company.—We should have given any shareholder more credit for business acumen than the instigator of the subjoined letter, which was given in the money column of a daily contemporary :—"Sir: Referring to the recent correspondence with reference to the interim dividend announced by the Anglo-American Telegraph Company, we beg to inform you that we have received instructions, on behalf of a holder of deferred stock, to commence immediate proceedings with reference to the payment of any such dividend, and further to restrain the payment of any further dividends until the capital represented by two of the cables which are said to be lost be replaced.—We are, sir, your obedient servants, Tyrwhitt and Son, 9, King-street, Coventgarden, London, W.C., Nov. 1."

A new system of electric lighting by the incandescence of filaments of carbon was shown and explained at the Society of Telegraph Engineers, in London, on the 25th ultimo, by Mr. Swan, of Newcastle-on-Tyne. Mr. Swan claimed to have solved the problem of subdividing the electric light so as to render it available, when certain minor difficulties be overcome, for domestic purposes. Professor Tyndall, who was present, said that if the durability of the carbon could be proved by experiment, Mr. Swan's success was complete.

The Jablochkoff light is to be introduced by M. Heyre-Mangon into the Conservatoire at Paris. It will be fed by a Gramme machine which the Government has purchased for its constant use. The light will be placed in the amphitheatre, where M. Heyre-Mangon delivers twice a week his own lectures.

Engineering Nov 19 1880

The Brush Electric Light.

Last Friday evening the directors of the Anglo-American Electric Light Company received at their works in Vine Street, Lambeth, a number of scientific and other gentlemen interested in the subject of electrical lighting. The visitors included Colonel Festing, R.E., of the South Kensington Museum; Captain Linden, Naval Attaché of the Russian Embassy; Mr. William Spottiswoode, P.R.S.; several representatives of the Admiralty; as well as Sir Henry W. Tyler, M.P., and Mr. John S. Sellon (of Messrs. Johnson, Matthey and Co.), who are the chairman and vice-chairman of the company respectively; Mr. Nettlefold (of Messrs. Nettlefold and Sons); Mr. Montgomery, the acting managing director; and others. The object in view was to demonstrate that the company was in full working trim and were executing orders for every variety of application of the Brush system to illuminating purposes. The Victoria works are illustrated by various electric lamps, which are kept going by a 16-light Brush machine. A new machine, just completed, and about to be despatched to Portsmouth, was also started, and instantly an additional fleet of light, said to be of an intensity of 9,000-candle power, and which was very striking, and almost overwhelming, shone throughout the works, making it as light as day in almost every part of the building. It had at first been proposed to display this splendid light outside and at the top of the building, but this intention had to be abandoned on account of the high wind prevailing, which prohibited the exposure of the naked light, there being no glass-globe at hand.

The Brush system of electric lighting, which in a great measure owes its introduction into this country to the exertions of Mr. Sellon, is very extensively used in the United States, and is making rapid progress in England. The system was described by us on its first number for the present year, so that we need only now observe that the Brush dynamo machines—one of which we then illustrated—are made in several sizes, capable of operating from one to sixteen or even more lights in a single circuit, which may be ten or twelve miles long. In construction they differ in some extent from other machines of the same kind, both in the armature-field magnets and commutator; and they are so constructed that the moving parts, such as the segments of the commutator and Brush contacts, can be easily replaced when necessary, by an ordinary mechanic at trifling cost. The current obtained is continuous, but of a highly electromotive force, in order to overcome the resistance of a long circuit and a considerable number of arcs. The lamps are exceedingly simple and practical in construction. Its appearance they are mounted on open rectangular frame of iron, with a closed box above containing the regulator and the two carbons down the middle. They contain no clockwork, and no adjustment is required beyond replacing carbons when consumed. By means of an automatic cut-off each lamp may be wilfully or accidentally extinguished without sensibly increasing the brightness of the others in circuit, for the corresponding increase in their illumination is only one-sixteenth. The lamp is placed in position by simply hanging it up, so that it is in every way suitable for general purposes. The carbons are in the form of two cylindrical rods pointing to each other vertically. It is claimed for this system that by it the drawbacks of expense, uncertainty, and complicated mechanism, which have hitherto stood in the way of an extended application of the electric light, are overcome, and economy, constancy and simplicity secured.

The Brush system should be considered as rather the multiplication than the subdivision of the electric light—assuming that, instead of dividing a large light into a number of smaller units, with a loss in the total light for each subdivision, we rather multiply one sixteen-candle light, say 1000 to 2000 candle-power, into an increased number of lights of the same size, absolutely energy proportionately to the increase of number. By simple manipulation of the regulator, the number of lights may be diminished or increased, as required, to any degree up to the maximum number, with a corresponding saving of expenditure. One of the most important advantages of the Brush system, and which arises from its peculiar construction, is the great ease with which lights may be worked at a long distance from the machine with a very small loss of power. Again, one pair of conductors only is sufficient for all lamps, no matter what their number may be, and the loss due to these conductors falls, not on each lamp, but upon the whole circuit.

The saving thus effected is considerable and only of electrical energy, but in the first cost of wire leads.

Under the guidance of Mr. William Ladd, F.R.A.S., and Mr. Montgomery, the visitors were conducted over the works, which are very extensive. They were shown the various processes connected with the manufacture of the Brush machines and the electric lamps, the latter being of an exceptionally substantial nature. The display of the light at the works showed conclusively its perfect suitability for factories and workshops, the light being white and very steady. On leaving the works the visitors proceeded to the Liverpool Street Station of the Great Eastern Railway, where the Brush light is undergoing probation, and where its suitability for station purposes was evidenced. Altogether the demonstration was very satisfactory as showing the practical progress of the Brush system. The light will soon be seen at Westminster, where it is to be introduced on the Clock Tower of the Houses of Parliament. Moreover, in a short time it will be visible on an extended scale in the City of London, a considerable portion of which is to be illuminated by it, namely, Blackfriars Bridge, New Bridge Street, Ludgate Circus, Ludgate Hill, the north side of St. Paul's Churchyard, and part of Cheapside.

On Monday evening another opportunity was offered for inspecting the company's works and their system of electric lighting. The weather being more propitious, there was a display of the large Brush light (of 9,000 candle power) on the roof of the building. The visitors were taken by omnibus to the north side of the river and to Oxford-street, which was very striking indeed. The light seemed to annihilate distance, for in Northumberland Avenue it appeared to be but a few yards off, although faced at least half a mile away.

London Mining Journal. [illegible]

The Electric Light for Collieries.

Coal Trade Journal. Dec 4 1880

The arguments from time to time put forward in demonstration of the electric illumination was altogether inapplicable in collieries appeared to be in every way justified when considered with regard to the character of the electric light, the increase of safety and the production, and the consequent saving in cost, not to speak of its unreliability and the great trouble attending its use. But these views must have been very materially modified by the interesting paper by Mr. J. W. Swan, of Newcastle-on-Tyne, explaining his system of subdividing the electric light, read before the Society of Telegraph Engineers on Wednesday evening. The light produced by Mr. Swan's system is of the incandescence class, and the essential feature of novelty appears to be in the excessively small carbons used and the completeness of the vacuum in which they are burned. He maintained that even where the electric light as produced by the new was of greater subdivision, the maximum necessary to counteract its tendency to vary in power, the cost and trouble of replacing the carbons, and other disadvantages, would frequently diminish and frequently entirely neutralise the advantages of its economy and extreme brilliance. The moment the attempt was made to produce a small sun with this light the chief working quality of that light—its economy—was sacrificed. He admitted that it had been claimed for several systems at work that they solved the difficulty of subdivision without sacrificing economy; but he maintained that their success was doubtful. The only direction in which we could move with any chance of substantial success towards making electrical illumination generally practicable was in that of abandoning the arc altogether and going to incandescence pure and simple. The process of incandescence a small enough light could be produced for domestic purposes, and it could be divided indefinitely. With a constant current the same amount of light was then obtainable at any part of a wire, whether it was short or long, and the one condition to be observed towards the maintenance of a constant current was the reduction of the electro-motor force in proportion as the length of wire varied.

That there were practical difficulties to be overcome in the application of the incandescence principle was fully recognized, but Mr. Swan considered those were neighter numerous nor insurmountable. He showed that those were neither numerous nor insurmountable. He three chief sources of failure were—that due to the carbons being so thick as to require a very strong and, therefore, expensive current in them, that due to the non-durability of the carbons employed, and that due to the lamps specially becoming blackened or obscured. He stated that 20 years ago he tried to overcome these difficulties, and to produce an electric light by the incandescence of carbonised paper in a lamp from which the air was exhausted, but owing to the less perfect appliances of that day the result was not satisfactory. The discovery

of the dynamo-electric machine, which has been constantly referred to in the *Mining Journal* in connection with the economic production of electric currents since the machine of this case, exhibited by Mr. Wm. Ladd at the Paris Exposition in 1867, attracted so much attention; the invention of the Sprengel pump, and the experiments of Mr. Crookes in the production of a good vacuum led to fresh investigations, and enabled Mr. Swan to employ successfully the thin filaments of carbon which he now uses. He explained that the filaments with which his lamps were fitted were extremely thin—only about a hundredth of an inch in diameter; they were 3 in. long, and the bulb of the carbon filament weighed only one-fiftieth of a grain. The material was both hard and elastic, so as to be more like a wire than a carbon. The economy of the light to be obtained by the incandescence of this conductor was limited by its capacity to endure an enormously high temperature corresponding to a extreme degree of incandescence. The carbons were more durable when heated to a moderate degree than when the temperature was pushed to a high pitch. It was still an open question what was the most light to be obtained by such lamps, but he knew that a well-made lamp with a carbon of one-tenth of an inch total superficial area would endure for several months, if not pressed to give more light than 30 standard candles. As evidence of the character of his light, Mr. Swan showed 12 globes, each containing three of his tiny lamps, and he stated that each of the enclosed lamps was of the power of from 20 to 60 candles, explaining that his object had been to imitate gaslight, but to give as much light as possible.

As to the commercial value of the invention, no definite opinion can be formed until details can be obtained with regard to the composition, cost, and durability of the carbon; but when such men as Professor Ayrton, Mr. Varley, and Professor Tyndall express their satisfaction with the experiments, there need be no doubt that something is to be expected from the invention. Professor Tyndall said the question that remained to be decided was the durability of those extraordinary filaments of carbon, regarding which their curiosity was aroused. Small lamps of this kind might possibly be made of considerable use in coal mines. It was very easy to inclose small lamps of the kind in water so that they should be protected from the explosive gases of the mine. When the question of the durability of the carbon was settled Mr. Swan's success would be complete. Mr. Swan showed by actual trial at the meeting that an inexperienced person could fit a new lamp much more easily than an ordinary gas globe is fixed in its place. As to the durability test, he had been burning the same lamps since Aug. 3, with one interval of three weeks only. From these data it may safely be assumed that Mr. Swan has some means of the production of an electric lamp applicable in collieries than any of his predecessors, and if it be demonstrated by actual trial that 50 lights, each of 20 candle power, can be produced with 4-horse power indicated, there can be no question that Professor Tyndall's suggestion will be adopted, and that collieries will be economically and brilliantly illuminated by a method which will render the ignition of fire-damp, and consequent disastrous explosions, practically impossible.

Electrician Nov 27th 1880

MR. EDISON'S LAMP.—The Patent Museum, South Kensington, now contains Mr. Edison's "original lamp," accompanied by a certificate stating that it burnt for 1,300 hours.

FRENCH OPINION OF MR. SWAN'S LAMP.—*La Lumière Electrique* reminds its readers of its oft-repeated charges by it not replied from, Mr. Swan. Mr. Swan's recent lecture affords some occasion for rejoicing at the confirmation contained therein of its opinions, and although refraining from any definite views with respect to the practicability of subdividing the light indefinitely, *La Lumière* speaks very highly of our countryman's labours.

ELECTRICITY IN COLLIERIES.—In his recents letter to the *Times* Mr. W. H. Preece pointed out that lightning was probably the immediate cause of some colliery explosions, and alluded to the Risca explosion as a case of the kind. His statements were criticised by Colonel Shakespear, and in reply to this criticism Mr. A. H. W. Radcliffe has written the following the whole of last week prevented my earlier answer to Colonel Shakespear's letter in your edition of the 6th, and as I am the Mr. Arthur Radcliffe alluded to by Mr. Preece (in his letter to *The Times*) as having investigated the matter of the Risca explosion on the spot, I feel called upon to respond to Colonel Shakespear's query as to my having charge of lightning, assuming it stands to the credit of which I prefer to take the course down the shaft in preference to the mass of metal in the engine house. In the first instance the engine is generally well insulated by having a solid bed of masonry or concrete for its foundation. In addition to this, at Risca the engine house is built at the side of the mountain, which is almost wholly composed of stone. At all events, wherever the shaft has slipped or been removed near the pit, scarcely anything but stone is apparent. And my experience as telegraph engineer for the Monmouthshire Railway Company, which runs by the colliery and through adjacent valleys, has shown me the difficulty of obtaining what is technically known as 'good earth' in such ground. In the collieries in the neighbourhood I have had to carry my earth wire several hundred yards; therefore it is only reasonable to assume that the conducting ropes and rods down the shaft, terminating in long lengths of metal rails, would afford a better channel for escape than the mass of insulated metal in the engine house. With reference to Colonel Shakespear's further remarks as to the engineman not having spoken on the subject, he did so on the day of the explosion; he said a flash appeared to strike the building, and a few seconds afterwards the explosion occurred. Whether this flash caused the explosion or not is a matter that must now be one of opinion only. Mr. Preece's object in writing his letter was merely to call attention to a very possible source of danger, which could only be avoided by having the head gears of collieries thoroughly protected by lightning conductors—not such as are usually fixed by rule of thumb—the end of the rope simply buried in the ground, regardless of the nature of the soil—but by conductors efficiently fixed and electrically tested. In vindication of the theory I propounded to Mr. Preece, and which produced his letter, I may say I had it personally from one of H.M. inspectors of mines that a manager of a colliery mentioned to him that some of his men have been very much alarmed at seeing a flash of lightning on the metals underground during the time a storm was raging overhead. What would have been the result in that case had there been gas present?"

REMINISCENCES

COMMERCIAL SKETCHES.

OLD PHILADELPHIA AND SOME OF HER MERCHANTS.

No. 6.

"LAMARTINE wrote that "it is not requisite one should be a great man in order to be a great king." True, and so of life generally. A man may be a great thinker without developing much of anything to himself, either himself or his fellow-men. Another may be a great administrator and yet be incomprehensible in all else. A great army officer may be a very mean man, or little-minded in everything that does not pertain to his particular pursuit. The author's idea of a great king was doubtless that he should comprehend fully the duties of his exalted vocation, and that so comprehending he would govern with breadth of vision, and that so comprehending he would govern with wisdom, justice, and humanity. Great fortunes are frequently made by men of very ordinary capacity or acquirements. Little men often pursue a single idea, or elevate their whole lives to the pursuit of gain in a beaten track, and thus accumulate wealth at the sacrifice of every duty that is imposed upon them by society and indeed by their fellows; but a great merchant is endowed with skilful capacity, acute discrimination, and farseeing judgment. Although not intuitively great he becomes a great merchant by the careful exercise of such powers. Greatness is the result of combination. Great storms arise from a combination of the elements. Great parties are formed by combining large numbers of men together, as are great armies, great fleets, great cities, and great countries, in which are embraced all the elements of population and civilization generally.

Among the most notable houses in our city, or indeed in the United States, engaged in the foreign trade fifty years ago was that of the Browns. The original house was established in Baltimore by Mr. Alexander Brown. After a very successful career as a merchant in the Monumental City, Mr. Brown associated with himself his three sons, and established branch houses in Philadelphia, New York, and Liverpool. In this city the firm style was John A. Brown & Co., and in New York that of Brothers & Co., Mr. James Brown being the managing partner. In Liverpool it was William and James Brown & Co., the first-named partner being the manager, while in Baltimore the firm name was changed to Alexander Brown & Sons; and thus was launched into the field of trade and commerce what in after years became a great financial power on two continents. The business of this combination of firms was a general commission trade and dealing in foreign exchange. During the cotton shipping season they had an agent or representative of the house stationed at each of the cotton ports, who bought from the planters or shippers the drafts that were drawn on England against shipments of the staple, paying therefore in cash or sight drafts on their Philadelphia or New York house as desired. The bills purchased at the cotton ports were sent to the house in this city or New York, and thence forwarded to the Liverpool branch for collection and thus John A. Brown & Co. were always ready to furnish to the importers of our city any amount of English exchange that might be required for remittances to pay for goods purchased on the other side of the ocean. The business of the house in this connection was for many years simply enormous, and must have been extremely profitable.

The unsettled and precarious condition of domestic exchange at this period, when every State had its own system of banking, some of which was of the "wildest" order, and when it was frequently difficult to buy a dinner notwithstanding one had an abundance of money so-called, must have contributed largely to the success of the Browns, and a recurrence in the experiences of that period suggests that after all the rebellion of the Southern States has not been without substantial benefit to the whole country. Up to the year 1861 the currency was phenomenally bad; now, under the national banking system, which was forced upon us by the exigencies of the war, it is the best in the world. With this admirable system in operation throughout the entire country, a note issued from any one of our Philadelphia banks is as good in New Orleans, San Francisco, or anywhere else as it is here. Not even the "All United States Bank, with its branches in various localities, was able to accomplish half so much. Under the present system, as is well known, the security to note-holders is so absolute that the issues of a bank that may from any cause have failed are worth as much as those of a perfectly solvent one.

The business place of the Philadelphia branch of this great commercial establishment was originally on the south side of Chestnut Street near Front. In later years it has been in the same building with the National Bank of Commerce, in which institution the firm is largely interested. The original members of the firm have all, we believe, been retired to their mansions whence no traveller returns, but the business has been continued up to the present time by the younger branches of the family. The first change of firm name of the Philadelphia house was when it was altered to Browns & Bowen, and then to Brown Brothers & Co., which it bears at the present style. The Liverpool firm was meantime changed to Brown, Shipley & Co., and is still so continued, a London branch having been established within late years under the same firm style.

Mr. John A. Brown, the old-time chief of the Philadelphia house, died some years ago. He illustrated the idea with which we introduced this article. Of a quiet, unobtrusive, and genial nature, he was not at all a great man, but he must have been a great merchant to have conducted successfully the affairs of a firm that was during many years of his life so conspicuous, not only in our own but in other countries. For many years he was a director of the Insurance Company of North America, and at times also of different banking institutions. Being of retiring habits he confined himself strictly to business and the care of his family. He accumulated a large fortune, and at the time of his death was said to be worth three to four million dollars, and yet we recall an incident in the history of the firm which for a time threatened to be more disastrous to the monetary results to all its members.

It was at about the year 1848 or '49 that one of those semi-periodical panics which have from time to time wrought financial wreck and ruin took place. It affected England and America alike. Old houses that for many years had been considered impregnable were shaken, and tottered as though they must fall before the sweep of the hurricane, and many, the proprietors of which considered themselves invulnerable, went down, and the debris of years of commercial enterprises and thrift was being strewn about like driftwood, not only in the United States but in Europe. It so happened that the Liverpool branch of the house was much extended at this time, and its assets were daily and hourly being loosened. Crumbling away under pressure of the panic they were becoming almost entirely unavailable as cash resources, and as a consequence the position of the house had become extremely critical. Every effort had been made to ward off the impending evil, and as a last resort the last expedient was resorted to by the Bank of England for relief and assistance, and Mr. William Brown, the senior member of the Liverpool firm, who, by the way, served some years as a member of Parliament, went up to London to meet the directors of the bank, and under the necessary application. The condition of the house was set forth, and its entire solvency was shown, provided temporary aid was afforded. Mr. Brown waited tremblingly and with impatience an entire day for the decision, and finally it was received in the shape of a negative, and which filled him with apprehension he returned to Liverpool and reported the failure of his mission to his partners. Among these was Mr. Joseph Shipley, a young gentleman, then of great energy and enterprise, one of those Englishmen who don't admit the word fail into their vocabulary, and justly proud of the standing of his firm he expressed himself as highly indignant at the bank's refusal, and declared his purpose to proceed at once to London and renew the application. He would see, he said, if the directors there to refuse an application that was so legitimate, and at the same time reasonable. "They shall do it yet," he added, "notwithstanding their refusal," and he took post at once for London. His first business was to get the managers together again, and this done he appeared before them in person, and related the case with such cogency of argument that ere the day had closed the board was induced to change its action and grant the needed succor. And thus was this great commercial and financial establishment saved from impending bankruptcy. If the Liverpool house had fallen the others must have gone down also, and thus would have been wrecked the several splendid fortunes that had been realized by the respective members of the different firms. Mr. John A. Brown was greatly alarmed on account of the ruin with which he seemed to be threatened, and looking only at the darkened side of the situation he was wellnigh in despair. And so greatly was he excited in regard to the matter that it was said at the time, and we believe truthfully, that he proposed to some friends that if they would secure to him an annuity of six thousand dollars a year during life he would transfer to them his entire interest in the firm. Such are the mutations of life, and such the changing vicissitudes of trade and commerce, that the millionaire of to-day may become the mendicant of to-morrow, and the servant, as it were of yesterday may aspire to be the assistant of the coming hour.

shore end, and not far from it, and added it upon the 22nd. The wire was first case of a cable breaking down and then being repaired.

In this same year (1850) a cable was laid by Messrs Newall, at Sunderland, was laid across the belt for the Danish Government. It had three conductors of No. 16 copper covered with gutta-percha, and was 7 miles in length. It was laid by Mr. Robinson from a schooner in the employ of a tug, and is the first example of laying a cable from a moving ship in tow. In November of the same year the author laid a cable of exactly the same pattern across the Solent from Cowes to Hamble cutter, with her mast removed, in tow of a tug. In December of this year the author laid from the "Monarch" a cable across the Firth of Forth and River Tay. The pattern of these cables was four copper cables laid up together in a similar manner to the ordinary shore-ends of the Hague cables.

1854. In May of this year, the "Monarch" was chartered by Messrs. Newall and Co. from the Electric and International Telegraph Company, and a machine was designed by Mr. Newall placed on board. It consisted of two drums about seven feet diameter, with grooves 4 inches wide and about the depth of half the diameter of the cable. These drums were driven by a pinion working into another wheel on the drum shafts. Bow bunks were fitted with a bow sheave about six feet diameter, with wrought iron spokes. The bunks projected beyond the sheave, and a bollard at the cable in between, but no check gear either at the bow or stern was used. With this machinery the 10 miles of Portpatrick and Donaghadee cable were recovered by Mr. Newall. The exact date of this expedition the author has lost, but it forms the first example of picking up a cable and the machine having two drums with grooves ins—ver been since employed for picking up from the bottom. The next year of the 1854 machine was a modification as regards two grooved drums. On October 6 of this year the single cable picking-up gear, with knife to cut the cable, designed by the author, was fitted by Messrs. Jackson and Amos, was fitted on board the "Monarch." A drawing of this machine is given in the author's paper, read before the Institution of Civil Engineers on 22nd February, 1859. It is the first example of a picking up machine with a cutting knife. It had also a ratchet, and could be worked by manual power, long handles extending on each side of the driving shaft to tackings on the gunwale of the vessel, and thus about thirty men could be applied to it. Steam power was applied in the next year, as the work got heavier.

On September 4 of this year a cable centrally similar in type to the Hague cables was laid between Holyhead and Howth, from the "Monarch," the break being picked up by the "Elfin." The expedition was under Mr. E. Clark, assisted by the author.

SWAN'S LAMP AT THE SOCIETY OF TELEGRAPH ENGINEERS.

A very large gathering took place at the Society's rooms, Great Georgestreet, Westminster, on Wednesday evening last, in order to listen to Mr. Swan's exposition of his new electric lamp, and to witness its performances before a professional audience. Sir W. H. Preece, the President, occupied the chair, and amongst those present we noticed Messrs. Latimer Clarke, Cromwell F. Varley, Sir C. Bright, Professor Abdank, Mr. Spagnoletti, Professor Carey Foster, Professor Ayrton and Perry, Mr. Shelford Bidwell, Mr. Preece, Mr. Sabine, Mr. Culley, and a number of many others well known in electrical and scientific circles. Various specimens of the lamps, exposed as well as enclosed, were suspended overhead, and one occupied the interesting position of being a substitute for an ordinary table lamp. These were all lighted later on in the evening, and remained burning to the end. We will describe them fully as we proceed.

Before introducing Mr. Swan, the President announced that the trustees of the Siemens Gift had made the investigation of the subject over, and had expressed their opinion that everything had been done in accordance with the conditions of the bequest. Arrangements would shortly be made, it was hoped, for opening the library not only to the members of the Society, but to the general public under certain conditions, and a proposition would be submitted to the members very shortly for carrying out this intention.

Mr. Swan, who was very warmly received, began by remarking upon the, as he thought, useless attention that had been given to lighting by means of the electric arc, and the more familiar method, as he say, the working of a continuous conductor, having been very little considered, at all events, in this country. Theoretically there was no question as to the superiority of the last-named mode of lighting, especially where a number of lights were required, and the more familiar method, and he was long ago convinced that incandescent lighting was the only and only form of popular light possible, if popularity was to be won for any system of illumination by means of electricity.

Arc lights, it was obviously limited. It can only be employed in large areas, for to attempt to use it where the space is small would be to waste the excess of light extravagantly, and to attempt to split it up into smaller lights, still of the arc pattern, by applications on the score of cost became only as he saw her in his enthusiastic youth. Nor [illegible] to the handkerchief decked with royal lace. The accounting now were serious. These objections applied even to the Wiesbaden and Regular lamps, although they were decidedly soothing, as regards the latter, on the other hand, they did not possess the steadiness of the Jablochkoff candle. Mr. Swan then discussed in detail his regret that the question of arc lighting was still kept very much in the dark, and that at the recent competition at Glasgow, from which so much was expected, only one lamp (Sir, Crompton's) held the period of an incandescent lamp. In the absence of figures, therefore, Mr. Swan observed, regarding the cost of producing arc lights, we have only inexperience, and the impression conveyed to the minds of most observers was that the biggest light was the cheapest. Mr. Swan noted, that a very big light was [illegible] 2,000 candles, gave 25 twenty-candle lamps and 2 arcs of 1,000 candles. On the other hand, the standards worthy of the name of arc lights, and the expenditure of candles and time of renewing them, skilled attendants being required to periodically attend to them. Then again, the question of the management of the current had to be encountered in one spot, not merely distributing very rapidly in strength as it extended, but by the very laws of nature, it was the reverse use of the term; "candle power." As is well known, this term is highly elastic, and upon its use or abuse a great many unfair statements have been based.

However, Edison almost universe connected with the Brush system of lighting to show that at any time, or under any conditions whatever, the Brush light, rated at 2,000 candles, ever approached one-fourth of the power of the single light, given by the A Crompton machine, which he (Crompton) valued at 4,000 candles. I will go further, and state publicly that had not the Brush system been withdrawn from the competitive trials at Glasgow, the fact would then have been made patent to the world that, under equal conditions of measurement—if 1 h.p. used in the Gramme system gives the light of 1,000 candles, 1 h.p. used in the Brush system gives the light of 1,000 candles only. These figures may be increased or diminished, but the proportion between them remains as above.

The facts and figures are really far less favourable to the Brush system than this, but I have preferred to keep on the safe side.

If these figures had been applied to the estimation of candle power in the City tender, the Crompton system would have been found to be far cheaper than the Brush for equal light supplied.

—Yours, &c., W. CROMPTON.

Mansion House-buildings, Queen Victoria-street,
November 24, 1880.

1852. Specimen Lamps: A. M. Clark, London. (C. F. J. Gravel-Lacroix, Paris), for 1 light, the chief improvement consists in the arrangement of the electrodes, which are placed in a vertical position, the positive above the negative, and in such a way that the latter is constantly pushed up by its own weight. The lamp is composed of two pairs of tubular carbon holders at right angles to each other, the one set of carbons [illegible] with the holders and mechanism is mounted on a frame [illegible] being thereof to it at a permanently fixed distance.

The arc electric-current carried in a shunt circuit, and serves to bring the carbons together to establish the arc, the spring A acts upon the upper carbon holder, and tends to separate the carbons, but by the pressure exerted by the electro-magnet B, which is in series with the main current passes, carried principally by the coil C, the carbons are kept at a distance from each other, the arc being thereby established. (Jan. 23, 1880.)

ENGINEERING. Nov 19

ELECTRIC LIGHTING IN THE CITY.

On Tuesday last a meeting of the City Commission of Sewers was held to consider the tenders submitted for lighting during one year three districts of the City, in answer to the requirements of the Act. The offers from tenderers were considered. The first four different systems were considered. The first district comprises Blackfriars to Hill, the north side street, Ludgate Circus, Ludgate-hill, and Cheapside as far as St. Paul's Churchyard, and Cheapside as far as King-street. The particulars of the tenders for this district were as follows:

—	Qnty. for 25 Lights.	Fitting and erecting.	Total.	Number of Lights.	Yearly Cost.
Crompton ...	£ 2375	£ 600	£ 2975	25	£ 119
Siemens ...	2000	1000	3000	25	120

The Siemens' lights will consist of 20 small and six large arcs. The Brush system of 16 small arcs awarded to Messrs. Siemens Brothers. Some idea of the different kinds of installations proposed may be gathered from the following particulars. The Anglo-American Lighting Company will erect lamps on separate posts, not less than 13 ft. above the ground. Overhead wires will lead from the company's Victoria Works, Vine-street, Lambeth, where the power will be derived, and from this post to post, overhead, except across the streets, when they will be carried underground. Messrs. Crompton and Co. suggested employing lamps capable of sliding up and down posts, or suspended across the streets, and to be lowered by cords and pulleys. Upon the bridges the lamps would have been carried on posts 25 ft. high. The Electric and Magnetic (Jablochkoff) Company will erect lamps on same system as on the Embankment, the wires being hung from lamp to lamp, and carried over the crossings, on high posts. Messrs. Siemens Brothers will employ large lamps in clear glass globes, with sawdrella-shaped reflectors, placed on posts 70 ft. or 70 ft. high, and mounted on the parity or wholly frosted clear globes, on 20 ft. standards. The wires will be laid underground, and the light-producing plant will consist of two 10-horse power semi-portable engines, three medium-sized dynamo-electric machines, and the siliconate current machines, with their sections. In making their report and recommendations, the Street Committee stated that they had been guided not only by the prices given in the tenders, but by the effect produced with the different systems in actual operation, all of which they had seen.

Do not photograph on this side

RECENT HISTORY OF ELECTRIC LIGHTING.

BY HENRY MORTON,

President of Stevens Institute of Technology.

On the 17th of October, 1878, in fulfilment of a promise made a year before, the present writer read before the American Association of Gas Engineers an address in which (alluding to the reports then resounding in the daily papers as to Mr. Edison's new form of electric lamp) he said, after quoting an account of a similar report current twenty years before in France: "These promising experiments, as we all know, reached no successful results. I would by no means, however, have it inferred that better success can never be attained. On the contrary, there are several very promising directions for experiment, on one of which no doubt Mr. Edison is at present embarked; but the difference between a promising line of experiment and a successful result, as all the world's history teaches us, is often a distance of many years, to say the least." An opinion so little calculated as this, to aid in "bearing" gas stocks, naturally excited no little disgust in certain quarters, and I had the pleasure of seeing myself very handsomely abused by those whose approval would have been a very doubtful compliment.

Looking back over the space of two years which has elapsed since those words were uttered, and remembering the events which have transpired in this connection, I feel that I have much more reason to congratulate myself than have those who took an opposite view.

Not only has "the promising line of experiment on which Mr. Edison was then engaged been separated by many years from a successful result," but it has, within this time, been totally abandoned by him, without, so far as known, either to say the least, still under approval, and the discredit and difficulties which has been cast from all sides, has shown how unfortunate and unwise were the reckless and unfounded assertions of the would-be Prophets of the Press.

Notwithstanding these draw-backs, however, continued progress has been made in the development of the art of lighting by electricity, and we have to regret that would otherwise have been a dignified march of advancing science, reflecting nothing but credit upon this country and its inventors, has been perverted to some extent into a carnival rout of grotesque and absurd extravagance.

In recording the progress which has been made in the art of electric lighting, the most important practical results have been achieved by those who have devoted their attention to the application of the electric arc, the peculiarity which presented itself two years ago in this subject, was the unsteadiness of the light, its great liability to extinction, and the extreme difficulty of maintaining it. By improvements in the carbon rods as to their purity of composition and uniformity of structure, a great increase in steadiness has been attained, and by other improvements in the mechanical arrangements of the self-adjusting lamps, this amelioration has been likewise assisted.

Among those who have done most for the improvement of the carbon rods, I would mention Wallace & Sons, of Ansonia, and among the most marked improvements in electric lamps, I would cite those of the Brush Co., of Cleveland.

The economical efficiency of the electric generators or dynamo-electric machines, has also been increased, and in this regard the best results, so far as accurate tests which have been published indicate, have been obtained by Mr. Siemens' machine, as tested by Profs. Young and Bracket, shows the very high efficiency of 84.1 per cent. of motive force or energy converted into electric current. The machines of other inventors appear to be only a few per cent. behind this, if indeed some of them are not found to equal it when accurately measured.

In consequence of these improvements and of the energy with which the several manufacturers have brought these machines to the notice of those likely to use them, their employment in factories, stores, workshops, and hotels, has become very general, and has undoubtedly proved of great advantage and convenience, although instances are not wanting (as for example in the great cotton mills at Lowell, Mass.), when the electric lighting was abandoned after a thorough test.

There is, however, so wide a field in which this light has manifest advantages over any other means of illumination that we may confidently look for a vast increase in its introduction in all parts of the country.

Turning next to the production of light by incandescence we find that this branch of the art also has made marked advances. This art had its beginning as early as 1845, when in the patents taken out in England by King, the representative of the American, Mr. Starr, we find described the use of platinum wires and thin rods of carbon, the latter inclosed in a torricellian, or absolute, vacuum. Extensive experiments in the same line were made by Mr. Moses G. Farmer, the widely known electrician, about the year 1858 and again a little later, by Dr. Isaac Adams, the inventor of the process of nickel plating, now widely used; but the costliness of an electric current derived from a galvanic battery prevented the earlier experimenters from reaching any commercial success, and even with the cheap electricity of to-day, there is still a limit set upon this sort of lighting, by its relatively wasteful expenditure of electric force and consequent costliness.

Great progress has, however, been made here also.

Mr. Edison supposed he had solved the problem two years ago when he had re-invented the earlier methods of Starr, Farmer, and others, but very soon finding, as they had done, the insufficiency of his solution, he attacked the problem afresh with an energy, persistence and originality of resources worthy of all praise. The outcome of his researches he has brought to light a number of astonishing results, and has discovered whole classes of new properties in platinum, and other metals, and lime, magnesia, zirconia and other substances.

Had his enthusiastic friends only claimed for him from time to time what he had actually done, his fame would have been unclouded as a discoverer, and without blemish.

Unfortunately, too many prophecies have been indulged in, and the credit of really great achievments has been overshadowed by the failure of still greater assertions and promises.

After the abandonment of the platinum lamp, Edison next took up the carbon-horseshoe lamp of Starr, and as before, his friends shouted "Eureka" at the beginning and not at the end of his search.

The carbon lamp, as first made by him, has met the fate of its predecessors, and has been abandoned by him likewise; but from its ashes have arisen, lamb in his other hands, improved descendents, which show the significance of survival.

Having found it practically impossible to make his paper carbons sufficiently durable when heated to such an intensity as would render them even possibly economical as sources of light, he has ransacked nature for some material which would fill these hard conditions, and in a certain variety of bamboo has found something which he believes will yield him a fine hair-like thread of carbon with which he can obtain the light of 16 candles from a single lamp, at an expense of 3.400 foot pounds of energy a minute. This would represent about 9 such lamps, or about 155 candles per horse power.

This is a decided improvement in efficiency over his horse-shoe lamps of last year, and with a durability, as is claimed, of six months, will seem to some a long step forward on the roads toward success.

Starting, also, with the idea of Starr as to the use of a strip of carbon in a vacuum, Mr. Maxim has proceeded along a different road.

In place of searching through nature for a substance which would yield a perfect lamp-carbon on hunting, Mr. Maxim has sought to make a perfect carbon strip in his lamp by building it up on any imperfect form as a substratum. To accomplish this he has taken a strip of carbonized paper as his groundwork, has covered this over with a metallic layer of graphitic carbon, by heating the original carbon strip by a current in an atmosphere of gasoline vapor. Under these circumstances, we only is a sheathing over the strip, but, if there is a weak spot anywhere in it, the carbon will be thrown off at this point (on account of its getting hotter than the rest), and thus an irregular or defective carbon strip will be repaired and rendered perfectly uniform.

By this process two objects are attained. In the first place a good carbon strip is secured, no matter what imperfections may have existed in the original paper or other carbon foundation. In the second place, the outer surface of the strip is composed of that variety of carbon whose resistance to heat and mechanical injury surpasses all others. All familiar with the material will know, that what is technically called "gas carbon" (*i.e.*, the carbon deposited in the mouth retorts by the decomposition of the issuing gas), of gas is a metal-like substance, the cutting, breaking, or shaping of which is very difficult, on account of its combined hardness and toughness. It very rapidly wears the best steel files and saws, and to break it with a hammer is almost a hopeless undertaking.

I have also known a weighted quantity of it to be placed with the fuel in a cupola furnace where iron was being melted and to have been taken out again after some hours, not sensibly diminished in weight.

This is the material of which the surfaces of the carbon strips in the Maxim lamps are composed, and should they prove as durable as I have hoped, it is to this that we should naturally credit their resistance.

I have measured a number of these lamps with such results as the following:

Lamp A. Resistance cold 2.04 ohms. and when yielding in its best position the light of 50 standard candles its resistance was 8.3 ohms. The current required to heat to its degree was one of 4.07 webers, and the energy expended was therefore 33.8 volts. Ans four pairs of these lamps were about five and a half (5½) such lamps to each horse power of energy of current employed or an efficiency of about 220 candles per horse power.

Taking 70 per cent. of this as the average for all positions we would have about 192 candles per horse power of current. Now the amount of actual horse power in the steam engine required to develop one horse power in the lamps will vary with the dynamo-electric machine the number of lamps in use and other considerations, but we may assume 80 per cent. as a safe allowance and this would give us about 115 candles per actual horse power on the engine as the efficiency of this lamp when run at 50 candles.

Another lamp (D) when resistance cold was 115 ohms. when yielding a light of 52 candles required a current of 1.35 webers and had a resistance of 64 ohms, when emitting the above mentioned amount of light.

The electric energy consumed in this case was therefore about 2.131 foot pounds per minute or about 64.4 metre kilogrammes per minute.

Taking 70 per cent. as the average light in all directions, reduces this to 42.1 candles, and assuming 60 per cent. as the efficiency of the conversion from motive power into electric current in the lamp, brings it to 138 candles per horse power of mechanical force developed in the steam engine.

We see therefore in this case also a marked advance upon the best of the art a year ago.

Undoubtedly an advance now made is sufficiently encouraging to authorize the experiments which are being made to apply these lights on a practical scale in situations where they have

Electric Light. Mackinet 1880

Electric Lamps.

THE SOCIETY OF TELEGRAPH ENGINEERS.

An ordinary general meeting of this Society was held on Wednesday, Nov. 24th, Mr. W. H. Preece, president, in the chair. The minutes of the last general meeting having been read and confirmed, the President announced that at a meeting of the Council trustees it was unanimously agreed that the Society of Telegraph Engineers had fulfilled the conditions upon which Mr. Ronald's library was to be held by the Society. On the 22nd a general meeting would be held on which application for opening the library to the public would be considered.

Mr. J. W. Swan then read a paper on "A system of sub-divisible Electric Lighting."

Mr. Swan first referred to the lighting and lighters by the heating of carbon rods by the passage of the current, and showed that theoretically a light produced by incandescence was above all others very good; that this light is unquestionably economical when concentrated, but possesses great mechanical defects. The arc light is not of much use for small lights, not being economical.

Several systems of lighting by incandescence have been stated to have been successful, but such has not really been the case. Definite numerical data are wanting on the subject, since mere impressions are not sufficient to guide any one.

Mr. Swan then referred to Mr. Edison's system of electric lamps, which was described before the Society of Telegraph Engineers, and after giving the theoretical data of the light which threw some light upon the nature of the materials material employed for obtaining the illumination—"I have found that when the carbon employed while the lamp is in action is borrowed, shaped plate, produced by cutting out the arch or horseshoe-shaped piece from a sheet of cardboard, and afterward carbonizing it by heat, that the arch or horseshoe-shaped carbon so produced is found to become distorted and ultimately to break in consequence of the unequal contraction caused by the unequal heating of the inner and outer portions of the arch during the use of the lamp. This defect I remedy by forming the carbon to be made incandescent of a strip of cardboard or paper cut into the form of a loop or strip; the front view of such loop or loop showing the section or thickness of the strip, and the side view its width. *The strip of cardboard or paper used as aforesaid is subject to a while heat in a close vessel or retort containing powdered carbon or other suitable air-excluding powder.*

There are now 318 telegraph stations in England and its operations in the United States.

POLICE.—The corresponding Chicago leads the way in adopting improvements for protection of public peace. Electric telegraphic stations have been established at different points in one important district, and relays of mounted officers are kept in waiting at a central station. Reliable citizens are furnished with keys to the telegraph boxes to protect their residences. To prevent, false alarms the keys are numbered, and cannot be withdrawn from the lock until released by a key carried by the policeman on that beat. When anything goes wrong in a district the alarm is sent to the central station, and explanations are given through the telephone. In case of serious disturbance a large force is sounded, and every officer on post runs to the nearest box to receive orders.—*Scientific American.*

peculiar advantages, as for example in the vaults of the Safe Deposit Co., under the Equitable building in New York, and in some adjacent offices.

When that experiment has been carried on for a few months we shall know much more than we do now as to the actual running cost of the system, but anything like a general adoption of the same in place of gas is still an affair of the future about which prediction is premature.

Gas and Electricity.

Illuminating Power of Gas in New York City.

Week ending	Consolidated Gas Co. Candle Power.	Harlem Gas Co. Candle Power.	Manhattan Gas Co. Candle Power.	Metropolitan Gas Co. Candle Power.	Municipal Gas Co. Candle Power.
Nov. 6.....	23-45	16.72	22.12	26.09	22.81	19.01
Nov. 13.....	25-54	18.53	23-13	25-90	27.11	20.06
Nov. 20.....	22-64	18.16	23.06	25.32	25.50	18.89

E. G. LOWE, Ph. D., *Gas Examiner.*

ERRATA.—The report of the illuminating power of gas in New York City, for the week ending Oct. 23, was erroneously stated. The average of the Metropolitan should have been 21.56; Mutual, 25.36; Municipal, 20.13.

The accompanying illustrations show two forms of heating apparatus, invented by Messrs. Ritchie & Co., and noticed in the *Metropolitan*. They are designed more especially for hot-houses, and doubtless answer this purpose well.

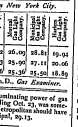


Fig. 1.

Fig. 1 is 3 feet 6 inches high, in which gas or oil may be burned, and consists of a central burner, placed within a glass tube. The products of combustion pass from the tube into a box at the top, and then down by the columns on either side. The object is to obtain the waste gases and vapors in a condensed form at the bottom. The condensed aqueous vapor will carry down with it most or all of the sulphur compounds, but a large part of the carbonic acid will escape. In a green-house, this of course is rather beneficial than otherwise, but if used in a dwelling, the carbonic acid would form quite a serious objection. Nothing is said of an escape flue, and we infer that there is none.

Fig. 2.

Fig. 2 is intended for lighting as well as heating, and has two burners on either side of a central column by which the products of combustion escape. It is 6 feet 6 inches in height; *Metropolitan* says that a burner consuming 3.4 cubic feet of gas per hour, and giving the light of 4.3 candles, will give the light of 22.1 candles in the Ritchie apparatus.

It must be a very poor burner or very poor gas that gives only 4.3 candles for 3.4 feet of gas. The only feature about the apparatus calculated to increase the amount of light is the reduction of the air supply by making the products of combustion pass downwards, and the arrangement with most gases would not give the necessary amount of air to the flame, if it could be made to work at all.

Much has been and will be said about the advantage of the electric light over gas in respect to the non-contamination of the atmosphere by the products of combustion. It is but natural that persons who have any grudge against a gas company should be very eager to magnify the great advantages of electricity over gas as an illuminating agent, but many of the objections urged against the one are to a certain extent to be found in the other. As to contaminating the atmosphere, Prof. Dewar, in a paper read before the Royal Society of Great Britain, showed very conclusively that as high as 12 and 13 grains of nitrous oxide per hour were produced by many of the electric lamps.

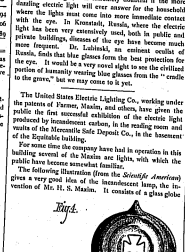
Buildings and rooms occupied by human beings or any other animals should be thoroughly ventilated, and it is certainly better to use gas with proper ventilation than electricity without it. The gas burners can be made to furnish the means for the ventilation of an apartment, and to persistently urge the "vitiating of the atmosphere" as an argument against gas is simply acknowledging our inability to establish proper ventilation. One might say, with almost equal force, that because the carbonic acid gas exhaled from the lungs vitiated the atmosphere that therefore we will stop breathing. It is not so important what our light is, provided it is adequate and suitable in other respects, as it is to remove the foulest air incident to all forms of combustion.

Another question which arises in considering the electric light from this standpoint, is the effect it is likely to have upon the eyes. In view of the many complaints which constantly come under our notice from persons using the yellow light of gas, it is extremely doubtful if the more dazzling electric light will ever answer for the household where the lights must come into more immediate contact with the eye. In Kronstadt, Russia, where the electric light has been very extensively used, both in public and private buildings, diseases of the eye have become much more frequent. Dr. Lubinski, an eminent oculist of Russia, finds that blue glasses form the best protection for the eye. It would be a very novel sight to see the civilized portion of humanity wearing blue glasses from the "cradle to the grave," but we may come to it yet.

The United States Electric Lighting Co., working under the patents of Farmer, Maxim, and others, have given the public the first successful exhibition of the electric light produced by incandescent carbon, in the reading room and vaults of the Mercantile Safe Deposit Co., in the basement of the Equitable building.

For some time the company have had in operation in this building several of the Maxim arc lights, with which the public have become somewhat familiar.

The following illustration (from the *Scientific American*) gives a very good idea of the incandescent lamp, the invention of Mr. H. S. Maxim. It consists of a glass globe



about three inches in diameter, in which is placed the thin carbon filament, and which is then filled with an attenuated hydrocarbon vapor; gasoline. Instead of using a glass globe it is closed by an elastic cement which resists both heat and pressure. The advantage of the hydrocarbon vapor is in the fact that as the current is passed through the filament, any defective parts become more intensely heated, the vapor is decomposed and the carbon deposited at the defective points.

The filament is either in the form of a Maltese cross, or like those in the Equitable building in the form of the letter M. By means of the button at the side, the lamp can be turned off or on. Mr. Edison, about a year ago, exhibited some lamps similar in some respects to those of Mr. Maxim. There was the same glass globe with the carbon filament, in the shape of a horse-shoe, but Mr. Edison attempted to produce a vacuum and then seal the globe by the fusion of the glass. Moreover, the carbon of the Edison lamp was destroyed in a short time. Mr. Maxim has constructed a current regulator which is a most important feature of this system of lighting by incandescence. By its means, it is claimed, the current in the lamp circuit is so regulated that any number of the lamps can be turned out without affecting the others.

In the reading room of the Mercantile Safe Deposit Co., which is about fifteen feet square, there are thirteen of these lamps, and the room is not brilliantly lighted at that. Mr. Maxim estimates that the large dynamo-machine will supply current sufficient for 200 of these incandescent lamps. It is also claimed that these lamps give a light equal to 20 candles.

At the recent meeting of the National Academy of Science in this city, Prof. Morton gave the results of some experiments with one of the Maxim lamps of high candle power. He found that when the conditions were such as to give a light of 12 candles, there was developed 12 candles per horse-power; when giving a light of 40 candles, 240 candles per horse-power; at 92 candles, 600 candles per horse-power.

To avoid the intensity of the light, the lamps are surrounded by frosted glass shades which considerably diminish the amount of available light. There is also noticed a changing in the intensity of the light, produced by the motion of the engine. This is seen when reading by the light, and as it is not obviated by the glass shade, it will sooner or later cause complaint.

They are said to be steadier than gas lights. If we look at the gas flame, protected by an ordinary shade with large opening at the bottom, we do notice more motion in some parts of the flame, produced by currents of air, but the body of luminous material is much steadier, and if one attempts to read by gas and then by the incandescent lamp, he will find that the light which falls upon the paper is steadier in the case of gas than in that of the lamp. On the whole, however, the new-comer must be considered the most successful incandescent lamp yet produced.

Mr. Edison claims that the Maxim lamp is an infringement of his patents, and that the United States Co. will not attempt to introduce it. Dr. Draper, however, proposes to light his house with the new lamp, which will be the first private residence in the city lighted by electricity.

At present the Electric Lighting Co., with which Mr. Maxim is connected, are very busy filling orders for the arc lights for out-door purposes, etc., but before long we may expect to see a thorough and extended trial of the new lamps.

Mr. Sawyer has been able to make an exhibition of his electric lamps in the Mercantile Library in Philadelphia, and the local newspapers speak highly of the results of the experiment. Five lamps were shown, the electricity being supplied by an Armour & Hochausen machine.

The lamp, it will be remembered, consists of a glass globe about ten inches high and two and one half inches in diameter, charged with nitrogen gas. In it there is a pencil of carbon one-sixteenth of an inch in diameter and about three inches long, which is pressed against a cylinder of carbon, one-eighth of an inch in diameter, by means of a coil spring. The carbon pencil is rendered incandescent for about three-eighths of an inch, and as it is consumed the spring pushes the pencil up from below. The lamps are calculated to burn about three hours, when they will have to receive new carbons and be recharged with nitrogen.

The cost of the small lamps is about $5, and Mr. Sawyer claims that the running expenses will be about 50 cents per day, but in most cases of this kind the lamps are owned by the company furnishing the power and rented. The larger lamps, giving a light of from 200 to 300 candles, will last from one to three months, and require one horse-power for two lamps, according to the inventor's claims.

It does not seem probable that any incandescent lamp will find favor which needs the constant attention which the Sawyer lamp demands.

An assessment of $60 per share has been levied on the stock of the Edison Electric Light Co., to cover $180,000 advanced by some of the larger stockholders for the purpose of experiments.

Do not publish on the other side

RECENT HISTORY OF ELECTRIC LIGHTING.

BY HENRY MORTON,

President of Stevens Institute of Technology.

On the 17th of October, 1878, in fulfilment of a promise made a year before, the present writer read before the American Association of Gas Engineers an address in which (alluding to the reports then resounding in the daily papers as to Mr. Edison's new form of electric lamp) he said, after quoting an account of a similar report current twenty years before in France: "These promising experiments, as we all know, reached no successful results. I would by no means, however, have it inferred that better success can never be attained. On the contrary, there are several very promising directions for experiment, on one of which no doubt Mr. Edison is at present embarked; but the difference between a promising line of experiment and a successful result, as all the world's history teaches us, is often a distance of many years, to say the least." An opinion so little calculated, as this, to aid in "bearing" gas stocks, naturally met with little disgust in certain quarters, and I had the pleasure of seeing myself very handsomely abused by those whose approval would have been a very doubtful compliment.

Looking back over the space of two years which has elapsed since those words were uttered, and remembering the events which have transpired in this connection, I feel that I have much more reason to congratulate myself than have those who took an opposite view.

Not only has "the promising line of experiment on which Mr. Edison was then engaged been separated by many years from a successful result," but it has, within this time, been totally abandoned by him for another, which other, to say the least, still under approval, and the discredit and ridicule which has been cast from all sides, has shown how unfortunate and unwise were the reckless and unfounded assertions of the world-de Prophets of the Press.

Notwithstanding these draw-backs, however, continual progress has been made in the development of the art of lighting by electricity, and we have to regret that what would otherwise have been a dignified march of advancing success, deserving nothing but credit upon this country and into a carnival rout of grotesque and absurd extravagances.

In recording the progress which has been made in the art of electric lighting, the most important practical results have been achieved by those who have devoted their attention to the application of the electric arc. "The word ARC . . ."

[illegible] have brought these machines to the [illegible] those likely to use them, their employment [illegible] tories, stores, workshops, and hotels; had very general, and has undoubtedly proved advantage and convenience, although it [illegible] are not wanting (as for example in the gr[illegible] ton mills at Lowell, Mass.,) where the [illegible] lighting was abandoned after a thorou[illegible] There is, however, so wide a field in wh[illegible] light has manifest advantages over any [illegible] means of illumination that we may con[illegible] look for a vast increase in its introduction [illegible] parts of the country.

Turning next to the production of light [illegible] candescence we find that three branch[illegible] also has made marked advances. In this a[illegible] its beginning as early as 1845, when the [illegible] taken out in England by King, the represen[illegible] the American, Mr. Starr, we find described [illegible] of platinum wires and thin rods of carbon [illegible] ter inclosed in a torricellian, or absolute, [illegible] Extensive experiments in the same line we[illegible] by Mr. Moses G. Farmer, the widely kno[illegible] trician, about the year 1858, and again [illegible] later, by Dr. Isaac Adams, the inventi[illegible] process of nickel plating, now widely us[illegible] the continuance of an electric current thro[illegible] a galvanic battery prevented the carbo[illegible] filaments from reaching any commercial [illegible] and even with the cheap electricity of [illegible] there is still a limit set upon this sort of [illegible] by its relatively wasteful expenditure of [illegible] force and consequent costliness.

Great progress has, however, been m[illegible] also.

Mr. Edison supposed he had solved [illegible] ten two years ago when he had recourse [illegible] earlier methods of Starr, Farmer, and o[illegible] very soon finding, as they had done, th[illegible] ciency of his solution, he attacked the [illegible] afresh with an energy, persistence and [illegible] of resources worthy of all praise. The [illegible] of his researches he has brought to [illegible] of astonishing results, and has [illegible] whole classes of new properties in plat[illegible] other metals, and lime, magnesia, zir[illegible] other substances.

Had his enthusiastic friends only [illegible] him from time to time what he [illegible] done, his fame would have been supp[illegible] a discoverer, and without blemish. [illegible]

Unfortunately, too many promises [illegible] indulged in, and the credit of really g[illegible] merits has been overshadowed by the [illegible] still greater assertions and promises.

After the abandonment of the plat[illegible] Edison next took up the carbon-[illegible] of Starr, and as before, his [illegible] "Berichte" at the beginning of [illegible]

[illegible] Edison's lamp consists of a [illegible] [illegible] about 2 inches in length; *Metropolitan* says [illegible] a burner consuming 4 cubic feet of [illegible] per hour, and giving the light of [illegible] candles, will give the light of 10.1 can[illegible] in the Ritchie apparatus.

It must be a very poor burner or [illegible] poor gas that gives only 4.3 candles [illegible] 5.4 feet of gas. The only fair test [illegible] the apparatus calculated to [illegible] amount of light is the reduction of [illegible] air supply by making the products of co[illegible] bustion pass downwards, and this [illegible] gases would not give the necessary [illegible] flame, if it could be made to work at [illegible]

peculiar advantages, as for ex[illegible] of the Safe Deposit Co., un[illegible] building in New York, and [illegible] offices.

When that experiment has [illegible] a few months we shall know [illegible] do now as to the actual runnin[illegible] tem, but anything like a great [illegible] same in place of gas is still as [illegible] about which prediction is pre[illegible]

Gas and Ele[illegible]

Illuminating Power of Gas in

Week ending	1879	1880
Nov. 6,....	23.45	18.75
Nov. 13,....	23.54	18.57
Nov. 20,....	22.64	18.16

E. G. LOVE, Fi[illegible]

ERRATA.—The report of the fi[illegible] in New York City for the week end[illegible] what missed. The average of the M[illegible] was 18.26; Mutual, 25.06; Manic[illegible]

The accompanying illustrations a[illegible] ing apparatus, invented by Messr[illegible] noticed in the *Metropolitan*. They [illegible] pecially for hot-houses, and doubtl[illegible] well.

Fig. 1 is 3 feet 6 inches high, [illegible] which gas or oil may be burned, a[illegible] cession of a central burner, plan[illegible] within a glass tube. The produce[illegible] combustion pass from the tube into [illegible] box at the top, and then down by th[illegible] columns on either side. The object [illegible] is to obtain the vapor gases and vapo[illegible] in a condensed form at the bottom [illegible] The condensed aqueous vapor w[illegible] carry down with it most or all of t[illegible] sulphur compounds, but a large part [illegible] the carbonic acid will escape. In [illegible] green-house, this of course is [illegible] beneficial than otherwise, but if use[illegible] in a dwelling, the carbonic acid woul[illegible] form quite a serious objection. N[illegible] escape for, and we infer that there is [illegible]

Fig. 2 is intended for lighting ga[illegible] as bearing, and has two burners on [illegible] side of a central column by which [illegible] products of combustion escape. It is [illegible] 4 inches in height; *Metropolitan* says [illegible]

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From Nov 26 1880

The Exhibition of the Electric Light.

The new system of electric lighting by the incandescence of filaments of carbon was shown and explained by the inventor, Mr. Edison, at Newcastle-on-Tyne, on Thursday evening, before a large audience, in addition to the electric lighting apparatus already in use. Mr. Edison's system is peculiar in the method of subdividing the electric current, for which purpose he employs a battery of small cells. Professor Tyndall, who was present, described the system as one by which the electric current could be greatly subdivided, and the light of the carbon could be greatly increased.

Clarence, Mr. Swan's success was complete.

TECHNICAL EDUCATION.—The London Company have arranged for a course of lectures being delivered, or papers read, at the hall of the company during the ensuing winter season. The course will consist of four lectures or papers upon subjects intimately connected with the materials used in the manufacture of cutlery, the 4 times to take place on the following dates:—Second ay, December 1st, 1880; Wednesday, January 5th, 1881; Wednesday, February 2nd, 1881; Wednesday, March 2nd, 1881. Sir Henry Bessemer, C.E., F.R.S., has promised to commence the course with a lecture on Wednesday, December 1st, 1880, on the Manufacture and Uses of Steel, with Special Reference to its Employment for Edge Tools." The admission will be entirely free, but by ticket, which may be obtained on application to the hon. secretary, addressed to the Cutlers' Hall.

American Machinist Dec 11 1880

The Latest Electric Lamp.

Arrival and Trial.

The Maxim lamp, which is mentioned as accomplishing the results sought for by Mr. Edison, is an incandescent lamp, having a filament of compressed carbon, which is placed in a glass globe from which the air has been exhausted and replaced by the vapor of gasoline. The carbon is a very weak point or thin part in the carbon filament when the current is passed through it, this part of course will become hotter than the rest, and will decompose the gasoline so as to deposit carbon in the form known as compressed carbon upon that particular spot. When this spot has been built up to an equal conducting power with the rest of the filament, the current from the machine is increased with the effect of making not the weakest point or thinnest part, and repeating the process just described. In this way the filament becomes gilded with gas carbon. The gasoline is then withdrawn from the globe, and the lamp is ready for use.

The claims are that the carbon will last for 1,000 hours, and the reason may be continued, that the City is a dwelling, the carbonic acid would form quite a serious objection. No escape for, and we infer that there is

Fig. 2 is intended for lighting ga[illegible] as bearing, and has two burners on [illegible] side of a central column by which [illegible] products of combustion escape. It is [illegible]

Edison's lamp consists of a [illegible]

Electric light is very perfect. The light is very steady, and the eye is not fatigued by looking upon it. The cost is as against the present Gas and Electric Light Company, and gives the rest as are: Gas, 10s. 6d. per 1,000 cubic feet; Electric Light, 1s. per lamp per hour. Another consideration from

1527. "Electric lamps." C. G. Arnold. Dated April 13, 6d. In electric lamps in which a stick of carbon is made to "burn" in a closed vessel or globe, the atmosphere contained therein, when the current is turned on by the current being cut off, consists of carbonic oxide and nitrogen. Owing to practical difficulties, in the way of making joints, it is generally found that the atmospheric air, while the lamp cools down, slowly enters the globe, and the atmosphere therein then consists of carbonic oxide mixed with oxygen and nitrogen, forming an inflammable mixture, which, when the lamp is relit causes an explosion and set a destruction of the globe, and sometimes also the interior parts of the lamps. The objects of this invention are to prevent the above evil, to regulate the consumption of the carbon as desired, and, as regards the point of the carbon, by incandescence, to preserve through the sole or cover plate, A, of the lamp, and the size of this hole is more or less according to the size of the carbon with a small quantity of air sufficient to preserve its form, and to burn the carbon dust thrown off, or nearly so. This aperture may be of desired, be made adjustable by being increased in size, and fitted with a somewhat conical screw, or one having one or more taper flats, which are broadest at the end and filed on it (like a tap for forming screw thread in nuts), or in any other suitable and well known manner. The tube, B, for the carbon and the weight resting thereon is narrowed at the top at A. C is an iron cup or tube valve, which is free to slide on the tube, b; it has a leather washer, c, beside the top, and has one or more holes at c the cup rests on the flange, a^2, on the tube, b; it is an insulating washer. As long as the current is not on, and the lamp burning, the cone tube, C, is down, and the leather washer, c, then rests on the top of the tube part, A, preventing air escape or entry at this place, but as soon as the lamp goes out, the current ceasing,

Fig. 1.

thus prevented; e is a helical spring for raising the cap tube, or valve, C, when the electric current ceases.

1513. "Insulators." A. Gilbert, G. Wells. Dated April 12, 4d. The invention has for its

Fig. 2.

object the production of an insulator so constructed as, without affecting the insulation, to secure the wire, so that, in the event of the wire breaking between any two posts, the other parts of the wire on the other sides of the posts between which the breakage occurs shall remain securely held as before. Fig. 1 represents a section taken through the insulator in line with the wire; fig. 2, a transverse section. The insulator proper is of the ordinary bell shape. The part, c, has embedded in it at the time of making a screw bolt, b, so that when the wire, after being properly strained, is laid in the groove made for its reception in the part, c,

Fig. 3.

the cap, a, of the insulator, which has a corresponding groove, and through the centre of which the bolt, b, passes, is placed thereon, and by means of the nut, e, it brought to bear lightly upon the wire, f, which is thus rightly held between the grooves in the insulator, c, and cap, a. The bolt, b, is made of the shape as shown in fig. 3, so as to allow of the wire being readily placed in or removed from the insulator, and at the same time to bring the pressure of the nut directly over the centre of the cap.

1511. "Telephone switches." John Henry Johnson. (A communication from abroad by Ernest Marx, Frank A. Klemm, and Julius Kayser, of New York.) Dated April 12, 6d. Relates to certain improvements in the construction of telephone switches. It is for objects simplicity and economy in construction and absolute positiveness in operation, and, stationary hanger-post in combination with a vibratory switch lever and flat spring, so arranged in relation to the main line wire bell telephone and transmitter wire and local battery, that the presence of the telephone in position will positively connect the bell with the main line, and upon the local circuit and its removal for use will cut out the bell, close the local battery circuit, and put the telephone and transmitter on the line.

1559. "Electric lamps." Alexander Melville Clarke. (A communication from abroad by Jean Moric Amilcar Edouard Lacroyer, of Paris.) Dated April 14, 6d. Relates to improved arrangement of electric lamps or burners, which is distinguished from all others now in use by its simplicity, yet great lighting

DECEMBER 17, 1881.]

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

Vol. VIII.—No. 188.

ELECTRIC LIGHTING IN THE CITY.

The most extensive trial of the electric light for public purposes yet made will, about the 1st of February next, be inaugurated in the City of London, as the City Commission of Sewers have adopted a report of the Streets Committee recommending that the tenders of the Anglo-American Light Company, of the Electric and Magnetic Company, and of Messrs. Siemens Brothers be accepted. The first company will undertake the lighting of Blackfriars Bridge, Bridge Street, Ludgate Hill, St. Paul's Churchyard, and Cheapside to King Street, by the Heath system, at a cost of £1,125 for 12 months. The second company will light Southwark Bridge, Queen Victoria Street, and Queen Street, by the Jablochkoff system, the cost being £1,250 for 12 months. Lastly, Messrs. Siemens will light London Bridge, Cheapside (from King Street, Mansion House Street, and King William Street), at a cost of £1,320 for the 12 months.

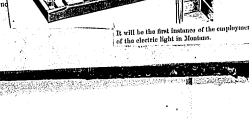
On a rough calculation, taking all the districts together, the cost (including the plant, machinery, fixing and replacing, &c.), will be about four times the price now paid for gas-lighting; but eliminating those expenses, which would not be recurring, the cost would be only twice that of gas, while the amount of light produced will be very much greater.

Messrs. Siemens are the only contractors who propose to bury the conductors wholly underground. There can be little doubt that the latter is the proper course to adopt. Open conductors slung from lamp to lamp, or pass to post, are very unsightly in broad daylight, as any one walking along the Thames Embankment can testify. If any system is permanently employed, underground wires will certainly have to be used, and we think the Commissioners should have insisted upon this course being followed in accepting any of the contracts.

A great deal has been said about the relative values of a large number of small lights compared with a small number of large lights; the coming trial will severely test this question, as the number of electric lights will be very far in excess; thus, number of gas jets they are to displace; thus, assuming in light. According to the tenders, 429 gas lights will be replaced by 116 electric lights, or roughly, 4 electric lights will take the place of 4 gas lights, so that the space between each electric light will be four times that between each gas light. In order, therefore, that the intermediate points between each electric lamp may be illuminated to the same extent as was the case when the gas lamps existed, the intensity of the illumination from each electric lamp will have to be correspondingly increased. It being recollected that the intensity of light diminishes as the square of the distance from the object it illuminates. In other words, if from each electric lamp will require to be four times as great as that given by the gas lamps, are, of course, other considerations to be applied, and which practically modify the above calculation, but the importance of establishing power by space illuminated and not by power cannot be too strongly urged.

During his trip of the Electric Light Arrangements on board the ship was asked to hold an electric lamp which was being swung up to light the stokehold. The man, being ignorant of the danger, grasped the lamp by the brass rod which runs around it, and at the same time inadvertently touched one of the bare wires which supply the electric current. By this act he interposed his body in the track of the powerful current which was, in part at least, diverted from arm to arm across his chest. The shock was sufficient to strike him down dead, all efforts to resuscitate him being unavailing. Nor was the effect due to heart disease induced by the blow, as is sometimes the case with comparatively slight shocks, for it was found next day that the tissues of his body had been disrupted in such a degree by the discharge that incendiate burial was resorted to. There can, therefore, be no doubt that the electric current forcing an ordinarily powerful electric lamp of the Jablochkoff type, such as is used in the Lizzolis, or the other types of Siemens, Lontin, Jamin, etc., is quite capable of causing death to any person who is unfortunate enough to come into contact with it so as to "shunt" the current through any of his vital organs. In passing from one hand to another the current is forced to traverse the breast and lungs, not to speak of the heart and spinal cord. For this reason it is absolutely necessary that great care should be exercised in handling electric lamps, as they are at present constructed. Indeed, it should be made a rule that these apparatus should never be intrusted to any unskilled persons whatever. There is no danger at all about of actual touching with two distinct parts of the body in such a manner as to discharge the current between them; but a person ignorant of the action of the lamp may establish this blunder at any moment, for electricity is invisible, and there is no sign to be seen of the deadly and subtle power which is lurking in the metal stock. Something more than care on the part of those using the electric light would seem, however, to be necessary. There is room for reform in the construction of electric lamps. Hitherto the attention of inventors has been chiefly directed to the proper working of their devices and the luminance of a brilliant light; but henceforth some regard will probably be paid to the safety of their apparatus. Bare wires and terminals ought to be abolished, or at any rate guarded from accidental touch, and electric lanterns made as harmless as ordinary oil-gas lamps were.

[1] The Butte Light in Montana.—A contract has been made with the proprietors of the Brush electric light for one of the largest sized machines, with fourteen lights, with which to illuminate the quartz mills at Walkerville, Montana. These lights will be disposed about the works as follows: seven will be used in the large mill, four in the small one, one in the hoisting works, and two will be placed so as to light the dumps. The illumination afforded by the number of lights will enable the men to work all night as well as by the day time, while the expense will be less than that of ordinary light.



It will be the first instance of the employment of the electric light in Montana.

A Fountain in which an Electric Eel is the chief Ornament on Exhibition, Oberstein a fel. explains the Electric Light now Illuminating the Aquarium in Berlin. Fountain, Fig. 6 plan the Model of the Establishment Concrete in Berlin, Aquarium, Fig. 7 Cross Section of the Establishment Concrete in Berlin, Aquarium, Fig. 8 Plan of the Model of the Establishment Concrete in Berlin, Aquarium, Fig. 9 Cross Section of the Establishment Concrete in Berlin, Aquarium, Fig. 10 Plan of the Model of the Establishment Concrete in Berlin, Aquarium, Fig. 11 Cross Section of the Establishment Concrete in Berlin, Aquarium, Fig. 12 Plan of the Model of the Establishment Concrete in Berlin, Aquarium, Fig.

of the carbons. This was simply done by a pernicious centre screw, like a lying finger post, proclaiming "Go neat this way," tendet to the progress along a good thoroughfare. It only remained to perfect the details of the lamp, to find the best material from which to form the carbon, and so fix this material in the lamp in the best manner. These points, I think, I have now satisfactorily settled, and you see the result in the lamp before me on the table. The carbon in this lamp is a waste body, quite homogeneous and fibrous, fairly in hardness, and becomes harder by the use of the lamp; the longer and the better it is burned the harder it becomes. It is essential to economy in lighting by incandescence that the incandescing carbon should be very thin. The carbon used in two candle lamps and the thickness of the thinnest of the carbons leisurely employed, and therefore, one-seventh of the current, costing one-seventh the price, will produce in this thin carbon the same degree of heat-mobility as twenty times more current in the thick carbons as were used in those ancient lamps."

The great purpose in view, of course, is to obtain a lamp applicable to the lighting of houses, and in view of such application two positives present themselves—one as to distribution, another as to cost. For the distribution of the light Mr. Swan claims to have made ample provision. He puts his lamps in series to, 50, or, perhaps, 100 lamps in one and the same line. As copper wire less than 4th. thick would, it is stated, supply current for one such series of 10 to 100 lamps at a less cubic clearance with a very small percentage of loss. The great difficulty in this system is that a break in any part of the line must extinguish all the lights in the series. To obviate this, it is proposed to use an automatic circuit closer, so that only such lamps go wrong the circuit is still unbroken. On the question of cost, we again quote the author, who says:—

"The economy of lighting by incandescence has not been exemplified by any working instance of actual practical use. One thing is, however, quite clear, and that is that electric lighting by incandescence in an economical process—it will be less costly than gas lighting. That is confidently demonstrated by the fact that 1 per c. of gas employed in working a gas engine to develop an electric current, and used in my lamps, will yield more light than one 6, of gas consumed in the most economical way in gas burners. This room is now lighted by twenty of my electric lamps, and to produce the same light by the consumption of cubic feet of gas per hour are being burnt in a gas engine: before my lamps were finished the room was lighted by seventy gas jets, consuming 5 an hour, and, also 2, per hour. It is very evident that we have got some light out of the gas through the medium of electricity than was got from the larger quantity of gas which those burners consumed. From measurements carefully made, both of light produced and current required to produce it, I am warranted in saying that 1 cubic foot of gas will be produced by 1 certain quantity of gas used to generate an electric current employed in my lamps, and that to obtained from this quantity of gas burnt in gas burners in the usual manner. If that is so, then it is evident that when, instead of the motive power of gas, that of steam produced in the most economical manner is employed, this method of electric lighting is very much less costly than gas lighting."

On the merits of the lamp above described, we refrain for the present from offering any opinion, beyond remarking that, whatever doubts may be entertained by those who, like ourselves, have not had an opportunity of seeing the lamp in use, there is in the scientific gentlemen who have heard this remarkable lecture are convinced Mr. Swan has advanced the electric light well within the economic boundary which has hitherto separated it from competition with gas for household purposes.

Charges for Public Lamps.—Complaint has been made at many of the meetings of the Gas-Light and Coke Company, that the Commercial Gas Company, while making successive reductions in the price of gas to private consumers, has not diminished the charge on account of public lamps in anything like the same proportion. While to private consumers the charge has been reduced 25 per cent, the charge for public lamps has been reduced from £4 12s. to £4 5s. per annum. It has now been explained, on behalf of the Gas Company, that hitherto the public authorities have been favoured in the matter of charge for lighting the street lamps, owing to "a desire to cultivate friendly terms." Now, however, it is not legal to continue this advantage, and, consequently, instead of the public lamps getting the advantage, it is distributed among all consumers. Consequently the charge having now been secured in future reductions, public lamps will share with private consumers in due proportion.

Electric and Magnetic Company Limited.—We hope this venture is not launched too late. Rumours are abroad, that the Telephone has made its appearance once more, and that the Electric Light Company's shares have consequently suffered a heavy depreciation. We have supplied with pure, cautious in the advent of the electric light, and on the unfortunate Company have given special attention to Electric Bells, and Patent Lamps. Under these circumstance should arise likely to impede the success of what promises to be a valuable addition to gas consumers. We shall subjoin to the subject more fully next week.

Iron Nov. 5. 1880

SCIENCE AND ART.

THE ELECTRIC LIGHT AT BARROW.—The electric light is being adopted on the Docks at Barrow. It is already in use at the Barrow Shipbuilding Yard.

Nov. 5 1880

IRON.

THE JABLOCHKOFF ELECTRIC LIGHT.

THE prospectus has now been issued of the Electric Light Company (Limited), the nominal capital is placed at £500,000 in £10 five per cent. preference shares, ten only of which are to be issued now. The company is to take up the Jablochkoff system of electric lighting, and has entered into an agreement with the Société Générale d'Electricité of Paris, by which it obtains the patent rights relating to the Jablochkoff system in the English colonies and dependencies, except India, as well as those existing in the United Kingdom itself. The works and machinery of the French company here will also pass into the hands of the new undertaking. The payment for these rights, privileges and chattels is to be made solely in fully paid-up ordinary shares. We may add that the company is formed with the object of developing the application of electricity to lighting and other purposes. The report of the Select Committee of the House of Commons on lighting by electricity is referred to, and also to the value of electricity as a source of light. Mr. Edward Graves, F. Inst.Elgrineer and Mr. Keates, to the Metropolitan Board of Works, upon the working of the Jablochkoff system on the Thames Embankment, proves the successful practical application of the electric light to public thoroughfares, and recognises "the superior suitableness of the system." Its use in the many and various establishments in the United Kingdom and on the Continent, where it has been for a considerable period successfully employed, proves its usefulness for general purposes. The contract between the Metropolitan Board of Works and the Société Générale d'Electricité of Paris for lighting the Thames Embankment and Waterloo Bridge, has recently been renewed for 12 months; this contract having been renewed by the Board after more than a year's experience, is a proof that in their opinion, the Jablochkoff is the best system for public thoroughfares. It has been ascertained in working under this contract that, considering the cost of electric light (Jablochkoff) candles at 1s. 6d. per candle and 14s. per horse power per hour, with moderately gas light at 3s. 4d. per 1000 cubic feet, the electric light is cheaper by 25 per cent. or about 25 per cent. on the cost of gas; and if the calculations are based upon London cost of coke, and it is believed that the comparison will be equally favourable in those towns where gas is cheaper, the cost of producing electricity being also cheaper. In manufacturing districts, where motive power is at the door, the comparison will be still more favourable. The extension of the circuits for lighting to long distances has been developed by the Société Générale, who have lighted the Victoria Station and the Metropolitan District Railway from the same source of electricity as the Thames Embankment and Waterloo Bridge. Circuits of over five miles have been in operation; and, in fact, distance is found to present so little difficulty that London might easily be lighted from one great central station. Any required motive power can be produced by the Jablochkoff candle. The size of candle now in use in England has been considered on account of its being the most generally approved and serviceable. The operations of the Electric and Magnetic Company will comprise:—(1) The lighting of streets, railway stations, buildings, theatres, warehouse, mines, shops, &c., by current. (2) The sale and leasing out the necessary plant for producing electric light. (3) The sale of candles, for the manufacture of within the English and colonial patents will be the exclusive right of the Electric and Magnetic Company (Limited). (4) The granting licenses to counties, provinces, towns, and corporations, &c., &c. (5) The supply and application of electricity in any other manner, from all of which the directors look for a considerable and gradually increasing source of profit.

ELECTRICITY AND GAS.

THE following letter by Dr. Siemens has been forwarded to *The Times*, in reply to that of Mr. W. H. Preece, on "Electricity in Galleries," which appeared last week:—

"Mr. W. H. Preece, in addressing you on the subject of 'Electricity in Galleries' on the 28th October, points out very properly that, in his opinion, the employment of the electric light would not be without danger in coal mines, because the electric arc and the incandescing carbon between carbons would be liable to ignite a gaseous explosive compound. When examining the Haswell Colliery, near Durham, on behalf of the Mines, I drew attention to this effect, suggesting only an indirect application of the electric light, by which, if necessitated, the chances of danger might be minimised. I am glad to see that Mr. Preece has come to the same conclusion. The electric light generally and under ordinary circumstances is, however, not dangerous to life and property; his statements to the contrary notwithstanding. I have actually caused unnecessary alarm to three fire brigades, and, incidentally for the illumination of public buildings, by the accidental breaking of a mere crack or pinhole were the arc in an insulating medium, the currents would escape to earth, generating heat and producing fire," emphasising this statement by asserting that it is not a chimerical danger, but the effect of practical information of his own. Now, the electric current is powerful in the sense of doing work, and effect of work, but its intensity is so moderate that it is only of taking the two unprotected conductors against one another that sparks or arcs are produced. The interposition of a thin sheeting of wood or other inflammable substance would in itself supply a sufficient insulating separator to prevent the spark, and I challenge Mr. Preece, notwithstanding his well-known skill as an experimenter, to the production of an ignuous discharge through a mere pinhole in the insulating covering of wire or other of the conductors. In practically arranging electric-lights for public buildings, the precautions are simple, merely suggesting themselves, and the likelihood of danger to building is practically removed by the precautions taken. Mr. Preece's reference to the unfortunate occasion and Russian ballet, may appear to have been struck dead by electric discharges while standing in part of an electric light, is somewhat sensational. They must have been predisposed to succumb to an electric shock, and must have grasped from one the two conductors leading wires with moist hands; for I and many other persons have frequently touched both poles of a powerful dynamo machine without feeling any the worse for it. At the same time there are dangers connected with the establishment of this, as of almost any apparatus or machinery, which do not in any way apply to the gas, but not upon examination danger. Mr. Preece also charges the electric light with being cold in expression, but has the Argand flame the source of heat which science possesses? Now, I quite agree with him in this latter respect, that the electric light is structed as at present made for lighting large spaces, and that it will be left to agent the inference that because the electric arc is cool, electric light must necessarily heat rooms in which it is employed to anything like the same extent as gas, candles, or other illuminants. By the following simple calculation, based upon actual experiment, I will show what is the relative heating effect of the two sources of light within a room. To produce 2000-candle power by electricity there is required of 34 Webers, which again represents 136 heat-units per minute. To produce the same amount of light by gas, 5 cubic feet are required, consuming 16 cubic feet of 10-candle gas per minute, which consumption represents 15,000 heat-units. Some additional heat will be produced in the electric arc, however, by the combustion of the carbon points, but even if this production amounts to 6·3 grains of carbon per minute, and will thus given in London at 1s. per ton. The total amount of heat produced by the electric arc is, therefore, 150+1·5=151·5 heat-units per minute, or rather less than 1 per cent. of the 15,000 heat-units produced by gas. Besides the consuming of the Gas-lights produce, however, the further inconvenience of depleting the oxygen of the air by carbonic acid, and by a minor, but still very sensible amount of sulphurous acid. "If this calculation be set against gas as a heating agent, it proves, on the other hand, its great value as a heating agent; and for one, when so much is said about the smoke nuisance, I may be allowed to add a few words on that subject. The question of the steps to be actively engaged upon the development of a system of working furnaces for the manufacture of iron, steel, glass, &c., by means of gas-fuel produced in a simple gas-gas-making apparatus. Numerous advantages will undoubtedly be found to accrue from the use of gas may be used operation, and furnish daily proof of its value in economical results as the smoky factory chimney, which is now generally considered to be the price where it still exists, proves simply a disregard for the principles of economy. In the year 1853 I was anxious to take steps to introduce the same direction in promoting to supply a better and less wasteful gas, and, having induced the Town Council of Birmingham to support my plans, measures were taken to obtain Parliamentary power to carry them into effect. It was intended to separate the two constituents of coal by a comparatively inexpensive method, supplying gas of low illuminating, but high heating power to consumers at a cheap rate, and reserving the coke for use in locomotive engines and stoves, for which purpose it is well adapted. The Bill was lost—but when, a few months later, the Bill was brought out by a committee of the House of Lords in consequence of the Sanitary Act, including the idea of smoke prevention, and the promoters had consulted me on the subject. While it is admitted by many that gas fuel can be used advantageously for heating furnaces, there still exists a great objection to its use upon the domestic hearth, which is one of the largest sources of consumption of coal, and certainly the cause of a great amount of smoke in our metropolis. The gas fireplace sometimes used does not meet with public favour, owing to its unchecked appearance, great consumption of gas, and most of all, from the evil which frequently results from its use. It is said to produce a 'dry' heat—but when, to my mind, conveys no definite meaning, seeing that the heat produced by an open fire is equally dry, and that, precluding the idea of smoke, there is no heat in the products of combustion of gas, consisting of a number of gas jets spread over a fire-grate, and which is with practice since or asbestos, the heat is not derived from the combustion descend through the grate bars, and thus first their way into the apartment.

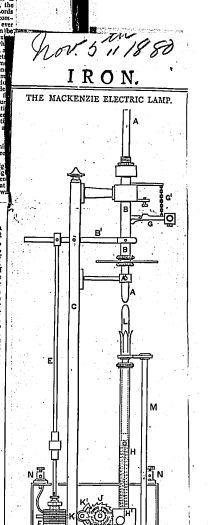
Electric Lighting in 1879.—The Committee of Sewers, on the recommendation of the Streets Committee, were to have been asked on Tuesday last to adopt the tenders of the Anglo-American Electric Light Company (Brush system), the Electric and Magnetic Light Company (Jablochkoff system), and of Messrs. Siemens' Brothers, for lighting the Embankment of the City, at cost for twelve months of £5060; but the matter was adjourned.

Nov. 5th 1880

IRON.

THE MACKENZIE ELECTRIC LAMP.

IN the accompanying engravings we illustrate a recent addition to the gradually increasing list of electric lamps. This is the Mackenzie lamp, which consists of a platform, P, and a standard, C, carrying a lower arm, B, and upper arm, A, each having a holder, H, which holds the upper or positive carbon, A—A, and, E, fixed to the lower carries the keeper of an electro-magnet, F, which, when the current is passing, is held down, and, when it ceases, raises the holder and carbon so as to form the electric arc at which the light is developed. When, from the consumption of the carbons, the current is weakened, the keeper is released, drops the lever and inhaled holder to descend. The small weighted lever and cam, G, being held up in this latter position by, G, allows the carbon to drop on the lower one, L, thus making full contact. when the keeper is again attracted, and pushs the lever and holder up again—the small weighted lever and cam descending, and holding the carbon light. The lower and negative carbon, L, is held in a tube, having a spiral spring, K, which presses the carbon upwards. The spiral spring is held down by a chain, H, which is attached to it, the other end being wound on a barrel to which an escapewheel, J, is fixed. The escape-wheel, J, is held by tooth by the lever, K, and pallets, K, every time the keeper attached to the lever, B, moves to release, is exhausted to burn five hours, and gives the light of 1600 candles, with about four-horse engine power; but it is obvious that it can be constructed to take very long carbons, and, consequently, burn for a very long time. These lamps are being introduced by the manufacturers, Messrs. Steele and Co., of Osnaburgh Street, Regent's Park. Two of them have been in successful operation at the Entrance Hall of the Philosophical Society at Glasgow. The current is supplied by a small dynamo-machine, and each lamp—either Siemens' or Gramme's will suit—requiring about four horse-power to drive it.



SCALE ¼ FULL SIZE.

ELECTRIC LIGHT IMPROVEMENT.—One of the great drawbacks to the economical use of the electric light is the waste of light attending the use of ground glass, no proper substitute for which has been suggested until now. A Frenchman, Mangenin, has been trying recently to use finely ground glass or "glass wool" for diffusing the light of the electric arc, the object being to destroy the wonderful clearness attending the employment of the naked light. By holding his globe, which is cut in shape with a pair of scissors, placed over the arc, the wool, which is closed at the top and bottom, retains the glass dust. The globes are afterwards cleaned by a peculiar process, so as to yield clear glass as much finer than the finest ever made. It is stated that he succeeded in reducing the absorption of light from 16% with ordinary globes to 10% by the use of his improved apparatus.

Death in the Electric Lamp.

It seems as though great improvements in the way of lighting are attended with peril to life, whatever the medium employed. Kerosene numbers its victims by thousands, and the light of the future—electricity—has already caused the loss of two lives abroad by careless handling. In Manchester, England, a person inadvertantly touched the exposed connections and diverted the current through his body. On the Brindisi a similar accident occurred to a sailor who was hanging an electric light in the fire-room. He grasped a brass rod which runs around it and at the same time allowed one of the connecting wires to swing against his body, thus sending the powerful current through it with instantaneous death as the result. With the rapid increase of electric lights in this country, the above record will show that they should not be handled by the inexperienced.

A Modern Electric Light.

A Mowbrie Electric Light, constructed for the Admiralty authorities by the Anglo-American Electric Light Co., was exhibited experimentally on the 21st ult. from the top of the company's works in the York-Town, Lambeth, London, and proved to be one of unusual brilliancy and penetration. This light is produced from a "Brush" machine, and is computed to be of 47,000 candle power, three considerably surpass, the largest and most powerful single light ever produced. The carbon poles used are 11 in. in diameter and to supply this with the current conducting wires 1 inch in diameter are required. The Brush machine employed in generating the current is of the same size as that used for producing 10 lights, but it is so constructed as to give in one light an excess of the total amount of illuminating power developed by the 16 lights, thus illustrating the superior power of Brush's system of dynamo-magneto machines. This machine is driven by an engine of eight-horse power, developing 14-horse power, which is that required for driving. The light, as viewed from the Thames Embankment, Northumberland Avenue, and the Houses of Parliament through the fog which prevailed, presented a very extraordinary appearance, indicative of great power.

The Edison Electric Light.

The Edison Electric Light Company has levied an assessment of $60 per share on its stockholders, and the books have been closed for that purpose to remain so until Dec 1. It is claimed that more money was needed to carry on experiments than was anticipated, and advances were obtained in consequence from some of the larger stockholders until the total sum due now reaches $150,000.

The assessment is for the purpose of paying this, the original capital being $500,000. Certificates of indebtedness will be given to those who pay up, which will be interchangable into new stock when the capital is increased. A meeting with this object in view is to be held shortly.—N. Y. Times, Nov. 6th.

THE ELECTRIC LIGHT—WHAT MR EDISON SAYS.

We printed last week what had been said respecting Mr. Maxim's carbon for the electric light. In a recent visit to Mr. Edison's laboratory there were found burning brightly, and with almost perfect steadiness, a dozen incandescent lamps, furnished with the bamboo carbons shaped like a hair pin. In the machine shops a score or more of men were hard at work preparing the material for an experiment of considerable magnitude and importance that Mr. Edison expects to make in little more than a fortnight. Several of the men were putting in place the parts of an immense dynamo-machine of 1,500 horse-power, with which the attempt will soon be made to operate a great number of lamps through eight miles of wire. It was the original intention of Mr. Edison to test the practicability of operating on this extensive scale in England, but he was disappointed in the Philadelphia machinists to whom he gave the contract to furnish the steam-engine for the dynamo-machine. This machine differs from the machines heretofore used at Menlo Park, and designed to do the work of a large number of them, and therefore better results at half the cost in plant. While draughting-room several men were putting the finishing touches upon their specifications for an elaborate system of electric lighting, including the plans for a number of central stations to be built in the city of New York. Mr. Edison has also built a factory for making carbons, and has taught a number of boys how to blow glass. As to the factory it is the expectation to have lamps made for use in New York when the company begins to enter the field against gas. have been finally and satisfactorily made. Vacuum pumps have also been perfected to prepare the lamps for use.

Reference having been made to what is claimed for an incandescent lamp under the Maxim's patent, Mr. Edison said that he had read what had been published on the subject, and that the claims for it were unfounded, for instance, the claim that it is the first lamp to utilize the portions of a divided electric current. "Every person," says Mr. Edison, "familiar with the history of the art of electric lighting knows that I was the first person to divide the current and use the portions. That was by the lamps I exhibited here last winter." "There is nothing new," he added, "in the principle of electric lighting by incandescence, lamps on that principle were made thirty years ago. The novelty is in establishing the current and utilizing the divided portions, thus producing many lights of less brilliancy; and this principle of subdivision is my discovery. I could have done six months ago what Mr. Maxim has done, but I decided to make a show. I did put my lights in the steamer Columbia in May last, and they have been in use ever since."

When asked if the Maxim lamp infringed upon his (Mr. Edison's) patents, Mr. Edison replied: "Maxim has infringed three of my patents and thirteen specifications. One of the men peculiarly interested in his lamp has admitted that it is nothing more than my lamp slightly modified. No doubt the display made by Maxim has a distinct object in view. I have been urged to operate my lamp in New York and have declined, because there is no object to be gained. There is no stock to be sold and I am not in the show business."

In answer to a question whether he had not been experimenting with bamboo carbons, expecting trees there great results, Mr. Edison said: "I have been testing a great variety of carbons. There is nothing in the bamboo to entitle it to superior consideration, except that it is very uniform in texture and has fewer imperfections than any material yet tried. The carbon of bamboo itself has no especial property to recommend it."

It is understood that an agent of Mr. Edison's company is to explore in Brazil, for which country he is about starting, for special growths in palm wood, of which there are many varieties in that country, with a view of finding the exact growth of fibre that fits the required use in lamps for lighting by electricity.

"I have been working," said Mr. Edison, "with a view of obtaining a steady light of about 16-candle power. The public may be taken at first with a light of great brilliancy, but people would soon become tired of such light in their houses; it would pain the eye and make it weary. In fact, people would soon get sick of such a light and have it removed. A moderately bright light of perfect steadiness is what is wanted."

"In a word, then, your object is to reach the point of successful competition with gas, and you are hopeful of reaching that point?"

"My object is to devise the means of establishing electric lighting on a commercial basis; to distribute the current from a central station and measure it, as gas now is, and to bring the cost down to a point where the enormous consumed influence of gas can be successfully encountered. I have no doubt whatever of success. The plans and specifications for central stations for the City of New York have been made, and proposals have been received. There remains nothing except for the company to obtain the permission from the authorities of New York. If that is done I expect to lay wires in January."

Mr. Edison also said that several persons in Geneva had become interested in this light, and that capitalists of that city had formed a company and went here to Menlo Park to learn the business. These men are now working daily in the laboratory and shops of Mr. Edison. The Swiss were greatly attracted by the brilliancy of the lights. One of the Edison lamps was run up to 2,500 candles at Geneva.

THE ELECTRIC LIGHT ON WESTERN RIVER STEAMERS.

From present indications the electric light is destined to play an important part in inland navigation, particularly on the immense rivers of the West and Northwest. As a rule the Western river men are very slow to adopt new ideas in the line of improvement, and the safety guards in the pilot-houses of their steamers are a case in point. Before they can be induced to believe that the electric light is a success they must be satisfied that it will not dazzle the eyes of the pilots, for slight annoyance of this character at the steering wheel would be fatal to the safety of the steamer and all on board of her.

Electric Light in Belgium.—A new electric lamp has been brought out at Brussels by MM. Clerk and Herson, engineers. It consists of a piece of marble or granite with holes in it, through which the wires fall through, the arc account of the shape of the holes, all burning, the being formed between the points which come through the grains. It is said to be more economical than Jablochkoff light gave equal to 100 Carcel burners as against 40 for the Jablochkoff candle. It takes about two horse-power to feed the lamp equal to 100 Carcel burners, and the lamp will burn for twenty hours without any adjustment.

The Lorin Light.—The Eastern of France Railway Station is now lighted by the system of electric lighting, which, after trial in the goods station, has also been adopted in the passenger station of the Lyons and Mediterranean Company.

DECEMBER 11, 1880.

Light has been affixed to some of the finest steamers on the Mississippi and Ohio.

The first boat to adopt the light was the Reuben R. Springer, plying between Cincinnati and New Orleans, and to-day the list includes the S. H. Pratter, the Mosher, the C. P. Choutesu, and Golden Crown, on the Mississippi; the Scotia, on the Ohio; and the new steamer Iron Age and Iron Duke, plying between Pittsburg and St. Louis; also the towboat Harry Brown, described some time since in these columns, and engaged in coal towing between Pittsburg and New Orleans. Other steamers will shortly be fitted with the new light. In most cases a single light is used, of 1,600 or 2,000 candle power, and located at the forward roof of the cabin deck. The carbons are placed in a movable lamp, similar to a locomotive "headlight," whose reflector projects the rays to the point desired, keeping the pilot house and the rest of the boat in shadow. To drive the generator an independent engine, vertical type, 8 or 10 horse power, is located in the engine room, usually 200 feet or more from the lamp. The main result so far is noted in the reduction of the time required in making landings. With the old cresset or "torch" the pilot was unable to land at the precise point desired, and backing and reloading was necessary. But with the electric light every object on shore is clearly defined in the darkest night, and the boat touches the shore just where desired. The handling of freight is also facilitated greatly. In coal mining, the Western pilot as yet refuses to tolerate the light, and prefers the old time guides of hills and other landmarks. In fog also the electric light is pronounced useless. When steamers are fitted with two lights, the second is portable, and can be taken on shore or moved portion of the boat, as may be necessary. or of the "tow" of coal craft surrounding the steamer. In all these cases the Brush light is used.

Mr. Swan's Electric Light.—Mr. Swan will bring his new lamp before the Society of Telegraph Engineers on next date—probably December 8.

The Gower-Bell Telephone.—We understand that Her Majesty's Government have presented the Sultan of Morocco with a pair of the Gower-Bell Company's long-speaking telephones.

Chatham.—The dockyard is to be lighted by means of the electric light, and if all goes well, one of the three projects will be tried and the most successful, in all probability, will determine the one best adapted for the purpose in view.

On Wednesday, November 17th, the quarterly meeting of the Society of Telegraph Engineers was held at the Institution of Civil Engineers, Great George Street, Westminster, S.W. The business, a Dr. Siemens in the chair. There was a large gathering, to receive the members, of the Society of Electricians. This latter is the junior of the two societies, and the society exists, it would appear, for the purpose of reading papers which cannot be read before the senior. Dr. Siemens, in a few words, explained the objects of the Society of Electricians; and C. E. Spagnoletti, Mr. Newton's successor, read a paper on the making of the Brush electric light machine.

Maxim's New Electric Lamp.—Mr. Hiram S. Maxim, of New York, has devised a new focusing electric lamp for use in connection with the telephone or any similar purpose of his design which we described in a recent issue. One great quality of the lamp is the sturdiness of its make; quality of the lamp is the sturdiness of its make; but there is no very great feature in its mode of action. As in the Dubosq, Serrin, and other forms before us, the carbons are simple vertical rods, the top one having a small suppressor. It is carried sensitive one hung loosely by its own weight and by a pillar which descends by its own weight and then feels the carbon that is consumed to the arc. In addition to the pillar actuates a pair of toothed wheels descending pillar actuates a pair of toothed wheels descending by grades of a screw, and the top one carried it is carried by a screw and nut. This is driven by a small electro-magnet through wheel and pinion gearing. The negative which the feed current is supplied to the lamp. The carbon is also fitted with a short holder which carries a pulley at its lower end. This pulley rests, as usual, on the top of the positive carbon holder, and by means of the feed wheels is lowered to a certain extent, holder can be raised or lowered to a certain extent, so that the negative carbon as well as the positive carbon is adjusted automatically by the current. The lamp is started by allowing the negative one, when to descend into contact with the positive one, when the current immediately passes, and by enabling the electro-magnet locks the train of wheels and stops the descent of the upper carbon, at the same time it lowers the pulley and allows the lower carbon to recede from the upper one; thus establishing the arc. As the positive carbon is consumed the arc widens, and the current weakens till the force of the electro-magnet is unable longer to detain the wheelwork. The positive carbon therefore resumes its descent until again stopped by the increasing strength of current in the longest proving sufficient to lock the gear.

Engineer, March 18, 1881

THE TRIAL OF ELECTRIC LIGHT APPARATUS AT GLASGOW.

WHEN last week we described the work at Glasgow connected with the trials of electric light apparatus, we certainly laboured under the impression that we should at length obtain real and tangible evidence as to the comparative value of the rival systems at present before the public. Unfortunately, however, only one maker could be found who would submit his lamp to the tender mercies of the jurors or the dynamometer, but, as far as is, nothing is known, except that machines under trial were then made according to the system of Gramme; whilst of lamps that of Mr. Crompton has been thoroughly tested, that of Brush being, after much vacillation, withdrawn. It is a sad pity that exhibitors should be allowed to withdraw. The withdrawal may be, say frequently is, prejudicial to the interests of the public, but it is also unfair to judges, who have to spend much time and energy in order to bring exhibitors to perfection. Of course the very facts the public desire to know are those which vendors of electric light apparatus desire should remain unknown. Which lamp gives the best light with the least cost? The trials at Glasgow would have definitely settled the value of all lamps entered for competition, but, as it is, nothing is known, except that Mr. Crompton has an exceedingly good lamp; and that a slight variation in the internal resistance of a dynamo machine has an appreciable effect upon its efficiency. In the main this information is not new, but the jurors' report will contain figures giving exact instead of general information. The three Gramme machines, by three different builders, tested, differed slightly in make, although, perhaps, not more so than any three tenders by the same maker. The first of (1) Jurgensen had a resistance Brush to brush = 0·750 ohms, from terminal to terminal of 1·097 ohms; that of (2) Sautter Lemonier had three resistances respectively 0·745 ohms and 1·098 ohms; and that of (3) Nilgren Hemmingway 0·616 ohms and 1·07 ohms. The Gramme machines ran at (1) a resistance of 1·098 ohms with 0·93 webers, and (2) a resistance of 1·098 ohms with 903 revolutions per minute; (3) 2·10 ohms power to produce 32 webers through a resistance of 1·07 ohms, with 1,134 revolutions. The values of (3) we have not yet received, a belt bearing preventing the taking of frictional diagrams. Nor have we the exact results of the photometrical measurements made with the Crompton lamp, but from other experiments made at Glasgow, though not for the jurors, we have every reason to believe that those measurements will assist in showing that it is, if not the best, one of the best lamps in existence. We must again revert to the misfortune of there being no public, unbiassed, and exhaustive testing of various machines and lamps, and trust that should any further exhibition of electric light apparatus be inaugurated, a condition of the exhibition shall be that the whole be tested in competition by men who thoroughly understand the subject. The jurors at Glasgow were of the greatest ability, and the testing would, if carried out on a large scale, have given us trustworthy information of a valuable kind.

Engineer, March 25, 1881

MECHANICAL TRIALS AT GLASGOW.

FOLLOWING up the brief general article which appeared in our issue of last week on the subject of the electric light trials in connexion with the Exhibition of Lighting Appliances at Glasgow, we now proceed to give some notes respecting the testings referred to. As mentioned in our former article, the trials that had then been instituted were confined to the dynamos and other apparatus shown by Messrs. Crompton and Co. These exhibits included (1) an A Gramme machine, made by Messrs. Jurgensen, Sautter, Lemonier, and Co., of Paris; and (2) another Gramme, of the same pattern, but made by Messrs. Sautter, Lemonier, and Co., of Paris; and there were also Mr. Crompton's lamps in their most improved form, and an engine constructed by Messrs. Marshall, Sons, and Co., of Gainsborough, by which the above named machines were driven. The engine is fitted with Hartnell's automatic expansion gear, which was found to act admirably, the distribution of the steam, as shown by the numerous indicator diagrams taken, being excellent.

The aim of the Committee of Jurors was to test the engine most thoroughly as to the power developed, then to trace that power into and through the dynamo-electric machines, and lastly by means of a photometer to determine the amount of illuminating force cut by each lamp. As carried out on the night of the 25th ult., the experiments were conducted on the principle of the division of labour, two or more of the jurors and assistants being engaged at each stage of the work. Starting at the engine, the power developed by the engines was determined by indicator diagrams, a method that, absurdly by the machines was measured by a dynamometer which was taken down to Glasgow by Dr. John Hopkinson, F.R.S., who had been specially engaged by the Executive Committee of the Exhibition to assist in carrying out the important experimental inquiry placed at by the Committee. The dynamometer used was that designed by Herr Hefner von Alteneck, and it was described by Dr. Hopkinson in a paper read by him last year before the Institution of Mechanical Engineers. The indicators used were most carefully tested and compared, and, as far as was possible, every means were taken to insure accurate results.

If we now turn to the consideration of the power used by the dynamo-electric machine which was first tested, we find that the mean gross horse power was 2.51. The frictional diagrams of the engine and dynamometer gave 2.92 horse power, and after deducting that amount we get 2.19 as the horse power used by the machine in producing a mean current of 32.5 webers, through a resistance of 1.098 ohms, exclusive of the arc.

In regard to the second machine tested, that made by Sautter, Lemonier, and Co., it should be mentioned that owing to the position which is occupied on the tumbril, the dynamometer caused the belts to be far too tight, thereby causing a slipping of the machine to become very considerably heated. The diagrams taken under these circumstances show that the horse power gradually increases in consequence, and it would scarcely be fair to judge of the efficiency of the machine under such conditions. The mean gross horse power taken at this stage was 7.06, and deducting 2.92 horse power, as before, we get 4.14 horse power used by the machine in giving a current of 31.19 webers.

When the third machine was under test it showed a mean gross horse power of 6.57, and after deducting 2.92 horse power, as in the other two cases, we have 3.40 horse power used in producing a current of 29.2 webers through a resistance, exclusive of arc, of 1.447 ohms.

Some diagrams taken by Mr. Crompton, also, when all the three lights were on at once show a gross horse power of 11.6. If only 1.6 be deducted as the engine friction we have 10 horse power for each light, which corroborates the general results obtained from the other diagrams.

The current passing through the light was measured by one of Siemens' electro-dynamometers. In this instrument, which is an application of one of Ampere's experiments, a copper frame, round three sides of which the current to be measured is led, is suspended by a silk thread, and the compensations to it are made by the extremities resting in cups filled with mercury. Four coils of brass the current next passes through an insulated wire forming several convolutions round the suspended frame. The tendency of the frame to be rotated by the current is opposed by a spiral spring, which, again, is supported by a moving head carrying a pointer revolving above a divided dial. When the current is passed through the dynamometer the frame is deflected, and it has now to be brought back to zero by the adjustment of the spring already mentioned. The number of degrees through which the head of this spring requires to be turned in order to effect this is read, and has now to be brought back to zero on a table worked out for each instrument.

Mr. Crompton's lamps, of the E pattern, was the one that was tested. In it the magnet coils are formed of wire of No. 11 B.W.G., surrounded by a secondary shunt coil of fine wire having a resistance of 120 ohms. The carbons used were made by Messrs. Sautter, Lemonier, and Co., and were 13 mm. in diameter.

It was finally arranged that the photometric experiments should have been carried out as follows: Two seats on the Corporation Gasworks were to be taken, one of direct light, the measurement, and another taken at an angle of 45° on the horizontal line. In the latter case the light was to be received on a white screen, and the measurements were to be made by a Bunsen photometer. The experiments were to be carried out as follows: The engine was to be started, and the dynamometer and indicators applied. The engine was to run a sufficient length of time to enable the dynamometer to get warm, and then the indicator diagrams were to be taken. The engine was then to be stopped, and the dynamometer and indicators removed. The engine was then to be started, and the lamps lighted, the current being carefully regulated by the electro-dynamometer

Miscellaneous News

ELECTRICITY.

SALT LAKE CITY, Utah, Nov. 13.—Ogden, Utah, is the first city west of the Mississippi River to adopt the electric light. A flag-staff sixty feet high is to be surmounted by a three-globe arc lamp, giving an elevation of 200 feet, from which will be distributed 10,000 candle power each arc, sufficient to brilliantly illuminate a space one mile in diameter. The lights are to be in operation before the first of February.

The annual report of the Lighthouse Board for the last fiscal year says: "It will probably contain an interesting review of the progress which has been made by the electric light during the year. In order to give the electric light a proper test, the Lighthouse Board, if further encouraged by an appropriation of $50,000, is recommended to place one of the new lights in the system of lighthouses, stationed on the Atlantic coast. Additional appropriations will be asked for to finish the lighthouse in the Detroit River, and for the testing of a system of constructing new lighthouses will be submitted exclusively with Congress.

It seems as though great improvements in the way of lighting are attracted with zeal to life, whatever the medium employed. Kerosene, petroleum, gas, Drummonds, and the light of the future—electricity—has already caused the loss of two lives formed by the explosion of a gas-chandelier, England, a paper journal-ist testily remarks, exposed connections and diverted the current through his body. In the London shelter no such casualties occurred to a visitor on his lamping an electric light in the fire-room. He found the wires in a safe position and at the same time allowed none of the connecting wires to swing against him lastly, that the electric current through his body was only 1-20th of a milliampere, as the meter registered. Though it will fascinate lights in the country. With the rapid increase of electric light people can be furnished by the inexperienced.

In the Glasgow exhibition of electric and gas lighting apparatus is a complete, portable, self-contained gas-engine, of large lighting capacity, of 10,000-candle, capable of lighting thoroughfare, hall or railway station. Its weight is 4 tons. It consists of a 6-horse power Otto silent gas-engine, by Messrs. Crossley and Co., by Messrs. Otto's steam engine, made for the purpose by Messrs. Crossley Brothers, and by Messrs. Crompton, which is mounted with the engine upon a strong framework, by which they are borne by the driving-wheels. The dynamo-electric machine, by Messrs. Crompton, has two or more sets of coils and field-magnets, driving the rather peculiar form of driving two belts, one outside the other, to suit a width of 8 inches is necessary.

Dr. Siemens has written a long letter to *The Times*, in reply to Mr. Preece's communications on the subject of the danger of the electric light, to which we alluded last week. We are not concerned with the differences on electrical matters existing between these two eminent authorities; but Dr. Siemens comes more within our province when he goes on to speak of the value of gas as a heating agent, with direct reference to the present agitation on the great smoke and fog question. Dr. Siemens points out that in the case of factory furnaces, which are responsible for nearly the consumption of fuel to such a measure as to cast forth smoke from the chimneys, by the more modern use of gas firing all smoke is not only prevented, but a considerable saving effected. The veteran originator of the regenerative furnace goes on to advocate the use of gas fires upon the Thameside hearth, out of the usual pattern, which may be procured perma- ently and economically. Considering probably for the first time Asbestos kept in an incombustible state by a gas-flame known beneath, but in a combination of coke and gas with a solid plate substituted for a fire-grate. The gas is supplied at any pressure from the front, and Dr. Siemens expresses himself in the highest satisfied with this arrangement, which he made in his own house. The combination is not new, having been introduced nearly thirty years ago, somewhere about the time when Dr. Siemens says he tried to get a Bill through Parliament for supplying Birmingham with heating gas, in which he failed, as he states, in consequence of the opposition offered by the local Gas Companies. We do not here wish to take up the subject of a controversy which terminated so long ago, especially as there is no apparent intention on Dr. Siemens's part to renew it. It may, however, be said that the failure of Dr. Siemens's efforts at that time was due to other causes than the opposition of any local competitors, although they may have had the attack on the invention. We must regard the project of supplying a heating gas in the summer proposed as having failed in reality from its own weakness, or it would assuredly have been adopted elsewhere, though Birmingham would have none of it. In such cases as this, where two analogous processes contend for mastery, and one is victorious while the other becomes extinct in consequence of one obtaining more or no doubt that it is the fitter which survives. Dr. Siemens, of course, could scarcely be expected to put forward these considerations, and, after all, the chief interest of his letter is to be found in the statement that he has discovered a satisfactory means of using common coal gas for the purpose of warming his residence.

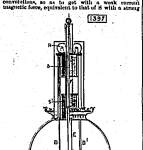
Engineering, speaking of the lighting of the Royal Albert dock, by Siemens lamps, says it is "the most extensive installation in the world of the electric light." The space, 8,500 feet long, and 200 feet wide, is lighted by 27 of Siemens pendulum lamps, placed on iron poles 80 feet high, the "electric illuminants" are of each lamp being equal to 2,000 ordinary gas-burners." The electric light is slightly cheaper where the arc, and not with them the leading for 4 engage, it stops

A SECRET item of the *Glasgow Herald* contains a account of the experimental application of the electric light at the Govan Graving Dock at the Glasgow Exhibition, under the direction of Capt. Douglas, R.N., C.B., Admiralty Superintendent of Dockyards, and Mr. Robert Hunter, engineer-in-chief of the Clyde Navigation Trust. The dock is the largest in the kingdom, which is to be permanently lighted by it.

wicks. To relieve the speed controls the pendu- l is lowered by a counterpoise, which is the cause of a slower movement of the clock-work.

1707. STEPHEN LIGHT, &c., C. *Jet-Action Bath* 5th April, 1880.—Not proceeded with.

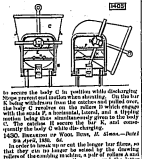
A Gentle sweat says F is free to move within the cylinder, and is fitted with a valve, G, which opens on the ascending motion, and closes on the descent, so that the water, and by in a short stroke of the valve in many convolutions, so as to get with a weak current of magnetic force, equivalent to that of a with a strong



current, and to present considerable resistance. When the armature is at rest, the spring, E, draws the valve, F, away downward with that of D is disturbed, the force F is attracted towards ascending the cylinder. When, on the other hand, the armature is drawn to the magnet, the valve, F, is closed, and the water forced through the valve, G, and escapes through the orifices to the bath. The action of the spring, E, may be varied by the screw, H, which is provided with a milled head, and a scale is applied to the socket tube of the upper screw.

1655. T. THOMAS, C. E. Cooper, *Sand* 4th April, 1880.—Not proceeded with.

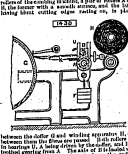
2,000. Thomas, In the end standards, C the body of the trunk, D rollers in parts, and E the end standards of the body. E runs here on which D roll, F sticks in the ground to keep the body from moving sideways. G runs on it. Above are shown on the standards H, I, and with them the looking for K engage, it stops



to secure the body C in position while discharging. Stops pressed and inclines when shown, On the bar E, being withdrawn from the catches as implied over. The bar E is drawn back by the lever L, which is fitted with the ends of the standards, hinged, and a working motion being thus simultaneously given to the body C. The standards are fitted with the ends of the body, and the ends of the bar E.

2,000. Thomas, Improvements in Wool Burrs, &c. *Sheets—Dated* 5th April, 1880.

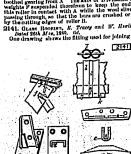
In order to break up or cut the burrs or other foreign matter in wool, the inventor employs a pair of "spiked" rollers, A and B, which are driven at different speeds, A being the faster, and B the slower with a smooth surface, and the latter having blunt cutting teeth, or projections, b, placed



between the flutes of and winding operation H, and between the flutes are passed [illegible] with rollers out in bearings D, A being driven by the other, and it by bevelled gearing from the shaft, E. The wool passing between the rollers is drawn from the ends of this roller in contact with a while the wool about is passing through, that the burrs are crushed or cut by the cutting edges of each.

2,014. Bell, *Sheep and W. Hardie*—Dated 10th April, 1880.

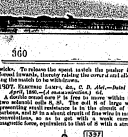
One drawing shows the filling used for joining the



ends of rubber in the slips true and well while respectively, the angle of the tip right part to the base being made to suit the angles which the rubber makes with the edge true and well plate respectively. Another drawing shows the method of joining the ends of rubber which have been previously prepared as above, and are prepared to cause different lengths of the filling for a cost of greater curvature. It is [illegible] that the ends of the rubber are cut to the angle of the tip, and the ends are then placed together, as before A B, joined together [illegible] and formed with dots and dashes, as shown, and the joint [illegible] by the

2193. Sellers Mills and Thatcher Wheat, *Mowers—Dated* 27th April, 1880.—Not proceeded with.

The inventors of a certain so that their guiders can conveniently, and over the [illegible] of the surface of the rollers at 4 and 5 45, the surface of the lower roller is provided with a series of projections, which are [illegible] by the [illegible] of the [illegible] They are driven by belt from a pulley on the roller



shaft e, which is geared with roller shaft a1, and also with the roller shaft b1, by means of the pinions f and f1, and worm i, and worm wheel on the roller shaft b1. The roller shaft a1 is mounted in bearings in the frame, and the roller shaft b1 in bearings in the [illegible] lever l, and regulating slide, and lasting rollers a1 and b1 are fitted with [illegible] and [illegible] against the rubber a at by spiral springs and set screws.

THE PREVENTION OF FRAUDS.—The Leicester Corporation are about engaging an officer to carefully test flood works at a cost of over £30,000, and the Corporation are also about appointing Mr. Mr. Hackesley, for the widening and deepening of the river Soar, at an additional cost of £60,000. It is claimed for the scheme that it will not only prevent floods, but will be a benefit to the town, but will increase the value of property in the neighbourhood beyond the actual cost.

SOUTH LEICESTER MOSSLY.—Visiting-day for the week ending Oct. 30th, was Monday, Tuesday, and Saturday, five, from 10 a.m. to 4 p.m. Number of visitors, 1,555; number of buildings visited, 7; total value of goods carried, £1,000. Thursday and Friday, admission 6d. from 10 a.m. to 4 p.m. Number, 1,555; mercantile marine, building materials, and other articles, £1,000. Total, 2,555. Average of corresponding week in former years, 1,127. Total from the opening of the Exhibition, 13,191.

THE BASIC PROCESS.—A correspondent who has recently visited the principal Bessemer districts and commercial affairs, states that Mr. Thomas, Professor at the Liverpool College, who has been making investigations in regard to the basic process, has come to the conclusion that the Professor's theories will be dealt with the cost of £1,000 per week. In Belgium the process is in full swing, and in Germany it is receiving with that under the Bessemer process. He proves that infinitely of phosphorus in the system at less than 70/. whilst labouring from 1 to 7 per cent. of phosphorus. It is found for the purpose of [illegible], that the material [illegible] have been economical, and that [illegible] by the use of [illegible] is equal to that of a Bessemer retort, and comes to the following table of values:—

	£ s. d.
Bessemer Rails.	
1111 tons at £5 0s. 0d.	5550 0 0
... per ton	7700
... ...	7700
... Rolled	7700
... Defective products ...	7700
... Rolled	7700
... Expenses of labour ...	1110
... Repairs	1110
... Repairs	1110
Total	11095
1173 tons at £5 0s. 0d.	5865 0 0
... per ton	7820
... ...	7820
... Rolled	7820
... Defective products ...	7820
... Rolled	7820
... Expenses of labour ...	1173
... Repairs	1173
... Repairs	1173
Total	11995

He states that the Gilchrist-Thomas process will be specially suited for present adoption first in the Eastern departments of France, next in the Cleveland district, in Staffordshire, Scotland, and Belgium, and finally in the Cleveland district. In Staffordshire, Belgium, and Germany, the ultimate difference in plant, and therefore the less expense being set their case in favour of the Gilchrist-Thomas process as against [illegible]. In the Eastern departments of France, the main question is the success of the new process will lead to a speculation in hematite ores.

PRICES CURRENT.

The following prices are corrected up to last night, but it should be borne in mind that [illegible] and [illegible] are prepared to meet different terms for any old contracts. It is obviously impossible to specify [illegible] and [illegible] and [illegible] in the quotations below, but [illegible]. Dealers should write direct to our correspondents.

PIG IRON AND PUDDLED BARS.

Scotland—		Lincolnshire—	
Mixed Nos. ...	2 5 0	No. 1 ...	2 5 0
No. 1 ...	2 7 6	No. 2 ...	2 2 6
No. 2 ...	2 2 6	No. 3 ...	2 0 0
No. 3 ...	2 0 0	Derbyshire—	
Cleveland—		No. 1 ...	2 10 0
No. 1 ...	2 10 0	No. 2 ...	2 5 0
No. 2 ...	2 5 0	No. 3 ...	2 2 6
No. 3 ...	2 2 6	Forge ...	2 0 0
Middlesbro'—		At Leeds.	
No. 1 ...	2 11 0		
No. 2 ...	2 6 0	Cleveland—	
No. 3 ...	2 3 0	No. 1 ...	2 10 0
At Ayrsome—		No. 2 ...	2 5 0
No. 1 ...	2 10 0	No. 3 ...	2 2 6
No. 2 ...	2 5 0	No. 4 ...	2 0 0
No. 3 ...	2 2 6	No. 5 ...	1 17 6
At Port Dundas—		No. 6 forge ...	1 15 0
No. 1 ...	2 10 0	Puddled bars ...	5 5 0
No. 2 ...	2 5 0	Staffordshire—	
No. 3 ...	2 2 6	No. 1 ...	2 10 0
Coltness—		No. 2 ...	2 5 0
No. 1 ...	2 10 0	No. 3 ...	2 2 6
No. 2 ...	2 5 0	No. 4 ...	2 0 0
No. 3 ...	2 2 6	No. 5 forge ...	1 15 0
At Port Dundas—		Puddled bars ...	5 5 0
No. 1 ...	2 10 0	Shropshire—	
No. 2 ...	2 5 0	No. 1 ...	2 10 0
No. 3 ...	2 2 6	No. 2 ...	2 5 0
Tees-side—		No. 3 ...	2 2 6
No. 1 ...	2 10 0	No. 4 ...	2 0 0
No. 2 ...	2 5 0	No. 5 forge ...	1 15 0
No. 3 ...	2 2 6	Puddled bars ...	5 5 0
Hematite—		Welsh—	
No. 1 ...	2 10 0	No. 1 ...	2 10 0
No. 2 ...	2 5 0	No. 2 ...	2 5 0
No. 3 ...	2 2 6	No. 3 ...	2 2 6
Mottled ...	2 0 0	No. 4 ...	2 0 0
White ...	2 0 0	No. 5 forge ...	1 15 0
Derbyshire—		Puddled bars ...	5 5 0
No. 1 ...	2 10 0	Scotch—	
No. 2 ...	2 5 0	No. 1 ...	2 10 0
No. 3 ...	2 2 6	No. 2 ...	2 5 0
Forge ...	2 0 0	No. 3 ...	2 2 6
Lincolnshire—		No. 4 ...	2 0 0
No. 1 ...	2 10 0	No. 5 forge ...	1 15 0
No. 2 ...	2 5 0	Puddled bars ...	5 5 0
No. 3 ...	2 2 6	Cumberland—	
Forge ...	2 0 0	No. 1 ...	2 10 0
Nottinghamshire—		No. 2 ...	2 5 0
No. 1 ...	2 10 0	No. 3 ...	2 2 6
No. 2 ...	2 5 0	No. 4 ...	2 0 0
No. 3 ...	2 2 6	No. 5 forge ...	1 15 0
Forge ...	2 0 0	Puddled bars ...	5 5 0
Staffordshire—		Hematite—	
No. 1 ...	2 10 0	No. 1 ...	2 10 0
No. 2 ...	2 5 0	No. 2 ...	2 5 0
No. 3 ...	2 2 6	No. 3 ...	2 2 6
Forge ...	2 0 0	No. 4 ...	2 0 0
Puddled bars ...	5 5 0	No. 5 forge ...	1 15 0
Shropshire—		Puddled bars ...	5 5 0
No. 1 ...	2 10 0	Welsh—	
No. 2 ...	2 5 0	No. 1 ...	2 10 0
No. 3 ...	2 2 6	No. 2 ...	2 5 0
Forge ...	2 0 0	No. 3 ...	2 2 6
Puddled bars ...	5 5 0	No. 4 ...	2 0 0
Welsh—		No. 5 forge ...	1 15 0
No. 1 ...	2 10 0	Puddled bars ...	5 5 0
No. 2 ...	2 5 0	Scotch—	
No. 3 ...	2 2 6	No. 1 ...	2 10 0
No. 4 ...	2 0 0	No. 2 ...	2 5 0
No. 5 forge ...	1 15 0	No. 3 ...	2 2 6
Puddled bars ...	5 5 0	No. 4 ...	2 0 0
Scotch—		No. 5 forge ...	1 15 0
No. 1 ...	2 10 0	Puddled bars ...	5 5 0
No. 2 ...	2 5 0	Cumberland—	
No. 3 ...	2 2 6	No. 1 ...	2 10 0
No. 4 ...	2 0 0	No. 2 ...	2 5 0
No. 5 forge ...	1 15 0	No. 3 ...	2 2 6
Puddled bars ...	5 5 0	No. 4 ...	2 0 0
Cumberland—		No. 5 forge ...	1 15 0
No. 1 ...	2 10 0	Puddled bars ...	5 5 0
No. 2 ...	2 5 0	Hematite—	
No. 3 ...	2 2 6	No. 1 ...	2 10 0
No. 4 ...	2 0 0	No. 2 ...	2 5 0
No. 5 forge ...	1 15 0	No. 3 ...	2 2 6
Puddled bars ...	5 5 0	No. 4 ...	2 0 0
Hematite—		No. 5 forge ...	1 15 0
No. 1 ...	2 10 0	Puddled bars ...	5 5 0
No. 2 ...	2 5 0	Welsh—	
No. 3 ...	2 2 6	No. 1 ...	2 10 0
No. 4 ...	2 0 0	No. 2 ...	2 5 0
No. 5 forge ...	1 15

Electricity in Collieries.

Mr. W. H. Preece, President of the Society of Telegraphic Engineers, has addressed the following important letter to the *Times* on this subject :—

Sir,—Several correspondents recently advocated in the *Times* the employment of electricity for illumination in collieries. One suggests that portable lamps made of a battery and a vacuum tube should be employed. Such lamps have been tried frequently, but they have failed from want of permanence in the current and intensity in the light. I have seen excellent lamps of this form, notably one made by Ducgnet, of Paris; but they proved much too feeble in illuminating power and penalties. Others propose the use of the electric light on the assumption that such a light is safe.

It cannot be too strongly insisted that the absolute safety of the electric light is a popular delusion. In the first place, the arc itself is the greatest source of heat which science possesses, and, in the second place, the wires conveying the electric currents that produce the arc may themselves be conveying energy in a form as insecure as a train of gunpowder. The degree of the electric arc is supposed to be removed by its insertion *in vacuo* in hermetically sealed glass bulbs; but what if these bulbs be broken, and what about the difficulty in maintaining the vacuum? Granting, however, that it be practicable to immure the light in a secure transparent vessel, what about the wires?

The currents employed to generate the light are extremely powerful, in some cases many thousand times stronger than those employed to work telegraphs. Not long ago a poor musician in a theatre in Birmingham, and quite recently a poor Russian sailor on board the "Livadia," were killed by incautiously seizing upon certain exposed parts of the conductors conveying these currents.

The difficulty in maintaining currents in their proper path in telegraphy is very considerable. How much more difficult must it be to maintain those employed for electric lighting! Copper wires are usually insulated in india-rubber or gutta-percha coatings, but these insulating coatings are liable to injury; they are inflammable, and if a mere crack or pin-hole were to occur in such a coating the currents would escape to earth, generating heat and producing fire.

This view is not chimerical. Offices have been set on fire even by the currents employed in telegraphy. I know of two such cases, one in New York and the other in Boston. It is not at all unlikely that the recent fire in Manchester arose from such a cause. The liability to such accidents is evidently much greater with electric lighting, and it is only technical knowledge and professional skill which can render such currents innocuous even in well constructed buildings. In mines, however, the difficulty is much greater. There the wires must necessarily be suspended in narrow, frequented galleries close to the damp earth, and be liable to incessant injury, and they could be rendered comparatively safe only by costly casings. It would be impossible to guarantee absolute security. To fight a colliery by electricity would therefore be both costly and dangerous.

The popular delusion as to the safety of the electric light is probably due to its being so frequently spoken of as a cold light, the word "cold" being used in its figurative sense of cheerless, the unscientific taking the word in its literal sense.

There is reason to believe that electricity plays another important part in colliery accidents. Some months ago there was a terrible disaster in the Risca colliery in South Wales; over 70 human beings were hurled into eternity. An inquiry was held into the cause of the disaster, and the conclusion arrived at was by unanimous consent that telegraphic engineer, Mr. Arthur Hodgkins, from evidence collected on the spot, arrived at the conclusion that the mine was discharged by a flash of lightning. He submitted his evidence to me, and I fully concurred with him. All the conditions for such a catastrophe were present. The flash of lightning was seen to strike the head-gear of the shaft immediately before the explosion. This machinery was connected with the bottom of the shaft by several continuous conducting masses. Iron rails, resting on poorly conducting matter, extending thence throughout the galleries. The gas was there, and it only wanted a break of continuity in the metallic masses conveying electricity, of which there were many, to produce sufficient heat to fire the charge.

I have no doubt that lightning was the cause of the explosion. These facts were submitted to those who were concerned in the inquiry; but probability, being incomprehensible to them, they were ridiculed and therefore ignored. Hence I advocate the employment of well constructed *lightning conductors* over the *head gear of shafts to keep electricity out of the colliery* and to insure safety, rather than the erection of conductors along the galleries to convey it in from the purposes of illumination and to incur danger.—London *Iron*.

DENORMANN INSULATOR BRACKET.

A most ingenious and practically successful insulator bracket has just been invented by Baron Denormann, the Mediterranean Extension Telegraph Company's manager in Corfu, well known in the engineering world for his numerous improvements in machinery, &c.

The object and obvious advantage of this bracket will be at once seen on reference to the enclosed sketch

Besides supporting the insulator more firmly than any existing bracket it prevents the wire from falling to the ground when it may have slipped from the insulator, broken or split by the thunderbolt and one causes which do break insulators; and by casting the iron with some insulating varnish the wire on alighting would in wet weather show a comparatively high insulation, and enable the line to be worked when, in the ordinary course of events, continuity would be extremely difficult or altogether impossible through the line being to earth.

Another advantage, and a very important one for those countries where poles and insulators are so frequently destroyed by electrical discharges, is the lightning guard arrangement formed by the outer arm of the bracket itself, which is considerably higher than the insulator, and effectually brought into communication with the earth by a wire twisted with the bracket into the pole, wound round it, and conducted down to the soil. In this manner all parts of the world and havoc is made amongst poles and many parts of the world are made amongst poles and insulators during heavy thunderstorms, and undoubtedly the insulators during heavy thunderstorms, and undoubtedly the Denormann bracket should offer great advantage over the primitive lightning protector at present in use.

BRITISH ASSOCIATION.

PRELIMINARY REPORT OF THE COMMITTEE, consisting of Professor W. F. Ayrton (secretary), Dr. C. R. Alder Lodge, Mr. J. N. H. Gordon, and Mr. J. Perry, appointed for the purpose of accurately measuring the specific inductive capacity of a good Sprengel vacuum, and the specific resistance of gases at different pressures.

In 1878 two of the members of your present committee concluded from a number of experiments on the analogy between the viscous yielding of bodies to mechanical stress, and the absorption of the electric charge in a Leyden jar, that some connection of an inverse order would be found to exist between the specific inductive capacities, and the specific resistances of dielectrics. As at that time it was only for guttа percha and india-rubber that the specific resistance was known, it was necessary, in order to put the theory to the test of experiment, to carefully measure the specific inductive capacities of other dielectrics, if which the specific resistances were known. This was done for shellac, sulphur, and resin, and it was found that in general when the bodies were arranged in increasing order of specific inductive capacity, they would be found arranged in decreasing order of specific resistance.

Professor Clerk Maxwell, in a different method of calculation for light, again, since different gases had different indices of refraction for light, it was felt that Faraday's not having succeeded in finding experimentally it was felt that Faraday's not having succeeded in finding experimentally any relation between the specific inductive capacities for the various gases must have arisen from the specific inductive capacities of his apparatus, and very delicate experiments undertaken by the present committee showed that this was the case. Thus, for example, the specific inductive capacity of air, and other gases, is slightly greater than unity, but the specific inductive capacity of glass, ebonite, and gas, sulphuric dioxide, &c., is considerably greater than unity. Hence the resistance of a gas to discharge, or discharge varied with the nature of the material of the apparatus. In addition to the results of Faraday's researches in which the specific resistance of gases was measured by experiments, that the specific resistance of gases was measured by experiments, that the specific resistance of gases is slightly different from unity, a conclusion also ordinary air-pump, it was slightly different from unity, a conclusion also subsequently verified by experiment.

Your committee was therefore reappointed, and has carried out the experiments undertaken for that investigation, which was conducted at Japan, Clifton, by using two insulated concentric cylinders as a condenser, the specific capacity, the other a closed conductor in which the gas at the pressure could be put. The specific capacity was first measured when the air was at the highest pressure which the latter was filled with air at the highest pressure which the apparatus could bear, and then the pressure was gradually reduced, and the specific capacity measured at each pressure. The specific capacity of the air at the highest pressure was taken as unity, and the specific capacity of the air at the highest pressure was taken as unity, and the specific capacity of the air at the highest pressure was taken as unity, and the

Nov 15th 1880

condition relatively to T, so that when the condensers on the two sides of the balance have perfectly equal capacity no sound is heard in an ordinary daily delicate telephone, T, when the commutator are made as in the figure. It will be observed that the effect of the arrangement is to make the influence of insulation in A would make it appear as if there was a less degree of insulation in B, and would be in this case with the method of experimenting previously described.

2. The air at pressures greater than one millimetre the committee have not thought it necessary to make many experiments, but between 0·05 and 0·001 of a millimetre pressure several sets of experiments have been carried out. At the latter pressure—that is, at about one millionth part of an atmosphere—the specific inductive capacity of glass, ebonite, and sulphur is practically identical with that in air, namely, 0·0 per cent., less than that numerically, whereas the greatest discrepancies before the air was thus thrown in the two previous investigations, when the pressure was not reduced to lower than five millimetres, was only 0·1 per cent. At this rate the rate of experiments for very low pressures there are decided waves in the reacting capacity and pressure, but whether these waves are really caused by a physical law, or whether they are due to the method of experimenting still requires further investigation. The committee think that they are due to the capacity not depending only on the pressure, but also on the rate of exhaustion, and that, probably, the aluminium cylinders, the committee have not yet ascertained, and, therefore, in this preliminary report they refrain from giving the curves. A sample of the observations, however, may be interesting :—

August 20th.—Pump continuously working.

Pressure in millimetres.	Reading on small sliding cylinder T_2, T_1 remaining stationary.
0·0230	163
0·0041	154
0·0031	166
0·0022	238
0·0020	162
0·0027	140
0·0029	160
0·0038	142

August 23th.—Air being very slowly let in.

0·0327	314
0·0256	338
0·0256	343
0·0765	350
0·1264	328
0·1923	292
1·9000	339
3·5500	341
7·0000	370
760·0000	395

The readings on either day may be compared one with another, but not those on different days. In either case, however, a difference of 100 in the reading indicates roughly a difference of about 1 per cent. in the capacity of the aluminium condenser. It will be observed that, in addition to the constant fluctuation in the capacity for the same small pressure, a result constantly obtained when very small pressures were employed, and which is probably due to the action of the mercury vapour, the capacity, as a rule, appears to be a useless diminution at the capacity at about 0·15 millimetre pressure. To make sure that this was not an accidental result, the air was pumped out again, when the pressure was about 3 millimetres, until it was reduced again to about 0·1 millimetre when the same diminution of capacity at about 0·19 was again observed. Now, although these numbers are merely now given as a preliminary indication of the results obtained by the committee, they are, as a matter of fact, the same as have been pointed out by Dr. G. F. Fitzgerald, of Dublin, as the values obtained for the capacity between about 0·22 and 0·2 millimetres pressure how a current consolidator in those obtained for the Condor's force.

One difficulty not with in the investigation consists in an apparent change in the capacity of the condensers Band C (partly, no doubt, arising from changes of temperature) from day to day. A similar difficulty was met with in the previous investigation made in Japan, but it was overcome by making alternate measurements of the capacity of the closed condenser, C, and of the air condenser, A, throughout the day. In the present case this is, of course, impossible, on account of the large internal capacity of the conductor A, and the considerable quantity of air which has to be kept at a constant pressure. It takes several days to obtain a measure of 0·001 of a millimetre, even although, at the suggestion of Mr. Crookes, indicating apples from a large induction coil (not shown in the figure) are kept passing between the two sets of aluminium cylinders at all times when the pressure is below 0·1 millimetre, and being made. Probably the best method of procedure is that followed on August 20th, the last day of the investigation, viz., first obtain slowly a complete series of measurements of capacity being necessarily made, then admit into the pump, drop by drop, mercury, sulphuric air, and make, during a couple of hours or so, a complete series of measurements of capacity as the pressure rises from, say, 0·001 of a millimetre up to ordinary atmospheric pressure. By this means the fluctuations during performed several times would probably give a fair indication of the true capacity. As it is also extremely desirable that the experiments should be made with electrical charges of considerable electricity, the committee have had constructed a somewhat modified form of Thomson's quadrant electrometer, which they also used in the investigation for the measurement of the specific capacities of the different substances, the second half of their work which they have not yet commenced.

THE SUCCESS OF THE ELECTRIC LIGHT.*

Not a little impatience has been manifested by the public at the seemingly unaccountable hitches with which the work of introducing the "carbon-loop" electric lamp into general use has hitherto progressed. It is now several months since the announcement was made through the newspapers that all the obstacles in the way of the utilisation of the electric light as a commercial and economical substitute for gaslight had been removed; that a method had been invented by which electricity for light or for power could be conveyed to considerable distances economically; that the current could be subdivided almost *ad infinitum*; and that the electric lamp was henceforth to be one manageable for household purposes, was, in fact, at last, so far as the public can see, the project has since that time made no appreciable advance beyond realisation. The lamp was exhibited to the public on the whole with a very fair degree of accuracy, the results expected, on the evidence of the inventor, were obtained, and the Patent Office records have been published their judgment, some of them pronouncing this apparatus to be the doubtered practical solution of the problem of electrical lighting that has been so long sought after. Meanwhile the day when the electric light should be thrown open to the public seems to be indefinitely postponed, and many people are beginning to ask whether, after all, the invention is not, like so many other highly-vaunted discoveries, destined to be a failure. Under the circumstances it was very natural that the unscientific public should begin to ask whether the time had not been imposed upon by the inventor himself or hoaxed by unscrupulous newspaper reporters.

Now, the fact is, that the system of electrical lighting was from the first all that it was originally claimed to be—namely, a practical solution of the problem of subdividing the electric light, and of conveying it to any part of a house, or of several houses, from a central station, by the mains which are required to carry its general introduction are chargeable, not to any defects since discovered in the original theory of the system or in its practical working, but to the enormous mass of details which have to be mastered before the system can get into operation on a large scale, and on a commercial basis as a rival of the existing system of lighting by gas.

With the inventor, no doubt, rests the credit of the first announcement that it was proposed to use, the electric light could have been made available for the lighting of private houses, and that it was in this respect, and in the considerably less cost of the electric light, the lamp would have been rendered comparable as a gas burner. But, fortunately, the unavoidable delay interposed by administrative and economic considerations afforded opportunity for further research and experiment, and the result has been to introduce many essential modifications at both ends of the system—both in the generator and in the lamp; at the same time many hitherto unknown, all in the direction of economy and simplification, have been made at almost every point in the system, as well as in the details of manufacturing the apparatus.

As for the lamp, it has been completely transformed. The external form of the two types of lamp is identical; the principle of illumination—incandescence of a solid body in vacuo—is also the same; but, in the earlier lamp, light was produced by the incandescence of a platinum wire wound on a spool of mica; in the perfected lamp the source of light is incandescent carbon. Another essential difference between the two is found in the form given to the incandescent body: in the platinum lamp it was coiled compactly on a small spool, in the carbon lamp it is a long loop of the finest carbon thread. The platinum spool was found to be incapable of afford a better light for domestic purposes than an incandescent mass of compact form; the shadows it casts are not so sharply defined, their edges being softened.

This loop of carbon is now prepared from the fibre of a millimetre species of bamboo from Japan. A thread of this material, after undergoing a certain chemical process, is bent into the required shape, and then reduced to carbon. The resulting carbon loop is of a remarkably homogeneous structure, and possessed of a high degree of tenacity, so that it can withstand, without breaking, all the concussions it is likely to be subjected to in household use.

The perfected lamp consists of an oval bulb of glass about five inches in height, pointed at one end, and with a short stem three-quarters of an inch in diameter at the other. Two wires of platinum enter the bulb through this stem, supporting the loop or J-shaped thread of carbon, which is about two inches in height. The stem is hermetically sealed after the introduction of the loop. The bulb is then filled with the vapour of mercury, which has been taken through the air in the bulb is extracted down to that of a mercury-gauge till not a trace of air remains in the bulb, which is then sealed in close chemi. The outer extremities of the two platinum wires are connected with the wires of an electric circuit, and at the base of the lamp is a screw by which the circuit is made or broken at pleasure. The circuit is made the resistance offered to the passage of the electric current by the carbon causes the loop to acquire a high temperature, and to become incandescent; but as this takes place in a vacuum the carbon is not consumed. The light is, in fact, produced without any waste of the carbon, continuously varies from seven hours to over sixty in duration between. With an intensified current the lamp is capable of a longer duration of life; and as the average time an artificial light is used is five hours per day, it follows that one lamp will last about six months. Each lamp costs about fifty cents, and when one fails another may easily be substituted.

The light is designed to serve precisely the same purposes as domestic gas, and is, therefore, fitted with a globe, or opaque glass, to modify its intensity, but can be gazed at without dazzling the eyes. The amount of light is regulated by the strength of the current employed. The light is steadier, and consequently less trying to the eyes. It is also purer light than gas, being white, while gaslight is yellow. Further, the electric lamp does not vitiate the surrounding atmosphere by consuming its oxygen, as gaslights do, and discharging into it the products of combustion. The best outlay for the lamp is found to be only one fifteenth of that entailed by a gaslight of equal illuminating power; the glass bulb is not expensive, and will last unbroken for years. Of course, there are accidents or inflexionable pieces to account for. The danger of fire is reduced to nil, with a consequent reduction of the rate of insurance. Finally, the light, unlike gas, is always of uniform quality. A set of meters registers exactly the amount of electricity consumed in each house. Finally, not to enumerate all the advantages which this system possesses over gas-lighting, the lamp can be manipulated even by the most inexperienced domestic servant; nor can the most careless person do injury to himself, to others, or to property, through not understanding its mechanism.

Another important modification of the system, introduced since the latest

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THE ELECTRIC LIGHT AT THE BRITISH MUSEUM.—The preparations for lighting the British Museum by means of the electric light were completed on the 18th October, and notices were posted on the reading room door that the library would remain open on and after that day till seven o'clock during the winter months. Experiments made have shown that the present lighting will be quite sufficient. Two Jablochkoff candles have been placed in each gallery, some of them consuming this apparatus to be the doubtered practical solution of the problem of electrical lighting that has been so long sought after. On the day when the library was thrown open to the public seems to be indefinitely postponed, and many people are beginning to ask whether, after all, the invention is not, like so many other highly-vaunted discoveries, destined to be a failure. Under the circumstances it was very natural that the unscientific public should begin to ask whether the time had not been imposed upon by the inventor himself or hoaxed by unscrupulous newspaper reporters.

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Another important modification of the system, introduced since the latest

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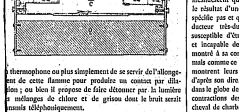
décrire, exigent pour donner leurs indications qu'on fasse une expérience spéciale, qu'on les consulte, et il estime qu'on ne les consultera pas. Il voudrait constituer des appareils scientifiques, à l'aide de conduites électriques, de transmettre dans toutes les habitations à un bureau central où une surveillance spéciale serait exercée. Je partage à cet égard son opinion : je suis convaincu qu'un semblable contrôle aurait la responsabilité en engagée, offre vingt fois plus de sécurité qu'on ouvrier qui est lui-même chargé de protéger sa vie. Rien n'égale l'incroyable imprudence des hommes dans une besogne habituelle, et un système d'avertissement centralisé serait certainement tout à fait précieux.

Malheureusement M. Somzée ne fait qu'indiquer des moyens de réalisation ; il est vrai qu'il en propose plusieurs, notamment pour l'aide, comme de faire agir la flamme des lampes à sécrété sur une plaque téléphonique fonctionnant comme



thermophone ou plus simplement de se servir de l'allongement de cette flamme pour produire un contact par dilatation ; au bien il propose de faire détonner par la lumière le mélange de chlorure et de grisou dans le bruit serait aussitôt téléphonique.

Tout cela, ce sont des idées jetées un peu en l'air, et cela ne se peu un seul appareil d'utilité ; ce qui me paraît réellement pendre en considération c'est l'idée de la centralisation des fications ; il y aurait lieu, ce me semble, de chercher dans ce voie.

FRANK GÉRALDY.

REVUE DES TRAVAUX

RÉCENTS EN ÉLECTRICITÉ

Perfectionnements apportés aux lampes à incandescence.

On doit se rappeler que dans plusieurs de nos articles pu- s sur la fameuse lampe de M. Edison (voir p. 19 et 93), ons dit que l'idée d'employer du charbon de paper n'a fait être rougir dans le vide avait été conçue et expérimentée lampes avant M. Edison par M. Swan; nous avons même que ajouté que les premières expériences de celui-ci n'- pas été très-heureuses, mais qu'il était sur la voie de lopter les difficultés qu'il avait rencontrées (voir la note de page 59). Or nous lisons dans l'*Electrician* que, le 20 oc-

tobre dernier, ce même M. Swan, dans une conférence faite à la Société philosophique et littéraire de Newcastle-on-Tyne, est parvenu à des résultats tellement avantageux qu'il croit ce système de lampes devoir résoudre pratiquement l'éclairage domestique. Quoique n'étant pas encore convaincu de l'importance de ce système, nous devons cependant convenir, d'après la manière plus sérieuse dont la question se trouve traitée par ce savant, qu'il y a un perfectionnement réel accompli, et que la lampe se trouve sensiblement dans de bonnes conditions de durée; mais bien que M. Swan fasse de très-heureux rapprochements pour prouver que la division de la lumière par ce système est économique, nous avons besoin d'expériences plus complètes pour être convaincus. Nous discuterons, du reste, le mémoire de M. Swan, car évidemment on commet toujours à ce sujet des confusions regrettables qui induisent souvent le public en erreur.

Quant aux perfectionnements signalés par M. Swan, ils consistent principalement dans la préparation du charbon employé et qui n'est plus du charbon de papier, mais le résultat d'une agrégation de matières carbonisées qu'il ne spécifie pas et qui aurait l'avantage de fournir un semi-conducteur très-dur, très-homogène, tout à fait infusible, susceptible d'être dévié en un ruban excessivement mince et incapable de se désagréger dans un vide parfait. Il a montré à sa conférence plusieurs échantillons de ces lampes, mais comme ce n'est qu'à la longue que ces sortes d'appareils montrent leurs imperfections, nous ne discuterons pas ce que d'après son dire. Pour éviter les effets de la rentrée de l'air dans le globe de la lampe, sous l'influence des dilatations et contractions des charbons métalliques qui amènent ce fait à chevel de charbon, il recouvre celles-ci de verre sur presque toute leur étendue, et ω. sont ces manchons de verre qui sont soudés dans le globe lui-même. Souvent les tubes de Geissler sont disposés de cette manière, mais nous ne voyons pas pourquoi les effets de dilatation et de contraction seraient évités par ce moyen. C'est pourtant là le point important, au dire de M. Swan lui-même, car il attribue à cette circonstance la non-durée des essais faits jusqu'ici. Il paraît de ce qu'il avance, il fait l'historique de toutes les expériences exécutées par lui à différentes époques depuis vingt ans, et ces historiques présente un réel intérêt.

Lors de ses premières expériences, il employait une spirale de carbon carbonisé qu'il plaçait entre deux blocs de charbon à l'intérieur d'une ampoule de verre dont on fit les moyens peu perfectionnés que l'on connaissait il y a vingt ans, et il s'aperçut, à son grand étonnement, que le courant n'est pas le charbon de Cailho, traversait cette spirale, sans se la faisait pas même rougir. Il attribua cet effet à ce que la spirale présentait trop de résistance, trop de surface de rayonnement et à ce que la pile n'était pas assez énergique. Il répéta alors l'expérience avec un charbon moins développé et en forme de fer à cheval; c'était exactement la disposition de M. Edison ; il mit à contribution une pile de 40 éléments, et il obtint de cette manière un effet calorifique assez intense pour faire rougir son charbon; mais il constata bientôt que celui-ci se désagrégeait et fournissait des va-

Maxim's Automatic Regulator for the Electric Light.

In previous articles descriptive of the improvements in electrical machinery devised by Mr. Hiram S. Maxim, we have referred to his self-regulating lamp. This is a very important element of his electric lighting system, and, as will be seen below, the devices which he employs meet the difficult conditions of the case in a very ingenious and practical manner.

The principle upon which Mr. Maxim has proceeded in the construction of his regulating apparatus, is to utilize the electric current itself to feed the carbons. No purely mechanical device can be successfully used for this purpose, since with all the care that may be bestowed in making them, it is quite impossible to produce carbon poles that will be perfectly uniform in

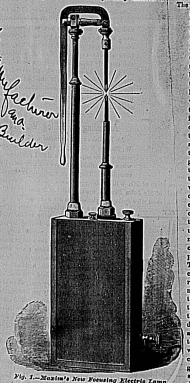


Fig. 1.—Maxim's New Focusing Electric Lamp

composition, and the slightest difference in density or homogeneity at once affects the passage of the current, and consequently the steadiness and brilliancy of the light. The poles also, by wasting away irregularly, throw the light out of center. It is obvious, therefore, that any regulator for the electric light to be successful, must operate on the principle of controlling the feed of the carbons by the electrical current itself, and the regulating devices must be so accurately constructed and so delicate in action, as to be sensitive to any trifling variations in the carbons themselves, so that their motions shall be controlled within very narrow limits.

An inspection of the accompanying engravings in the following description, will show how fully Mr. Maxim has comprehended the difficulties we have pointed out, and how ingeniously he has met and overcome them. In the engraving, Fig. 1 represents a perspective view of the lamp and Fig. 2 a section through the case, exhibiting the regulating mechanism. Referring to Fig. 2, A and B are tubes in which the carriers of the positive and negative carbons respectively operate. The positive carrier A is provided with a rack, partially seen in the cut, and which engages with a train of toothed wheels. The lower end of the negative carrier is provided with a pulley D, whose movement is controlled by a cord that is lengthened or shortened by the movements of the train of gears that actuate the positive; E is the coil of an axial magnet; G is an adjusting screw which determines the length of the voltaic arc; and F is a stop for arresting the train of wheels when the light is extinguished.

The action of this regulator is as follows: Connections having been properly made, the positive carrier is drawn up to its highest position and the carbons inserted in their respective holders. The weight of the positive carrier causes it to slowly descend, carrying the positive pole with it, and setting in motion the train of gears. At the same time, the cord of the pulley from which the negative carrier is suspended, is wound up, carrying the negative pole upwards, until the combined movement of both carriers brings the poles in contact. This completes the circuit, and the current at once commences to pass. At the same instant the helix is excited the coil E is drawn downward. Being attached to a detent, this downward motion of the coil E looks the gearing, and at the same time it draws down one end of the cord which sup-

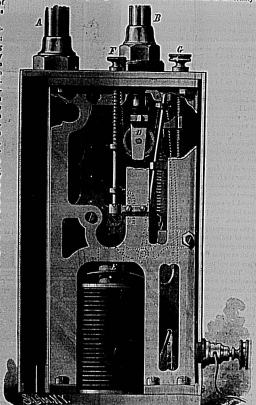


Fig. 2.—Movement of Maxim's Lamp.

ports the negative carbon, which likewise slightly descends. The trifling separation of the two poles by the descent of the negative pole, establishes the voltaic arc, and the lamp is lighted. As the carbons are consumed, the resistance becomes greater by the lengthening of the arc, and the power of the current to excite the helix is correspondingly diminished. The excitement of the helix is lessened, and the coil E is drawn upwards by the pull of a retractable spring seen in the engraving, the session of which is adjustable, to insure extreme delicacy of action in the apparatus, and which the coil is no longer able to oppose. The spring pulls the coil upwards until the detent unlocks the gears, thus setting the train again in motion, and causing the carbons to approach each other as before described, until the arc is sufficiently shortened, when the current, having been restored to its original strength, again draws the coil downward and locks the gears. The construction of this ingenious regulator is so accurate, and the adjustment of its parts so nicely effected, that the locking and unlocking of the gears is accomplished by very trifling variations in the electro-motive force of the current, and consequently the movement of the carbons is controlled within very narrow limits.

From this description, it will appear that Mr. Maxim's regulator is perfectly automatic in action, and controls the light by means of variations in the intensity of the electric current, whether these proceed from the consumption of the carbons and the consequent lengthening of the arc, or from want of uniformity in the carbons themselves. It is claimed, as a proof of the superior delicacy of this form of regulator, that tests have shown that machines of all makers run lighter on this lamp than on any other, and with much less fluctuation of power.

Further information may be had on application to the United States Electric Lighting Company, 199 Broadway, New York.

[ITEM FOUND IN BOOK]

Clarence Fork 27

p 83 "Edison's Electric Light"

p 108 "W. J. Hammer on Edison Light"

Dot 8481

Menlo Park Scrapbook, Cat. 1016

No. 11F. "Electric Light"

This is the sixth of nine scrapbooks containing clippings about electric lighting. The book covers the years 1877-1880, but most of the clippings are for 1882 and 1883. The book contains approximately 140 unnumbered pages.

1016

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THE IRONMONGER. London
[Saturday] 1884.

THE ELECTRIC LIGHT.

THE Sun Electric Light Company have acquired a patent for the manufacture of fexible carbon—a very important advantage, as it can be rolled up and stowed away in a small space—and they are about to use it in the patent lamp at the Crystal Palace. If the experiment answers, it is anticipated that the new Palace will be lit up in the same manner. The Agricultural Hall at Canterbury is to be lighted next year by the same company.

The London correspondent of the *Liverpool Daily Post* writes:—Some important information has reached me on the nature of Edison's electric light. It is formed by a coil of platinum being placed over a wire heated by the electric current. The coil itself is the source of light, the current sent through it being just enough to make it white hot and self-luminous. The difficulty to be overcome at this point of the invention was the melting of the wire to fuse, and spoil the light—a difficulty which Mr. Edison claims to have obviated by the introduction of a simple device, which, by the expansion of a small bar the instant the heat of the coil approaches the melting point of the platinum, interposes a check to the flow of the current through the coil." Mr. Edison can raise and lower each light independent of the others, and is also said to have effected an improvement in the burner by which the amount of light with the same power can be doubled. The discovery was the result of pure accident. He swore that on his plan, when a light is turned out its extinguishment immediately regulates the force of the current, so that only enough is supplied to keep the other burners burning. He can already measure the current used, and intends to divide his 300-candle power so as to make it seem as reliable than the 1,000-candle power of a carbon-point lamp.

Mr. G. William Siemens, on December 12, wrote:—"I may comparison between the cost of the electric current and its rival, gas, must be limited until central motor stations are established in populous districts, where motive power may be produced at the cheap rate of 1lbs. of coal per horse-power per hour, and whence radial conductors may supply the neighbourhood within, say, a mile radius, with both light and also with mechanical power for minor industrial purposes. It is well known that in order to produce the electric light cheaply it should be effected in as concentrated a form as possible, the reason being that the light increases in the square ratio of the current employed. The same reasoning points to the fact that extreme sub-division of the light for domestic purposes must be attended with great loss of effect."

An experimental illumination of the Thames Embankment has been made by the Société Générale d'Electricité, of Paris. Sir James Hogg, M.P., Chairman of the Metropolitan Board of Works, and Mr. Joseph Bazelgette, engineer, witnessed the display, which they pronounced highly satisfactory. Ten lights were used between Westminster and Charing Cross Bridges. The putting up of the electrical apparatus was carried out under the direction of M. J. A. Berly, engineer to the Paris company, and the contract has been executed by Messrs. Wells & Co., of Shoreditch. On the following evening the electric light was experimentally tried upon the Holborn Viaduct. The system used was the Jablochkoff, and the battery was driven by a 20-horse power engine, constructed by Messrs. Bisbey. The light was remarkably steady and brilliant, and about one-fourth of the lamps used in the ordinary way were required. The trial, it is understood, will be continued for some time, and arrangements are being made to light the Royal Exchange and the Mansion House by the Wendermann, so as to afford the public an opportunity of comparison. An interesting experiment in street-lighting by electricity on a practical scale is also in progress at Westgarten-See. The system adopted is that of M. Jelbochkoff, and there are six lamps, carried on standards 9 feet high, and placed 80 yards apart, their situation being the sea road, which is laid out on the curve. The trials hitherto made were very successful. The contractors for the supply of the electrical apparatus, cables, and lamp fittings, are Messrs. J. Edmondson & Co., of Westminster.

The electrical light is to be adopted by the Royal Carriage Department at Woolwich Arsenal, in a large building known as the mounting-ground.

Messrs. Shoolbred have had their establishment in Tottenham Court Road partially illuminated with the electric light, and so satisfied were they with the result that it is said to be their intention to use it in every department of their business, both inside and outside. Messrs. Wells & Co., of Old Street, Shoreditch, have the management of all the engineering portion of the work.

The North-Eastern Railway Company have just introduced the electric light with great success into their large engineering works at the South Dock, Sunderland. The light burns night and day, and is much preferred to gas by the workmen. It is understood that, owing to the success of the introduction, the company will shortly extend the electric light to their other works in the North.

Mr. Edison, according to the latest American papers, has completed his lamp, and is now at work to ascertain the description of generator that will produce the greatest amount of electricity per horse-power. It will be several months before he can make a public exhibition of his light. He has obtained several patents, but he will not take them out until he has completed his invention.

Ironmonger. May 10, 79.

THE ELECTRIC LIGHT.

MR. W. H. PREECE on Wednesday evening delivered, at the Albert Hall, the inaugural lecture on the Exhibition of Electric Lighting Apparatus. The Prince of Wales, the Duke of Edinburgh, and a large assembly of ladies and gentlemen were present. The Westminster Hall was one of the first shown, and while it lasted, was both bright and steady. Much attention was also excited by the light produced by brilliun rendered incandescent by electricity, and much satisfaction was expressed at its extreme brightness, purity, and steadiness. The Jablin light also made a brilliant show, and the Lane-fox was greatly admired on account of its steadiness. Then came the turn of the so-called "candles," comprised on the systems of Jablochkoff and Wilde. The forms of these, ranged round the upper corridor, for an instant shone brightly, but afterwards gave evidences of capriciousness. On the other hand, the Wilde lamps, from their being close together instead of distributed over a wide circuit, or from some other cause, burned very steadily and well. Mr. Preece then introduced the audience to the "Swiatoshaw," a powerful lamp for "filtering the depths of the sea," about to be introduced into the ports at Spithead, with a view to testing their value in protecting the advance of an enemy's torpedo. He next referred to the advantage of the "arc" over the "incandescent" system in economy of power, and the strength of the incandescent lamps in their great steadiness and durability. The Wallace-Farmer lamp was then tried, with very satisfactory results; and the eyes of the audience were next directed upwards towards the great Siemens light, or rather chandelier, hanging from the inside of the dome, and which made a noise far less agreeable to the ears than the light was to the eyes. Mr. Preece dwelt upon the many shortcomings of the electric light as at present produced—the noise, the flickering, the deep shadows, and the whiteness of a light which sets all calculations based upon the warm yellow of gas-light at defiance. On the other hand may be set the absence of smoke and the nutrition instead of the poisoning of the air in large buildings.

N.Y. Herald, June 19, 80.

The Electric Light as a Preventive of Collisions.

The great question raised afresh by the late steamship collisions is the availability of the electric light as a preventive of such disasters. But if the utility of the invention is not now settled while the public is agitating the question shipowners and shipmasters will be likely to dismiss it till another Narragansett goes down. Despite the prejudice in the minds of seamen against every innovation in their ancient craft, the electric light strongly commends itself for use by passenger steamers, especially while moving through thick fog. The trite objection which some nautical men urge against it is that its brilliance obscures distant objects lying on the ship's path, but not within the circle of dazzling illumination. But this is without force, since in many fogs the opacity of the air entirely conceals all objects a ship's length ahead, and, if the navigator is steering by the compass, it must frequently happen that he will be in positions where the view of distant objects is for the time of no consequence, while the view of an object near or nearing him is of vital importance. The electric light, by proper manipulation, is confessedly capable of irradiating the entire area of danger, and this is all that is necessary for a vigilant captain. The Select Committee of the House of Commons a year ago reported—"So far as the practical application of the electric light has gone, there seems to be no reason to doubt, it has established itself for lighthouse illumination." But if its range of beam is as great as to warn vessels of high speed from running on a sunken ledge why should it fail to warn them against collision?

In 1877 the steamship Faraday, while moored at Gravesend, previous to her voyage to America, was illuminated by the electric light which she carries—an intensely brilliant light, equal to about five thousand normal candles—placed near the bridge, and persons on shore, nearly a third of a mile off, could see to read ordinary writing with perfect ease. "A vessel carrying so powerful a light," as the London *Telegraphic Journal* forcibly says, "is better able to sight any distant objects on dark nights, and she herself can be sighted even by other ships; the electric light thus provides a ship with a better safeguard against collision." The Faraday's powerful light only absorbs about three and a half horse power, used by a small steam engine placed on deck. The English war ships *Temeraire*, *Benedmeight* and others are similarly equipped with electric lighting apparatus, and if they can employ it to advantage why may not merchant ships? Doubtless the chief use to which the light is put is to prevent collision in dense fogs; but experience shows that even on a clear night at sea collisions occur from mistakes that could hardly be made if either endangered vessel was electrically illuminated. At two o'clock in the morning, November 22, 1873, with fine weather and the night starlight, the Ville du Havre was fatally run down by the Loch Earn, an English ship, both vessels, as all the testimony shows, carrying the well-trimmed colored lights required by law, and the French report stated that the Loch Earn was seen by the other ship three and a half miles off. As this is one of the most familiar and disastrous of modern collisions its voice should still be heard, demonstrating that the most skilful mariner at night—clear though it may be—needs all the artificial light he can get to avoid the fatal crash.

SEPTEMBER 6, 1882.
THE STANDARD,
DOMESTIC ELECTRIC LIGHTING.

(FROM OUR CORRESPONDENT.)

NEW YORK, TUESDAY NIGHT.

Mr. Edison's system of providing an incandescent electric light for use in a given district has just been put to a practical test in this city. The district selected comprises an area of nearly a square mile. Only one source of supply is provided, and that furnishes the illuminating power for sixteen thousand lamps, the electric current passing through eighteen miles of mains. The result is that the soverest demands which the consumers have been able to make upon the new system have been satisfied.

The *New York Herald* is using in its business premises an isolated plant on the same principle; and the managers assure me that they are satisfied in respect to the commercial aspect of the question.

No new obstacle has presented itself to the success in practice of Mr. Edison's theory; and scientific men will be interested to know that this first practical experiment demonstrates the soundness of the inventor's application of the multiple arc system, pure and simple, as distinguished from the series system, or the combination of the arc and series systems.

Throughout the entire district lighted as described, each lamp was independent of all the others. On the inquiry before the Select Commission of the British House of Commons, Dr. Siemens said it was impossible to apply electricity for domestic lighting, from one source, over a greater area than a square quarter of a mile. Last night, although only five thousand lamps were lighted, they were distributed over the entire district of the square mile. In the district there are fifteen hundred consumers of gas, of whom eleven hundred have subscribed for the electric light.

N.Y. Herald, March 27, 80.

The press interest which is now being felt throughout the civilized world in the economy of the various sources to light homes by electricity, together with the contradictory statements made with respect to Mr. Edison's method, have induced us to attempt a brief examination of the efficiency of his lamps. We have chosen this important because most of the information on the subject has not been given to the public in a trustworthy form. We have endeavored to make a test but constitutes—test of the efficiency of the light—that is, the amount of light which could be obtained from the horse power of work given out by the steam engine. For if the light be economical the minor points, such as making the carbon strips last, are undoubtedly be put into practical shape. Three methods of testing the efficiency presented themselves to us. The first was by means of measuring the horse power required to drive the machines, together, with the number of lights which it would give. But the dynamometer was not in very good working order, so it was difficult to determine the number of lights and their photometric power, as they were continued throughout a long duration, and no one disturbed. Another method was by measuring the resistance of and amount of current passing through a single lamp. But the instruments available for this purpose were very rough; and so this method was abandoned for the third one. This method consisted in heating the lamp under water and observing the total amount of heat generated in the water per minute. For this purpose a calorimeter, holding about one and a quarter bitumens of water, was made out of very thin copper; the lamp was held firmly in the centre, so that a stirrer could work around it. The temperature was noted on a delicate Beckin thermometer graduated to 0.1 C. or 0.2 F. As the experiment was only meant to give a rough idea of the efficiency within 10 or 15 per cent no correction was made for radiation, but the error was avoided as much as possible by having the room temperature of the calorimeter as near that of the air as possible; and the loss by evaporation under the error would then be small. The following table will show the results of the experiments. In the seventh column the total amount of heat generated in the water, in the calories of energy must have been very minute. In order to obtain the number of units of work done by the engine and machine two points were generally used, one being in the vicinity of 1,000 and the other of 1,500 revolutions per minute. The mean of the two results was then taken. The apparatus for measuring the light was one of the ordinary Bunsen photometers used for determining gas lights, with a grease spot on paper, and a standard candle placed on one of the ordinary candlesticks. Two points per burner. They were retained before and after each experiment, but no change was observed. The standard candle was placed two feet from the grease spot before comparisons were made.

As the ratio of carbonized paper was fat very much more light was obtained at the expense of the carbon strip which burned there. In the prime of the lamp? Two observations were taken of the photometric power—one by a dynamic [illegible] to

NEW YORK HERALD, THURSDAY, OCTOBER 17, 1878. TRIPLE SHEET.

ELECTRIC LIGHT.

The Invention Discussed by Members of the American Gaslight Association.

IS IT PRACTICABLE?

A General Impression that Gas Will Not Soon Be Blown Out.

The American Gaslight Association met yesterday in the Fifth Avenue Hotel at the fifth annual convention. About one hundred members and forty-five members were present, among whom were delegates from most of the large cities. Nominations for officers were made, the President, General Charles Stewart Smith, occupying the chair. The following officers were elected, for the ensuing year:—President—Charles Stewart Smith, New York. Vice Presidents—H. Price, Cincinnati, Ohio; Charles Smith, Boston, Mass.; Secretary and Treasurer—Charles Hodenpyl, New York. Executive Committee—Richard B. Dennison, Philadelphia, Pa.; George S. Cahill, Lawrence, Mass.; A. Hewlett, Brooklyn, L. I.; Henry Cartwright, Philadelphia, Pa.; F. G. Sherman, New Haven, Conn.; Henry Sherry, Indianapolis, Ind.

IN GENERAL SUSPENSE.

Shortly after twelve o'clock a recess was taken until two o'clock in the afternoon. During this interval and after the adjournment in the evening the members discussed the practicability of the electric light for illuminating use.

"I have witnessed experiments made with the electric light," said Mr. Henry Cartwright, of Philadelphia, "and I am very confident about its having been perfected. The Exposition Building in our city has been lighted by it, and I am sure that gas would have been far more efficient and satisfactory."

PROFESSOR SMITH'S OPINION.

"You have not much faith, then, in the success of Mr. Edison's invention? You think it is impossible to so widen the electric to serve cities?" he was asked.

"No, I do not say that. Of course I do not know anything about his invention, and I cannot comment in writing saying it. But it seems to me that he fails to measure properly the great excellence of using electricity for illumination. It is very easy to say that each burner or lamp will cost only so much per day or hour; but I really think that he is ignorant of the actual advance or his proposed system. Gas companies have been in existence for years, and people are very accustomed to come to their centres almost exclusively. They are ready to believe almost anything in reason that is told them, and I am sure that gas companies have more confidence in their system than ever."

Mr. Henry Sherry, of Indianapolis, added—"He has not been here to-day, and I do not like to express an opinion in his absence. Besides, I have not had any experience with Mr. Edison's electric machine. The light was very brilliant and powerful, as it certainly must be, as each one was to take the place of 2,000 gas burners. I am very much interested in Mr. Edison's invention although I am unable to pronounce upon it."

"Do you," the reporter said to Professor Smith, "believe that the electric light can sustain itself in competition with gas?"

"I think, however, that your question is premature. I have not had any experience with the electric light, and I am not prepared to say. I am sure that Mr. Edison is a man of great ability, and I am sure that he has done all that he could to perfect his invention. I am sure that he has spent a great deal of money, and I am sure that he has had the most intelligent people were most interested in it."

"Do you think that the electricity will finally supersede gas as an illuminating agent?"

"That is one of those things that no living man can tell. I have no doubt, however, that the electric light will have a great many uses, and in one respect I think that it will surely be preferred—at least the use of it will prevent the explosions of gas. Whether it will or will not be the gas successor, of course, I cannot say. I am sure that the electric light will never be introduced as cheaply as gas."

"The question of cost is an exceedingly difficult one," said Mr. Hodenpyl, of the Edison Company, "and one which we have not yet considered."

Mr. R. S. Greenleaf, of the Boston Gas Company, said:—"I have had no experience with the electric light, and I do not think that I have sufficient right to say just much. I understand, however, that Professor Farmer, of the Boston Public Library, has had the electric light for two years, and considers the invention of Mr. Edison's a great improvement upon the old system. I have also been told that Professor Farmer says that the electric light is very much cheaper than gas. I understand that Professor Farmer has just summed up the comparative cost of the two lights, and that he finds that the electric light costs but one-half as much as gas. I understand that Professor Farmer will soon publish his statement."

Mr. Greenleaf, in response to a question, said that he could not say whether the electric light would be introduced as cheaply as gas.

Mr. Hodenpyl, of the Edison Company, said:—"I have no doubt that the electric light will be introduced as cheaply as gas."

The discussion of coal in an exceedingly difficult form which to burn and in its relation to gas was then taken up.

Mr. R. S. Greenleaf, of the Boston Gas Company, said:—"I am not prepared to say which is the best coal for gas purposes. I have been in the business for ten years, and I have always been in favor of the cannel coal. For coal, cannel coal contains a greater percentage of illuminating power than any other coal. I have used the Pittston coal for the past summer for the purpose of enriching the gas, and I find that it is a very good coal. I have also used the Cumberland coal, and I find that it is very good coal. However, its cannel the cannel coal."

THE ELECTRIC LIGHT DISCUSSED.

The Gaslight Society is evidently despised as a failure—not only the future, as Master Professor Farmer has said, but also and heretofore by planter of Price and Edison. Professor Farmer, of the Boston Public Library, has had the electric light in use for two years, and it was used in October and ten inches long. They are to be used in the Exposition Building in our city and have been used in other cities, and the electric light. Proof of these are usually fixed on a stand which an operator can move at will. The light is produced by a current of electricity passing between two points of carbon. They cost twelve cents each.

Mr. Greenleaf said that gas companies themselves could not be interested. One, he thought, would be in the case against any other illuminating material.

At the afternoon session of the association Mr. Charles Stewart Smith, of New York, was elected President, and Messrs. Greenleaf and Sherry as Vice Presidents. Mr. Hodenpyl read one on "Gas Meters in Lecture Rooms," which was followed by a discussion of the necessary precautions to be taken in the use of gas in lecture rooms. It was shown that under these circumstances the meters were not to be used, but meter meters for the amounts, many, one for and one for the lecture room. The meeting then adjourned to meet in Boston on the third Tuesday in October next.

EDISON'S VIEWS ON ELECTRIC LIGHT.

At the close of the session adjourned until to-day. This evening it will proceed to a body in the Fifth Avenue Hotel, to-morrow, and listen to a paper by Professor Morton on the electric light. The lecture will be illustrated by experiments. Mr. Edison will be present to explain his methods, so that by attending this the public will be afforded an opportunity of seeing the light which is so far that the secrets of the inventor will be revealed. Professor Morton's lectures are always interesting, and the experiments which he will make will be extraordinary exhibitions of skill and electrical knowledge.

The gentlemen authorized to Engineer have thrown a flood of light on the electric light in connection with Edison's invention. Mr. Edison's 1,000 candle power light is equal to that of 2,000 candles, and is produced by 2,000 burners. Mr. Hoppenstedt Pennington, one of the directors of the Edison Company, explained the principles of the electric light machine, &c.

The electric light does not interfere with gas light, nor does it affect the telegraph wires.

The electric light is produced by the current passing through a carbon burner, and in case a gas is used, the electric light is produced by the current passing through a carbon burner, and in case a gas is used, the electric light is produced by the current passing through a carbon burner, and in case a gas is used, the

London. Daily. News.
May 4, 82.

EDISON'S ELECTRIC LIGHT AND MOTORS.

—Mr. E. H. Johnson, the representative in England of Mr. Edison, delivered a lecture last evening before a crowded audience in the Organ-room of the Crystal Palace, upon the subject of Mr. Edison's incandescent light and electric motors. In doing so he described, with the aid of immense dissolving views, the construction and working of the machinery necessary for the production of the electrical current for supplying light and power to dwelling-houses. The nature of the incandescent lamp was also explained, and several experiments were made with a view to showing its simplicity, tractability, and also its perfect safety. Care is taken, it was pointed out, to keep the wires perfectly insulated, while if they should by an almost inconceivable mischance become overheated, the lights would be immediately extinguished and no harm would be done. The building in which the lecture was delivered was lighted by a handsome electrolier in the centre, as well as a number of incandescent globes hung from the balcony. At a given signal these lights were all turned down almost to vanishing point, like the sunlight at the theatres when a "dark" scene in a melodrama is to be presented. Again particular lamps were not only turned on and off at will, but whole clusters were extinguished and relighted simply by the touching of an ordinary electric switch. The perfect safety of the new illuminant was strikingly illustrated by the lecturer. Placing a covering of gauze over one of the globes containing a sixteen-candle light, he proceeded to smash the glass to atoms, and the result was that the light was extinguished without even scorching the material. The current itself, it was affirmed, unlike that produced for the arc lights, might pass through the human body without the slightest harm being done. In many cases people who had tried the experiment were unable to feel the slightest shock. Mr. Edison's system of working machinery by electricity was shown in practical operation, and a thick log of wood was quickly sawn lengthwise in half. Proceeding to deal with the subject of Mr. Edison's electric railway, the lecturer showed a portrait of the locomotive at present in use upon the three miles which have been completed. With the exception that no funnel was to be discovered, the engine was very similar to those in use upon the American railways, with cow-catcher and all complete. The inventor, it was stated, was engaged in perfecting the apparatus, and had expressed it as his confident belief that electricity would eventually entirely supersede steam upon railways. In conclusion, Mr. Johnson said a few words upon the subject of Mr. Edison himself, and the hostile criticism which he had encountered. Something had been said about his selling his shares in electric lighting and other companies and in speculating in gas shares. It happened, however, that Mr. Edison was in such matters one of the most simple-minded of men, and had never bought or sold or had any interest in any gas shares. As to his selling his shares in electric lighting companies, it was not until the last few months that he had parted with any of them, and then he had only done so because he found that he would otherwise be unable to meet the expenses of his great establishment from which he had undertaken to supply the whole world with electricity.

N. Y. Herald, Sept. 5. 82.

EDISON'S ILLUMINATORS.

THE FIRST DISTRICT BRILLIANT WITH THE INCANDESCENT LAMP—THE ISOLATED SYSTEM IS IN SUCCESSFUL OPERATION.

In stores and business places throughout the lower quarter of the city there was a strange glow last night. The dim flicker of gas, often subdued and debilitated by grim and uncleanly globes, was supplanted by a steady glare, bright and mellow, which illuminated interiors and shone through windows fixed and unwavering. From the outer darkness these points of light looked like drops of flame suspended from the jets and ready to fall at every moment. Many scurrying by in the preoccupation of the moment failed to see them, but the attention of those who chanced to glance that way was at once arrested. It was the glowing incandescent lamps of Edison, used last evening for the first time in the practical illumination of the first of the districts into which the city had been divided. The lighting, which this time was less an experiment than the regular inauguration of the work, was eminently satisfactory. Albeit there had been doubters at home and abroad who showed a disposition to scoff at the work of the Wizard of Menlo Park and insinuate that the practical application of his invention would fall far short of what was expected of it, the test was fairly stood, and the luminous horseshoes did their work well. For a long time the company have been at work preparing for the lighting of the district. But there were obstacles to them which occasioned worrying delays. The insertion of meters had first to be attended to, and then came the inspection by the Board of Fire Underwriters. As there was but one competent expert encharged with this work it naturally lagged, and it is still being pressed forward in places where the lighting apparatus is not yet ready. Then there were difficulties to be encountered in the laying of the wires and the establishment of connections. So, many people shook their heads at failure of the promised radiance and believed something was amiss. The company went on untiringly, however, and last night it was fairly demonstrated that the Edison light had a very fair degree of success.

THE LAMPS AGLOW.

It was early in the evening that the current was first transmitted over the wires and the carbon horseshoes became aglow. The machinery worked well from the start and the marked difference of the electric and gas illuminators was apparent at once. Some had based their ideas of the Edison light upon the pole electric light made familiar to them on the thoroughfares. They were a trifle disappointed at first when they saw the soft, mellow radiance of the incandescent lamp devoid of the anticipated glare and brilliancy. But when they came to remember that the light is to be used indoors for purposes of business where the eye would suffer from the too trying glow—for the store, the counting house, the workshop and for domestic uses they came to appreciate how well the mellow yellowish light performed its functions. When the illumination was begun Mr. Edison stood in the workshop of the central office of the first district, at No. 257 Pearl street, in his shirtsleeves, superintending the work. Through the machinery the men flitted about busy as bees. Messengers came speeding in to say all was ready, and then the complicated apparatus was set going, and in a twinkling the area bounded by Spruce, Wall, Nassau and Pearl streets, where the incandescent lamps had been introduced, was in a glow. There had been scientists who claimed the lighting of such a space by such a method an impossibility. But the result proved the contrary. Edison was vindicated and his light triumphed. Over the lighted area were big buildings like the Drexel and little stores tucked away in dark corners, but the communication nowhere failed, and the practicability of the multiple arc method was attested. All the lights in this space were not started last evening. In some places only a few of the number in readiness for lighting were wanted, but about three thousand were aglow, and if everything goes well over five thousand illuminators will soon be in readiness for use. Among the larger buildings in this section where the light was used are the Drexel Building, *Times* Building, Polhemus', Barnes', Greene Sons', Washburne & Moore's and others.

ACTION OF THE LIGHT.

As the evening progressed the action of the light was curiously watched by those who had it close to them. But it rarely lessened its strength, and for the first night the illumination, except in very odd instances, was singularly powerful and even. The group in the company's office seemed perfectly satisfied, and expressed a full conviction that once it was fairly set in operation there would be no interruptions. Mr. Edison said that he was convinced such would be the case did not any unforeseen and unknown phenomena intervene. Care would be taken to watch all influences that would offset the light, and doubtless new information tending to make it even more perfect would be gleaned. Altogether the experiment in district lighting was pronounced a success.

The other method of introducing the incandescent lamp has also been well received. In some of the buildings down town, where an immense number of lights are used, the Edison Company for isolated lighting have put in their apparatus. They are able to put in plant in houses with a capacity of from fifteen lights upward. The HERALD building has the largest isolated apparatus for lighting in the city. In it are 500 lights, of which 500 were used for illumination last night. To supply them are used a Babcock & Wilcox boiler and an Armington & Sims engine running with two of the 250 light dynamos, and with a capacity in boiler and engine to add three more dynamos. The isolated system of lighting has also been introduced in the American Bank Note Company building, in Thurbers', E. S. Jaffray's, Everett's Hotel, Aitkinson's and Ams'. If the light is made of thorough avail it is proposed, too, where great power is required, to introduce electric motors instead of steam.

The Democrat.

SUNBURY, PA., JULY 13, 1883.

THE ELECTRIC LIGHT.

An Interview With Mr. Thomas Edison About His Great Invention.

Edison, the great inventor, has been in Sunbury for the past week taking charge in person of the construction of his electric light works. He has taken a great interest in the works at Sunbury, but will leave to-night for New York. A reporter of this paper called at the City Hotel in this place and asked permission to interview him on the workings of his system. In reply to a question asking him to explain his system of lighting by electricity, Mr. Edison said:

"The system consists of generating electricity at a central station, running mains through the streets, either underground or overhead, connecting consumers by a service and selling light at a certain amount per thousand candles, the unit being the amount of light given in one hour from a sperm candle six to the pound and burning 120 grains per hour, the business being conducted in a manner perfectly analogous to the distribution and sale of gas, each light being entirely independent of each other. There is no other electric lighting system of general distribution. In a system called the Arc, of which the Brush is a type, the lights are not independent of each other. They are large, powerful and unsteady and unsuitable for domestic illumination, and are generally used for lighting large spaces and for advertising purposes."

Q. What are the advantages of your light over gas?

A. The advantages of the incandescing light over gas is that it gives off but one-twelfth the heat of a gas jet, gives off no poisonous gas, is perfectly steady and also safer than any other means of artificial illumination, is capable of being so placed as to produce a better illumination with less jets than by gas and in many places can be sold as cheap or cheaper than gas, giving the same amount of light. The electric jets used in Sunbury will cost one and one-fourth cents each per hour, the number of hours of burning being determined accurately by an electric meter placed on the consumer's premises.

Q. How about the cost of construction?

A. The cost of connecting a consumer's house with the main varies according to the number of lights and it is less than gas. The cost of running wires on the premises of the consumer varies from $1.75 per light to $3. The present chandeliers and kerosene fixtures can be utilized for holding the electric jets. Lights of 10, 16, 20, 32, 50 and 100 candle power may replace each other, all that is necessary is to detach a lamp of one power and attach another of greater or lesser power, the cost being in proportion to the candle power of the lamps.

Q. Is your system in general use?

A. Central stations on the general distribution system, as carried out in Sunbury, but on a much larger scale, have been in use for some time in New York, where there are nineteen miles of underground mains laid capable of supplying 900 stores, of which 520 are now supplied, to the entire exclusion of gas. The New York *Times*, *Herald*, *Sun*, *Commercial Advertiser*, *Truth* and the Stock Exchange are supplied from this station, the light being sold at the same price as gas. Central stations are in operation at Santiago, Chili; Milan, Italy; Berlin, Germany; Lawrence, Mass.; Holborn Viaduct, London. The following places are having the system introduced: Erie, Pa.; Hamilton, Ohio; Davenport, Iowa; Appleton, Wis.; Minneapolis and St. Paul, Minn.; St. Louis, Mo.; Utica, N. Y.; Brockton, Mass.; Shamokin, Pa.; Lowell and Fall River, Mass. Companies are being formed in fifty other towns for its introduction.

Q. Is Sunbury the first town lighted by your system?

A. The system used in Sunbury was especially designed for towns of from 2,000 to 7,000 inhabitants. Sunbury is the first town where its introduction has been completed on this plan.

THE DAILY NEWS, OCTOBER 6, 1882.

COST OF ELECTRIC LIGHTING.

The various electric-lighting companies are now busy sending out estimates to corporations for lighting large areas. It is plain that, the stages of wonder, advertisement, and special legislation being passed, electric lighting has got upon a commercial basis. There is a wide-spread consumers' demand for the article, and we have now to see which of the purveyors of the new light can supply it cheapest and best. For years we have heard of the advantages of "the" electric light, and every new company has referred to its own particular patent or system as "the" electric light. But invention has to be combined with practical and financial ability before it can stand among so many competitors. It may be doubted whether the advantage of having been early in the field now counts for much. The local corporations, having to face an expenditure of thousands of pounds, will in most cases rigidly require the best light, not only scientifically, but commercially speaking. Tenders and specifications will stand on their merits.

Now, we cannot pretend to judge between the inventors and electric light companies who claim superiority each for his own process. The vast difference in the tenders as regards cost would seem at first sight to suggest that some of the companies are wholly out of the race; but on closer inspection it usually appears that special merits can be claimed for this or that process when applied to special forms of lighting. One can supply a number of lights well and cheaply; another is best in a position to supply isolated lamps. Moreover, even if we could pick out absolutely the best system, we could not even yet be sure that another and better system would not be perfected next month.

Hitherto the great test of electric lighting on a large, popular, economical, but still profitable scale has not been made. Until we can see a town lit up by electricity from one centre—like gas from a gasometer—it will remain doubtful whether the new light is to be a practical success or not. We refer to the incandescent light. The arc lamps were very well for glaring advertisement, but the mild, useful light of the incandescent lamps has yet to be brought within reach of the ordinary householder. It is pretty certain that the light can be applied, not only usefully, but safely. Can it be supplied cheaply enough to warrant towns and parishes bringing it to the doors of the inhabitants? On paper it can be so supplied.

Without pretending to have pitched upon the very best system, we may confidently assert that the sample of estimates for supplying light by the new Ferranti process is far from being the worst. If others can supply the light more cheaply, so much the better; but the following estimate for "house-to-house" lighting by the process named compares favourably with gas itself:—

Estimate for Electric Lighting by Ferranti System, with 2,000 Incandescent Lamps, each of 20 candle-power:

	£	s.	d.
1.—Preliminary Outlay:—			
1. Dynamo machine	1,200	0	0
2,000 lamps at 5s. each ..	500	0	0
2,000 sockets..........	100	0	0
Switches	25	0	0
Indicator	6	16	0
Fixing, packing, starting, &c.	300	0	0
Foundations	25	0	0
	2,156	16	0
Laying mains, and wire	3,000	0	0
Station and machinery house..............	500	0	0
Engine of 200-horse power..............	3,000	0	0
Insulators, &c.	50	0	0
Total capital outlay	8,706	16	0
2. Annual Cost:—			
10 per cent. of this total for interest and depreciation	870	13	0
Salaries of Engineer and Assistant ...	400	0	0
Engine fuel, 3lb. per horse-power per hour's work	350	0	0
Lamp renewals	1,000	0	0
Sundries	39	7	0
Total cost per annum	2,660	0	0

There is nothing so familiar as gas to take for a basis of comparison, and we may proceed to place this annual cost of 2,660*l.* for the lamps in question beside the annual cost of gas giving the same illumination. Reckoning the week at 35 lighting hours (five hours per diem) in each case, it appears that the same power of light would require the consumption of 500,000 cubic feet of gas per week. At 4s. per thousand cubic feet, this would make up a cost of about 100*l.* per week, or about 5,200*l.* per annum, or just twice as much as the cost of electricity as above specified. Of course, gas is taken at its retail price, and the Ferranti estimate is the cost to the Corporation, without addition for officers, collectors, and so forth. The comparison, nevertheless, gives an idea of what can be done in the way of supplying electric light on a large scale. Were we to detail the estimate from the same source for only a few lamps, say 100 instead of 2,000, it would be seen that gas is supplied cheaper; but, on the other hand, the estimate would be additionally in favour of the new electric light were many more lamps served from a single centre. And we need hardly point out that the real test of popular electric lighting comes in when it is applied to areas as large as those which gas now lights from a single centre. Until the gasometer principle is well at work in both cases (a huge dynamo representing the gasometer in the case of the electric system), a fair understanding of the combined cost and efficiency of the new light will be difficult to arrive at.

London Daily News, Aug. 24, 82.

Address which was delivered yesterday by Dr. SIEMENS, as President of the British Association, was of a more technical and personal character than is usually to be found in those compositions. It differs as widely as possible from Sir JOHN LUBBOCK elaborate disquisition of last year, and from the impassioned harangue to which Professor TYNDALL declared that he dreaded no matter the force and potency of every form of life. Dr. SIEMENS, from beginning to end of his remarks, stuck to business. The idea of his life, as Sir JOHN LUBBOCK happily said in resigning the chair to the new President, has been to economise energy, and to make use of the forces of nature. His is well known as among the foremost, if not the very first, of the pioneers of electrical engineering, and on that topic he had much that was interesting and important to say. But he did not confine himself to his own more special subject. A review of the advance which science has made during the year is the staple product for the manufacture of Presidential addresses, but Dr. SIEMENS has been content to consider science chiefly, if not solely, in its applications to social and commercial purposes. Sir JOHN LUBBOCK, presiding at the jubilee of the Association, found a magnificent subject provided for him in a retrospect of fifty years' scientific progress. The second half-century of this time most famous of annual congresses is opened with a series of illustrations of the utility of science, from a distinguished practical experimentalist. It may be that this fact is typical of a change notable the Association itself. So far as such things can be foreseen, the present generation may be said to stand upon the verge of a material revolution to be wrought by science. Among the many thousands who visited the Electrical Exhibition at the Crystal Palace last spring, there must have been not a few who, as they contemplated that vast expanse of artificial daylight, felt that the human mind had achieved a new conquest over nature. The marvellous improvements in the transmission of sound, the telephones, the phonographs, the mouthphone, the photophones which have come into being alongside of the electric light and the electric railway, and the other new modes of applying force conquered only yesterday, open an almost boundless prospect of distance abridged and power economised, and the mechanism of life transformed. It is but natural that at such a time, as in the Jesuolan age, men should look upon science rather as a source of practical improvement and assistance than as a method of elevating the mind, and leading it, as PLATO said, to the study of abstract truth. The boundless ardour of scientific speculation, the limits of positive knowledge, form a subject on which physicists when they are compelled to be more or less popular, and desire to be more or less profound. But a President of the British Association who descends to humbler themes deserves respect for his courage and gratitude for his pains.

"Electricity," says Dr. SIEMENS, stands foremost amongst the exact sciences." In "ultimate nature it is wrapt in mystery," but its latest developments are within the knowledge of all. It is a "mode of motion," the heat and light, and it is the form of energy best suited for transmitting an effort from one place to another." Among the most interesting and curious uses of the force it is practically applicable to agriculture. After two years' experience Dr. SIEMENS is able to say that "economical transmission of power seems well adapted for effecting the various operations of the farm and fields from one centre." The wonderful influence of the electric light in ripening plants has been described on previous occasions by Dr. SIEMENS himself. It will be found from his Address that corn so treated came to maturity in less than half the time required by that which was ripened in the ordinary way. There is an electric railway now being constructed in the North of Ireland, which when completed will be twelve miles long. The electric current is to be communicated by a separate conductor, returning through the rails themselves. Dr. SIEMENS is not, however, disposed to believe that this new locomotive power will in its present condition supersede steam on ordinary lines. The Address sums up the advantages of the electric light in a convenient and compendious form. In the first place, electricity does not, like gas, give out products of combustion which heat the room and poison the air, and its carbonic acid and compounds of sulphur. Being as rule white, instead of yellow, it does not by altering equally the appearance of flowers and pictures, as indeed most people have by this time had the opportunity of deciding for themselves. Its effect upon growing plants is, it has been already observed, salutary, whereas the result of other artificial light exhibited in their presence is injurious. The difficulty of keeping steam engines continually at work for the supply of the light is, as Dr. SIEMENS explains, being gradually overcome by the introduction of the secondary battery, which discharges analogous functions to those of a gasholder. How completely in its infancy the question of electric lighting still is may be seen from Dr. SIEMENS' remark, not now made for the first time, that "the electric light may be worked by natural source of power, such as waterfalls, the tide, wave, or the wind, and it is conceivable that these may be utilised at considerable distances by means of metallic conductors." It is somewhat surprising therefore to read that, in Dr. SIEMENS's opinion, "gas-lighting will hold its own as the 'poor man's friend'." Dr. SIEMENS believes that gas has a great future, before it, not only as light in improved burners, but also as fuel. In an interesting digression on the composition and sense of London fogs he arrives at the conclusion that the social nuisance and sanitary danger will not be removed, nor even seriously lessened, so long as raw coal continues to be burnt in grates.

Passing from the subject of light, Dr. SIEMENS devoted the remaining portion of his remarks to the recent progress of engineering science. In such a sketch the Panama Canal naturally fills a prominent place. We have, therefore, unfortunately consolatory, and not critical now, the unbearable pretensions which have been put forward by the Government of the United States in respect of the projected waterway. The project itself is a splendid one, well worthy of the genius of M. DE LESSEPS. If it were constructed, it would be the shortest route between England and Japan, and to the whole of the Pacific would be reduced by 3,000 miles the present length of the journey. The sum of twenty millions, the estimated cost, has already been subscribed, and the principal difficulty is one of detail. The engineers who have been employed are said to have perished in great numbers, though on this point there is, we believe, some conflict of evidence. Whereas M. DE LESSEPS, now "dead," left the "best" behind him, Dr. J. GARRETT WILLIAMS, who has just left Egypt, may visit the site of the new enterprise himself. M. DE LESSEPS's third plan, the flooding of the Oasis-Algerian Chotts, or, as it is otherwise described, the re-establishment of the ancient Lake Triton, has not yet assumed a practical shape. Dr. SIEMENS, of course, commemorates the opening of the completed tunnel through the St. Gothard, whereby Italy is directly connected with Switzerland and the South of Germany, and the world scarcely have passed over without notice the projected tunnel under the British Channel, which has been indefinitely postponed. Prudently abstaining, on such an occasion, from political or quasi-political controversy, Dr. SIEMENS confined himself to the single observation that "a strategical point of importance" grew "dull" "minimised the engineering difficulties," but spoke favourably, nevertheless, of Mr. JOHN FOWLER's plan for taking trains across on large ferry boats. Some of the most formidable of the objections have been or could well be raised. The invention by a Cornish Professor of a gunpowder which "resists the action of water, and need not, therefore be kept dry, may live to be the death of the scheme. Such are the main facts contained in Dr. SIEMENS's exhaustive summary. They are stated briefly and simply, without rhetorical flourish or literary embellishment. But their effect upon the imagination

London Daily News, July 11, 82.

ELECTRIC LIGHTING IN THE CITY.

It had report to the Streets Committee of the Metropolitan Board of Works, that they had received notice of the intention of the experimental engineer of the Brush Company to light up, for the purpose of the investigations he was about to undertake, the Thames Embankment, from Westminster Bridge to the Temple, with the electric light on the night of Monday last, and that the Chief Engineer had, in consequence, given instructions to the contractor, and the gas lamps were not lighted on that night. Before the Committee met on Tuesday, however, they received a letter from the Brush Company, stating that they had been unable to carry out the experiment on the night in question, owing to the failure of the steam engine, and requesting that the Committee would allow the experiment to be made on the following night. The Committee, however, declined to accede to the request, and resolved that the Brush Company should be informed that they could not allow the experiment to be made on any night, unless they had received a week's notice of the intention to make it. The Committee also resolved that the Company should be informed that they could not allow the experiment to be made on any night, unless they had received a week's notice of the intention to make it.

Daily News (London) Sept. 6, 82.

ELECTRIC LIGHTING IN NEW YORK.

(BY ANGLO-AMERICAN TELEGRAPH.)

(FROM OUR OWN CORRESPONDENT.)

NEW YORK, TUESDAY.

The first experiment of lighting sections of the city with Edison's incandescent electric lamps was successfully accomplished last night. Edison has laid eighteen miles of wire in pipes, and had placed seventeen thousand lamps in stores and offices. The work has been completed in about a third of this section, and about 6,000 lamps along six miles of wire were burning last night; the circuit including the Times and Herald buildings and some large offices. In all of these places the lamps were perfectly steady, and seemed more evenly distributed than from gas burners, while it gave out only a fifteenth of the heat of gas. The expense will be less than this, the lamps consume have a porcelain shade over an air-tight cone-shaped ground-glass globe four inches in diameter, in which is a carbon horse-shoe. All the lamps are on a multiple arc circuit, with the experiment light half-a-mile from the supply station. Where the work in the section is completed 20,000 lamps will be supplied from one station.

THE LIGHT OF THE FUTURE.

PROGRESS IN THE USE OF ELECTRICITY AS AN ILLUMINANT.

THE LIGHT.

The marvellous progress that has been made in this country within the past three years in the development of the electric light for ecclesiastical purposes renders it indispensable that the assessment of gas as the steady illuminator is rapidly ending, and that the electric will, as its partisans have persistently claimed, take out be the light of the future. Those who have any doubts on this score have but to make inquiries at the offices of the different electric light companies in this city, where hundreds of orders have already been filled and where thousands of applications for the new light from cities, towns and villages throughout the Union have been received; note the immense capital that has been subscribed to carry into effect their schemes, and examine for themselves the intricate but simple apparatus which is so rapidly revolutionizing the whole system of lighting, and which already bids fair to make the holders of gas stocks tremble with apprehension.

Of the several great electric light companies organized in the United States during the period referred to, six have established their headquarters in this city. In addition to these, several local companies—branches from the parent stem—are located here, and before the close of the year, from the orders that each have received and the extensive preparations that have been made, it is not at all unlikely that not only the metropolis but all the principal cities of the Union will be illuminated by the electric light. One company already has made satisfactory experiments in town, another will commence operations in a few days, and the remaining six have in some part of the island of Manhattan, or of Allerton will, in a few days, take decisive step; it is conjectured, favorable action on the report of the committee, recommending the passage of an ordinance granting the use by the municipality of the electric light as a means of illumination, and under which any company authorized by any law of this State can carry on its operations.

While the several electric light companies conduct their operations by different methods, they in reality are governed by two systems only—the Voltaic are system, named in honor of the inventor of the battery with which it was produced for the first time, and the incandescent system. These differ merely as to the means employed, the current being generated in the same way for both. The Voltaic are system requires that a number of pencils of carbon placed end to end are in the same circuit for so exacting their incandescence as to keep the ends of the two pencils stubbly separated from each other. The current of electricity is then made to pass through these ends, they are at first placed in contact with each other, and as soon as the current begins to pass are slightly separated, and what is known as the Voltaic are is formed between the ends of the pencils as the current leaping across from one to the other. This is intensely bright, and is the most powerful source of artificial light known.

The incandescent system consists of a continuous strip, made of material which is a not conductor of electricity, placed in a glass globe from which the air has been exhausted, and which, when the current is passed through it, is rendered so white heat, technically known as "incandescence," and so produces light. Carbon is now employed almost entirely for the incandescent part of each lamp, and as it would quickly consume in the open air it is enclosed in a clear globe in a vacuum or some gas which does not unite with carbon. The light produced by the Voltaic are lamp is very brilliant but of a blush tinge, and always more or less unsteady on account of the impurities of the carbon points and the difficulty of always precisely regulating their movements. In this form of lamp the pencils are gradually consumed, and the regulating machinery feeds them together to keep the proper separation of the points, but has not yet been sufficiently perfectly as to avoid considerable disfigurement of the light. The light produced in the way is much cheaper than any other artificial illuminator, and is especially adapted to places where the quality of the light is not so much of an object as quantity. The Voltaic system is largely used for lighting railroad buildings, large halls, exhibition, factories, warehouses, but is not adapted to lighting ordinary rooms, both on account of its objectionable adequateness and the great difficulty of subdividing it into small lights. The incandescent system, or electric attention, as the carbon pencils have to be renewed at least once a day.

The incandescent light is by far the most perfect artificial light yet devised, and is entirely free from all the objectionable qualities of the Voltaic are light, but is somewhat more expensive, although recent experiments have demonstrated that it is considerably cheaper than gas. In lamps of this form the currents can be subdivided to any extent and can be used in rooms of ordinary dwellings as gas is now used, the intensity of the same being easily controlled in regard to color. It is safe and requires no attention whatever.

The six electric light companies in this city, together with their branches, have a total capital of between $2,000,000 and $3,000,000. The rivalry between them for supremacy is extraordinary, each, of course, claiming to be the first in the field, the owners of letters patent of all the good points claimed by the other and of possessing the simplest, surest and best modes of all lights produced by machines of electricity. One or more are contesting almost every point on this score in the courts, but notwithstanding these trivial drawbacks all are making rapid progress, and are meeting more orders than they can fill for weeks to come.

The system of the Brush Electric Light Company is the Voltaic are system. The company occupies the entire building at 127 to 131 Broad, in connection with which it has a repair shop, a vibrant accretion, one of the most successful. It was organized under the laws of the State of New York June 10, 1878, with a capital of $1,000,000. The principal office of the company is in Cleveland, Ohio. Its officers are: President, Charles B. Pitzi; Vice-Presidents, Marcellus Hartley and Anson Phelps Stokes; General Manager, S. D. Schuyler; Secretary, L. E. Curtis; Treasurer, G. H. Williamson; Trustees, Charles B. Pitzi, Louis Fitzgerald, D. Willis James, D. O. Mills, Marcellus Hartley, Robert H. Mansfield, Henry B. Hyde, D. H. Haich, G. H. Williamson, Anson Phelps Stokes, Moses Taylor, Thomas H. Hubbard and L. E. Curtis; Consulting Engineer, Professor Elihu Thomson; Mechanical and Electrical Engineer, Charles F. Clarke. Of the different companies established in Boston, Lowell and Lynn, this is the only one which works both the Voltaic are and the incandescent systems. From the time the company's operations up to the present date it has made the Voltaic a specialty and has recently added the incandescent to its business with marked success. The vaults of the Mercantile Safe Deposit Company, the banking offices of Fisk & Hatch, on Nassau street, and the banking office of Hatch & Foote, on Wall street, are now lighted with the incandescent lamps furnished by this company. The current of electricity that supplies these lights are generated by dynamo-electric machines located in the basement of the Equitable Building. The company is now actively engaged in introducing the light in the city with orders for many residences, factory and business houses. The system is fully described in the city with letters of this description, and the company has in connection with its business facilities the avoidance of orders which have been pouring in, and has recently purchased a factory and machine shop, direct fire spaces and six stories in height at the corner of Avenue D and Seventeenth street, which it is now fitting up. Among the firms using the Voltaic lamps as proposed by the United States Company are the following: American Exchange Bank Chatham Bank, Equitable Life Assurance Society, First National Bank, Mercantile Trust, Company, D. O. Mills, New York Central and Hudson River Railroad Company's depots, Mercantile Safe Deposit Company, Mail and Express Building, Equitable Building, Mechanics' and Traders' Exchange, Produce Exchange, Cotton Exchange, Coffee Exchange, Consolidated Stock and Petroleum Exchange, Mutual Union Hotel, Saratoga; Central Line of Steamboats, Brooklyn, Co.; Harrison, Havemeyer & Co.; and John Wanamaker, Philadelphia; Forest Fibre Company, Berlin Falls, N. H.; New York and Paterson's Hosiery Company; Pennsylvania Coal Company; Scranton, Pa.; Pennsylvania Railroad Company, West Philadelphia; United States Torpedo Station, Newport, R. I.; Warner Brush Co.; Masury and Wonderful Inventions, in which electricity is the motive power, and which are also in use for extended description of the system, which is a well known, would be superfluous. The thousands of orders in this country and in Europe, however, who have been waiting patiently these many months in view of the successful completion of the incandescent systems, will be gratified to learn that he has overcome all obstacles, and that by the time before the close of the year will be not duty to all the principal cities of the world. The application of the Edison Electric Light Company for exclusion to use certain streets for wires to supply public and private buildings with the Edison lamps is now before the Board of Aldermen, and there is no doubt but that it will be granted. The company is already not yet known to the general hosiery by Wall Street and Gerome streets and the East River, and eventually will extend the system throughout the city. Application for the Edison light from any parts of the country and abroad have been pouring in in such a volume that it will be impossible to fill them for many months to come. The requirements of the great centres may be shown when it is stated that a separate committee has been formed for lighting railway trains, steamships, factories, factories and manufactories, and have their own electrical engineers. The Edison Electric Light Company of Europe, with offices in London, Paris, Berlin and Vienna, has been formed for lighting all Europe with the Edison Electric Light Company, of Europe, with offices in London, Paris, Berlin and Vienna. The officers of the Edison Electric Light Company are: President, Vice-President; R. L. Cutting, Jr., Treasurer, and E. H. Johnson, Secretary. The Board of Directors is composed of the following gentlemen: Edward H. Johnson, of the firm of the State of New York; Grosvenor P. Lowrey, of Lowrey, Kerr & Co.; Edison, Novelty Group, 21 to 25 Union Square; Edison Electric Light Company, 65 Fifth avenue; Edison Electric Light Company, 65 Fifth avenue; Edison Electric Light Company, 65 Fifth avenue

New Zealand Times, May 20th, 1888.

about three-sixths of an inch of the length of the carbon, and then flows off. The result is efficient by a pinch cylinder, which is sealed and fitted with screw caps. The full power of steam is thrown on the engine at first, and the power can be maintained per horse-power. The invention is the result of many years' ingenuity and ingenuity in its construction. The purpose of the Eastern Electric Manufacturing Company is to supply the electric light to towns and railway stations, but while retaining the right of manufacturers to grant exclusive licenses in certain districts. Mr. Hayes, Mr. Hayes, Washington, and others, associates have been organized to work on the plan. All the parts and accessories are made by machinery to advance interest the cost of manufacture. The Eastern Company was manufactured by the Eastern Electric Company, and when the right of manufacture is obtained the Company intends to supply the lamps at so much per lamp, in addition to the license fee. Any company desiring to manufacture, to be used in the Eastern States, can obtain the outside contracts by application to the Company.

The office of the Eastern Electric Manufacturing Company is at No. 113 Broadway. Its factory is at No. 37 Fulton street. The officers of the company are: President, Mr. Hayes, Washington; Secretary, John Hayes, Washington; Secretary, C. Sawyer, Electrician, W. E. Sawyer.

THE CENTRAL ELECTRIC LIGHTING COMPANY.

The seventh company on the list, The Central Electric Lighting Company, is also a new one, having widely in its methods from all others, gives promise of becoming popular and is doing an immense business. The company has been incorporated for the manufacture, construction, and operation of New York. New Jersey, Connecticut, Pennsylvania, Trenton, and Philadelphia, and the President Latimer, for saving in restrictions and conditions of the Company's charter. The system of Automatic lamps as operated by this firm any season be halted or extinguished at will.

The Company's system is known as the Constant Current Automatic Regulator, and Pendant Burner. The Automatic the gas is turned on and off automatically, and the current may or may not be used. The Pendant Burner is a simple burner set in a handsome fixture. The connection with Automatics, or Regulators, or them, the Pendant burners are applied. A light is produced by the passage of the current through a carbon with the gas fixtures, hangs from each burner. By pulling the cone the gas is turned on and off, and the second pull turns off and so continues indefinitely.

Three inventions have been introduced with marked success in Boston and other New England cities by the Central Electric Company. The exhibition of the system at the Mechanics' Fair in Boston and at the Academy and the National office and warerooms at No. 97 Union Square.

Danbury News (Ct) Dec. 19, 88

Edison Electric Light Co., of Danbury.

At a meeting of the subscribers to the stock of the above company held Friday evening the following persons were elected directors:

John H. Nichols, E. S. Davis, T. A. Mallory, D. H. Rogers, S. C. Hoisy, Benjamin Lynes, H. C. Lynes, A. T. Chase, Wm. H. Rider, J. E. Weed, F. S. Hastings (treasurer E. E. L. Co.).

These directors proceeded to elect the following officers:

S. C. LYNES, president; L. P. Trendwell, treasurer; Wm. E. Mallory, secretary.

Mr. Hastings explained the working of the system, and where plants similar to the one proposed to be placed here are proving financially successful. It is now expected that the remaining shares of stock will be taken, and the work immediately commenced and pushed to completion as rapidly as possible, and we may expect to see our stores, dwellings and other buildings lighted by the improved light within a short time. This shows the enterprise of our citizens, as Danbury will be the first place in this section, or in the State to be lighted by the electric incandescent system.

THE ELECTRIC LIGHT IN WELLINGTON.

Until a few days ago very few people in Wellington knew that the electric light was being introduced among them, and that the Parliamentary Buildings were not to be the only ones lighted by means of this new and important invention, and it did not transpire that the Queens had been completed to enable the Government Printing Office with light from the same source as the Houses of Parliament. The whole machinery was actually in hand. Two days ago the first work was commenced by Mr. E. Hayes, to whom the task had been entrusted, and right merry was the thing we in were to make a trial. Mr Willis J. Snow, the engineer representative of the Edison light, who had been chosen in preference to all others, was present throughout, giving directions with regard to detail, and especially with regard to the erection of the dynamo machine. A new building, measuring 30ft by 20ft, has been erected for the purpose, the engine and dynamo outside, and from here light and darkness is to be controlled. To begin at the beginning, it must be stated that the motive power is obtained by means of a portable steam engine of ten-horse power, made by Marshall and Co., and very handsome power is, however, required to secure the necessary velocity of the dynamo machine. The engine has been thoroughly secured, the wheels being fixed by struts which have been strapped and bolted in such a fashion as to reduce oscillation to a minimum. To fully describe the dynamo machine would be simply a repetition of what has already appeared in print with regard to the Edison inventions. The following brief notice will, however, convey a fair idea of its construction. The layman simply sees two plates about 4ft 6in high and 8in in diameter, which stand not less than a foot apart and are connected on the top by a heavy piece of wrought iron. They apparently left at the bottom, there being cut here to admit of the insertion of a bobbin measuring some twelve inches in diameter and about two feet in length. The bobbin knows that the ends of the wire are the two poles of a powerful electro magnet—not a magnet of soft iron as those which we generally wear, but a core of soft iron wound with fine wire. The bobbin is the armature of the magnet, and it is by the rapid rotation of the bobbin between the poles of the magnet that electricity is generated. In other words, it is by the rapid cutting of the lines of magnetic force, between the two poles. Two magnets are used, the two poles of the lamps. A particularly neat ingenious contrivance by which the armature is kept in the correct one to a hundredth part of a thousandth of an inch, according to the number of lamps which it is desired to burn, is in connection with the field magnets. By throwing in more or less coil magnetism of the field can be increased or reduced at will, according to the number of lamps to be lighted, and the expenditure of steam power can be regulated accordingly. The value of this important saving can thus be clearly becomes self-evident. The bobbin makes about 1,000 revolutions per minute when running at full speed, additional velocity being gained by means of a thunderbolt wheel. The wires leading from the dynamo are two No. 16, and are thoroughly insulated and kept apart a distance of two inches, the main branches which lead direct to the lamps being also allowed to come closer. Wherever a branch has been taken off special provision has been made for safety against the accidental insertion of a loaden plug. Should the current prove too strong for a branch this plug simply melts away, thus disconnecting the branch without interfering with any other part of the work. The total number of lamps at present put up in the building is 58, but this will be increased to 65. At present they are suspended by the wires which feed them, but these are to be put on proper fixtures. Each is of 16-candle power, and one of them serves the purpose of an ordinary gas jet, giving a far better and steadier light. Portable shades have been fixed over all of them, in order to throw the reading on the tables or below. We may say that the filament used is the small globes is an obtained bamboo, only the finest portions being shaved off for this purpose just under the glass of the cam. What the steam was first turned on by the present was less than 200lbs, and each lamp simply gave a red glow; but as the pressure increased the gradually turned into a brilliant white light, by which the gas appeared to be exceedingly dim. One or two stoppages had to be made, but they were entirely owing to adjustments which were required by the engine, and not by any portion of the dynamo wire or lamps. Henry lamp burst with the greatest bell fancy, and the works fully justified the explanations of Mr Snow and Mr. J. R. Hayes. We understand that the public will have an opportunity of inspecting the office while it is lighted up under the new and certainly superior system.

THE WIZARD'S SEARCH.

Phila Ledger, May 18 '82

The Edison Electric Light in the Ledger Building.—On Tuesday and Wednesday nights the composing room of the PUBLIC LEDGER office was lighted by means of the Edison incandescent light, which proved a very satisfactory substitute for gas, both on account of its illuminating power and of its agreeable character as compared with gas, in that the incandescent light does not heat or vitiate the atmosphere. The electric light is furnished by what is known as a 60-light dynamo machine erected in the press room. This machine differs very much in appearance from machines of the Brush and Gramme type. Its magnet is very large, five or six feet in height, and the armature revolves between its poles at the rate of twelve hundred revolutions per minute. It is driven by an engine nominally 15 horse power, which runs at the rate of about 300 revolutions per minute. Ordinarily the engine is connected by belt directly with the dynamo machine, but in the LEDGER office it was deemed desirable to provide against accidents by having the machine also connected with the large engine that drives the printing machines. An overhead shaft was therefore erected, connected by belting with the dynamo machine and with both engines, friction clutches being arranged so that either engine can be used to drive the shaft while the other is idle. The change from one engine to the other can be effected while the light is being supplied without perceptibly affecting its illuminating power. The electric light machinery occupies a floor space of about 9 by 12 feet, with room for another dynamo machine, for which provision has been made in foundations, &c. [illegible]

Connected with the dynamo machine is a "regulator," made of resistance coils, to be used in keeping the lights at a fixed rate of illuminating power whether few or many lamps are in circuit. A lamp hangs near the machine, which may be taken as a sample of others in the circuit. If a number of lights are suddenly turned off, thus throwing more current into those remaining, the fact is shown to the engineer by the greater intensity of the "sample" light, and by turning a crank on the regulator he puts in more or less resistance corresponding to the number of lamps not in use, thus reducing the power of the field magnets, until he sees that the lamp at the machine (and therefore all the others) is of the right degree of illuminating power. The conducting wires, heavily insulated, are from the basement to the fifth story in the grooves of a flat board fastened to the wall, the grooves being covered by a lid screwed on after the wires have been put in place. On the main and all branch circuits are "safety-catches," consisting of lead wire interposed in the circuit, the design being that if from any cause the current becomes too strong and threatens to heat the conducting wires, the lead wires shall be melted and the connection broken, thus removing all danger. The wires are carried overhead on several circuits above the compositors' stands, and down through gas pipe "drops" to swinging brackets, very similar to ordinary gas fixtures, but terminating in a screw socket, in which the lamp is to be fastened. The fixtures are in all respects the equivalents of gas fixtures, and the light is turned on and off from each lamp as with the gas by means of a simple key. The lamps used are of two sizes, one rated at 16 candle power, the other at 8 candles. The circuit is completed in each lamp through a loop of bamboo carbon filament, bamboo fibre taking the place of the cardboard originally used. The globe covering the filament is exhausted of air to a very high degree and the lamp sealed. In the base of each lamp there is a safety catch of lead wire to prevent dangerous heating. The lamp has simply to be screwed into the socket of the fixture and is ready for use, metallic contact being made through the screw threads and a brass terminal on the lamp.

There are sixty-five lamps of sixteen-candle power in the composing-room and stereotyping foundry, and sixteen of eight-candle power, besides one of sixteen-candle power in the press-room, making a total equivalent of seventy-four of sixteen-candle power. Although the dynamo machine is rated as a sixty-light machine, it furnished a satisfactory light from all these lamps on Tuesday evening, and there was still some reserve power, a part of the resistance coils being in circuit. The lamps are hung with the bulb downwards, so that there is nothing to hinder the light from falling directly on the compositors' cases. They have over them white glass shades, like those of argand burners, which greatly help the light by concentrating it. The trial so far has been entirely satisfactory, so far as the electrical features of the light are concerned. It is too early yet to speak of the economy of the system. That will depend to a greater or less extent on the lifetime of the lamps. The average lifetime is said to be eight hundred hours or ninety working days or nights of nine hours each. When broken the lamps are replaced by others by the simple process of screwing a new lamp into the vacant place.

Boston Herald, Jan. 26. 83.

POSSIBILITIES OF ELECTRICITY.

[illegible]

THE CURRENTS

[illegible]

MORE RAPID AND STEALTHY

[illegible]

Boston Herald, May, 82.

THE DOOM OF GAS.

What Edison Has Accomplished to Perfect Electricity.

New York City Soon to be Generally Illuminated by Electric Light.

Millions of Sewing Machines to be Run For Five Cents a Day Per Machine.

Interesting Interview with the Great Inventor About His Plans and the Future.

How He Has Worked Twenty Hours Out of Twenty-four to Master Every Detail and Overcome Every Difficulty.

About One Thousand Millions of Dollars Invested in Gas Stocks, and Their Enormous Profits.

In New York the Profits Amount to $4,000,000 Per Year—In St. Louis to Over $800,000—$50 Shares Sold at $315—How Edison Looks and Talks—What He Proposes to Do for St. Louis—Our Local Monopolies.

Special Correspondence of the Post-Dispatch.

NEW YORK, April 27, 1882.—Is the electric light cheaper than gas? Can it supplant gas as a cheaper means of general illumination? These are questions which the public, judging from the great advance in gas stocks, have generally answered in the negative, and not a few have declared that the electric light was therefore a failure. But Mr. Edison, in the interview which follows, insists that he will compete successfully with gas, and within a few years drive gas as a means of illumination out of existence, and he says his experience in the district which he is now about to light up between Spruce street (the Tribune building), Nassau, Wall and the East River, will abundantly prove this. Mr. Edison has been quite ill at the Everett House for a couple of weeks, but yesterday was well enough to sit up in an easy chair and to chat on the subject of the impending battle between the electric light and gas. What a wonderful amount of nervous energy there is in this man, who knows not what it is to have dyspepsia, though he almost lives on pie, who says he has no beard because he pulls out the hair roots of his mustache and is always tugging away at his eyebrows, and whose eyes are so continually changing in color that one man says they are hazel-brown, the other blue, the other gray, while he himself declares he doesn't know what color they are. "Sea green!" declared the [illegible] inquisitor, after noting their rapid change from dark blue to a light greyish or greenish hue, and Mr. Edison laughingly consented. With his smooth, thin, wan faces sharp, decided, strong features and light brown hair, prematurely tinged with slight streaks of gray, Edison makes upon one the impression of a man who has put seventy years' work into the thirty-five which he has lived, and yet there is a quickness and lightness about his manner which is almost juvenile, and his utter beardlessness make him look (when the treacherous gray of his hair is covered by his hat) younger still. Mr. Edison comes of old Dutch stock on the one side—he remembers hearing his grandfather talk Dutch—and of Scotch on the other. One of his oddest traits, beside his pie-eating, is that he says he never can reflect in bed; he always thinks out his great inventions amid a clatter of tongues around him. The first question asked Mr. Edison was whether it was true that Mr. Vanderbilt had his electric lights taken out of his new house because they did not work well and because they had set fire to the woodwork, as some of the gas people had stated.

THE LIGHTS IN VANDERBILT'S HOUSE.

"It is false," Mr. Edison replied, pulling together his open vest. "He never tried our light. We have wired his house for lighting it from our station, in the way of general distribution; but he thought he would rather not wait till we came along there, and preferred to have an isolated plant himself. The first night on which the engine ran it made a noise, as all new engines will, and Mrs. Vanderbilt complained of it, and that settled it."

"How about the alleged setting fire to the woodwork?"

"There is nothing in it except just this: In running temporary wires in different directions just to show Mr. Vanderbilt the effects, one of them came in contact with a burglar-alarm wire, and this one, being overheated, charred some of the gold-thread wires of the cloth wall-paper which it ran into—that is all."

The questioner now turned to the main purpose of the interview, the cheapness of the electric light.

"The best answer to that question is that we are going to sell the light as cheaply as gas," Mr. Edison replied. "There are 16,000 gas jets in this first district which we shall commence lighting up within a couple of months, and we have arranged to light all these 16,000 lamps, with the exception of 850. We have got written agreements with ninety-three per cent of the gas consumers in this district that they will take the light, provided we furnish it at a price not to exceed their gas-bills."

"And who is to decide what these bills were? Have you seen them?"

"Yes; we have taken copies of them all; we have got twenty-four books containing these records."

"What will be your investment per 1,000 feet of gas in the electric light plant?"

"Ah," exclaimed Edison laughingly, "that's coming home pretty closely." After a little reflection he added, apparently still amused at what he called the "closeness" of the question: "Well, I'll tell you. Our investment will be $3 75 per 1,000 feet."

"And what is the investment for gas?"

Edison, who appeared to have the figures at his fingers' end, said: "$5 75 per 1,000 feet."

"Do you include in those figures everything except running expenses (coal, lamps and wages) and depreciation of the plant?"

"Certainly. My real estate investment is smaller than theirs. We can have our stations in the back slums, and don't want so much room. I can put all my works to light up the city of New York inside the gasometers of the Manhattan Gas Company. For instance, our outside pipes, which are full of an insulating material, will last fifty years, while gas pipes rot in twenty years, and our copper rods (wires) will last forever. The depreciation in our dynamos is not over one per cent per annum."

THE LOWEST COST OF GAS.

"Do you know precisely how low the companies can make gas?"

"Precisely," Edison retorted. "I have gathered the statistics for years past. In New York the gas in the gasometer costs them 45 cents per 1,000 feet, and the expense of distributing, collections, legal and other items make up 45 cents more, so that it costs 90 cents altogether, and for this they get $2 25 from the consumers."

"In saying that it costs 45 cents in the gasometer, do you allow for their sales of ammonia, coke and tar?"

"For every cent they realize in that way. At 90 cents, if they retain all their present consumers, they can't make any money—not a cent."

"Well, supposing they put it down to $1 per 1,000 feet just to crush you, what then? Can you compete with them at that figure?"

"I'll tell you exactly what my ideas are," Edison replied, with great energy. "We are not going to charge less than $1 50 for our light, equivalent to 1,000 feet of gas, even if they put it down to $1. Electric light is commercially worth 50 cents more than gas, because it is a better, cleaner, purer and more wholesome light, giving out almost no heat."

"You might then have to compete at $1 50 as against their 90 cent rate?"

"Oh, no," Edison cried, his eyes lighting up shrewdly. "It only costs them 90 cents with their present custom at their present output. At $1 50 I should certainly take away one-half of their consumers, and when I have reduced their output one-half, I have very carefully figured out that their gas will cost them $1 28 per 1,000 feet."

"But the gas companies are rich—"

"No, they aren't," Edison interrupted. "They have paid out all their gains in big dividends. They haven't accumulated any large surplus."

EDISON'S LOWEST CHARGE FOR THE LIGHT.

"In any case, supposing they put gas down lower still, what then?"

"I can say right here that even if they put it down to one cent per 1,000 feet we shan't charge less than $1 50, for our light is so superior that we should get a large number of their consumers anyhow; and," he added, with a twinkling eye and a grimly humorous smile, "they aren't so anxious to be bankrupted in a few years. They'll look out fast enough for number one."

"What will the cost of the light be, taking your first district? For instance, can you give me a detailed official estimate of the various items of cost?"

This innocent query made Edison laugh heartily for several minutes. "I say," he finally responded, comically, "you have mistaken your vocation; you ought to be a cross-examiner. Do you think that we want the Legislature after us the moment we have got started reducing our rates? We are not going to lose any money, that you may depend on, or else we shouldn't be going into the business."

"How can you compete with gas in England, where it is sold as low as 45 cents per 1,000 feet?"

"Ah, that is in Leeds and right in the coal fields, where it is sold by the city corporation themselves and is used in immense quantities. The average charge in London is 87½ cents, and many companies in England charge $1 25 and more. Some of the small companies charge as much as $3 45."

"Why is the cost of gas so much lower in Europe than in this country?"

"The cost of the machinery and the entire plant is much less and wages are much lower. Everything is lower, in fact."

"But not in the extraordinary proportion of the difference in the cost of gas, as between London and New York, for instance—between 87½ cents and $2 25?"

"Well, that is accounted for also by the far greater consumption of gas in dark and foggy London. Remember, the more gas you sell in a given district, made by one plant, the bigger your profits. Supposing I were to light up a square mile in London, I'd sell three times as much light there as in New York, on account

of the [illegible] consumption there." [illegible]

"But, taking the comparative cost of your plant, wages, etc., where will you make the most money, in this country or in Europe?"

"Oh, here," Mr. Edison replied, with a broad smile of pleasurable anticipation. "The gas business in England; in Germany, where they charge from $1 25 to $1 75; in France, where they charge about $1 50, and in the other European countries, is a very fat thing, but nothing like as fat as it is here." (Edison pronounced the word "fat" with a funny unction which showed that he appreciated the "fatness" of big profits.) "In this country it's a perfect bonanza, and, though we can successfully compete with the gas companies in every country in Europe, we shall make more money with the electric light right in this country than anywhere else."

"But can you tell yourself what precisely it will cost?"

"Why can't I?" Edison queried. "I've got all my plant, bought the land, erected the building, put up the boilers, engines and dynamos. I know what we shall have to spend on coal, lamps and wages of employes—why shouldn't I be able to tell it?"

"You have never yet made it on a sufficiently large scale, have you, and never for house-to-house distribution?"

"We have been making the light for two years. We have the isolated lights in 200 different places running successfully in this country, besides having it at La Scala in Milan, in Finland, in Santiago (Chili), Strasburg, and almost every country in the world. And for the last two weeks we have had a station running in London, just as this one will be, at the Holburn viaduct, for house-to-house distribution from street pipes, and all the stores, churches, hotels, etc., within half a mile are being successfully lit up. Dr. Parker's church has 170 lights. The station runs over 1,000 lights successfully, and if they had found that they couldn't do it at a profit and that it was a failure, I should certainly have heard of it by cable before this."

PROFITS OF ELECTRIC LIGHTING.

"You say that your total investment will be $3 75 per 1,000 feet. For that you will get $2 25 per annum or 60 per cent, if you charge as much as the gas companies do. Isn't that rather high, Mr. Edison?"

"There he is again," Edison broke out, laughingly. "Isn't he a sharp one to ask questions? My dear boy, the $3 75 is our investment in plant—of course, that don't include coal, lamps, wages and the operating expenses generally."

"How about your coal consumption—how will that compare with that of the gas companies?"

"Oh!" Edison exclaimed with a triumphant wink and a pleasant smile, "we'll burn $3 anthracite slab coal, and theirs is $5 gas coal."

The delighted emphasis which Edison put on the "$5 gas coal" showed that he regarded this point as a "clincher."

"And how much light will you get out of your coal as compared with the gas companies?"

"They get five feet of gas out of one pound of coal, but as they realize 50 per cent of the cost of the coal from their by-product, they really get ten feet out of their $5—gas coal."

"And you?"

"We get a little more—11¼ feet—out of our $3 coal. You see, 3½ pounds of coal gives me one horse power, which runs 8 lights of 16 candle power each. Now, each light is equal to 5 feet of gas, which would give me light equivalent to 40 feet of gas for my 3½ pounds of coal. That's 11¼ feet per pound, ain't it?" Edison queried, Yankeewise.

"How many people will it take to run your first station?"

Edison laughed again and, after some hesitation, said, "Fourteen."

"How will their work be subdivided?"

More hilarity on the part of the good-humored inventor, but after some cross-questioning, to which he gracefully submitted, this was the list of employes for the first district which he furnished:

ELECTRIC LIGHT EMPLOYES.

Engineers, 2; firemen, 4; metermen, 3; collector, 1; regulator for pressure, 1; boy for supplying lamps, 1; superintendent, 1; assistant superintendent, 1.

"In your calculation you speak of light equivalent to 1,000 feet. What do you mean by that, Mr. Edison?"

"Well, we know that 1,000 feet of gas gives the light of so many standard or 'parliamentary' candles, as they are called. Experience shows that the result per hour varies from 1,800 to 3,600 candles, depending somewhat on the quality of the gas and the state of the burners. Now we give a uniform, unvarying light of 3,000 candles as our standard basis of 1,000 feet of gas. Our customers won't get 1,800 to-day and 3,600 to-morrow. They will always get 3,000 candles. That will be our basis."

"What is the gas business in New York worth? What are the combined gas stocks selling at?" [illegible]

"I will give you the very last figures from the Gas Light Journal." Mr. Edison did a little lightning calculation and gave this to be the result: Total nominal capital of the New York gas companies, $19,500,000. Total selling price of stock at last quotations, $40,000,000.

"And how do you account for the high prices of the gas stocks if the industry is doomed to destruction?"

"Because they are still paying big dividends and we are not yet in operation. But just wait till they see that we are running 10,000 lights successfully!"

"How many gas jets are there daily burning in New York City?"

Edison calculated awhile and then said: "About 800,000."

"And you expect to supplant all these 800,000 by so using electric lamps?"

"Certainly; within ten years I believe that gas will practically be extinct in New York except for heating. But the gas stocks won't keep up over two or three years. People will see that while they may be contending to receive big dividends for three or four years, yet their capital is dwindling away all the time—namely, their custom, their business."

"Even in tenement houses you expect to do this?"

"Yes, we can afford to run one light in a house even. Of course, many of the tenement houses have kerosene, which costs only sixty cents for the light equivalent to 1,000 feet of gas, and we now address ourselves most to the people who now find it to their taste to pay $1 65 more per 1,000 feet for a better light, for gas. But there again, we shall make a mint of money by selling power to run sewing machines, just as we shall use our electricity all day in the down town district for running machinery."

"Oh," Edison declared, in a tone of deep conviction, "with what we can make in selling power into the bargain they can't compete with us—they can't do it," and he reiterated the conclusion in a tone of the most absolute conviction.

THE NEXT DISTRICT TO BE LIT UP.

"When will you begin work on your second district?"

"Immediately. Our second district to be lit up will be that bounded by Twenty-fourth and Thirty-fourth streets, and Eighth and Madison avenues. This is one of the most profitable gas districts in the city. There are 42,000 gas jets in it, and we shall have it lit up this summer. We shall also find here 4,400 sewing machines to run."

"Mr. Edison, you say that gas is henceforth doomed as a light. Please give me your reasons for that opinion."

Mr. Edison, who had hitherto maintained a chatty, colloquial tone, now became more formal and said: "Gas is a barbarous and wasteful light. It is a light for the dark ages. The distribution of gas through a city is done by means of an immense system of sewerage pipe, through which it is forced and kept under pressure—a gas reeking with impure material and made by a dozen different processes. This gas is allowed to escape through holes into our apartments where it is burnt, taking oxygen from the air to support combustion, the products of which are carbonic acid, carbonic oxide, sulphuric acid, sulphuretted hydrogen, and a host of other substances, which vitiate the atmosphere. It thus gives 96½ per cent more heat than light. In fact the result of the vile poison is almost entirely heat and only incidentally a little light. It is a nasty, yellow light, too, and far removed from the color of the lovely natural light. And it is charged for by quantity and not by quality, for it is passed through meters which measure the quantity and not the quality of the light—certainly a wrong system. At the source of supply the crude material from which this gas is made, namely, the coal, is passed through a distillation process, from which it is liberated from the other constituents of the coal, more or less imperfectly. It is then stowed in the gasometer, ready for distribution. This is one half of the process. The other and final portion of the process takes place in our sitting and bed-rooms, much to the detriment of our health, our sight and our household effects. In other words, matter is sent into dwellings for the ostensible purpose of producing light, whereas its main product is heat."

"Well, how as to the manufacture of the electric light, Mr. Edison?"

"In the case of the electric light nothing is sent into the house but energy whereby the light is produced and a very small amount of heat, about 3½ per cent as compared with the amount of light. It does not flicker; it does not vitiate the atmosphere. It shows colors in their natural hues and does not hurt the eye. The meter measures quality and quantity both."

THE MONEY NECESSARY TO INTRODUCE IT.

"How much money will be required to introduce the electric light all over New York?"

"It will take about twelve million dollars to install my light throughout New York City. It will take just about three-fourths of the actual money invested in gas, which is about $16,000,000."

MONEY INVESTED IN GAS.

"How much money will it take to introduce the electric light all over the world?"

"Oh, that's hard to tell. What we do know is that there are about $385,000,000 invested in gas in the United States, and about $100,000,000 in England. According to the London Gas Light Journal there are about one thousand millions of dollars invested in gas throughout the world, while there is only seven times that amount invested in railroads—so you see what a gigantic industry it is. There are only about two hundred million dollars invested in telegraphs and cables and only seven millions in telephones. The telephones, as investments, pay best of all."

"What guarantee will electric light consumers have that the light won't go out?"

"In all central stations we shall have twelve separate steam dynamos, and we shall never use more than ten at any one time. When we shall have three districts started, if the central station belonging to one should burn down, the other two central stations will supply the three districts. In fact there will be far less chance of our light giving out than is the case now with gas, which occasionally does go out. I have heard of as many as 150 people complaining at a gas company's office in one afternoon during very cold weather that they have got no gas and can't get any."

PROFITS OF THE GAS BUSINESS.

"For the $12,000,000 to be invested here in electric lighting, how large a return do you expect to get?"

Mr. Edison's eyes twinkled again, but he finally said: "Well, the Gas Companies in New York City make about $4,000,000 net per annum. They sell 3,630,000 'm's' (1,000 feet) every year, for which they get $2 25 each, or $8,[illegible] in all, and more than half of this is profit. That's what they make. What we'll make it is perhaps premature to say, but whenever in competition with gas we shall come down in our price to a point that will prevent the gas companies from clearing any money whatever, we shall still be earning profits, making our stock as valuable as the gas stocks are to-day, when the gas companies have no competition at all."

WATER GAS.

"Is water gas as deleterious as coal gas?"

"Much worse, owing to the large proportion of carbonic oxide—which is a blood poison—contained in it. I would just as lief have sewer gas come into my room as water gas; just as lief."

"How cheaply will you be able to run the sewing machines?"

"We can run a sewing machine all day long, at a cost to the consumer of five cents. It takes the same amount of electricity to run a sewing machine as it does to light a lamp giving sixteen candles. We can subdivide the electric motor down to one-hundredth of a horse-power. There are in New York 240,000 sewing machines and there is no reason why we should not supply power to run most of these. Of course in the tenement-house districts our business will be simply enormous."

MR. EDISON'S OPINION OF GAS MEN.

"What do you think of the gas people generally?"

"I have a very poor opinion of the men generally engaged in the gas business. Like all large corporations making very large profits, any mismanagement is never inquired into as long as the company pays fat dividends, and of all the corporations in the United States the gas companies are those most grossly mismanaged. For years they have been squeezing the public as they would a lemon."

"But if the electric light is such an invincible foe of gas, why haven't they bought it up?"

"They never thought that the thing could be done, and having so much interest in not having it done, they would not reason or listen to anything tending to show that it could be done, and, besides, they could never buy our company up any way."

This declaration appeared to imply a proclamation of unpurchasable virtue, and the question therefor suggested itself naturally:

"Why not?"

"Because the gas stocks are extremely subdivided as regards the holdings of the investors and are owned, generally speaking, in small lots, and the managers, as a rule hold no very considerable or controlling amount of stock, so that there would be no concerted action. Indeed there has been no one among the rich gas stockholders to take the initiative in such an undertaking as buying up the Edison Company."

"In other words, as I understand you, gas, in your opinion, has no Commodore Vanderbilt—no Jay Gould?"

"No, certainly not. Gas has no bright, enterprising, live men. The leading men in it are nearly all old fogies. Commodore Garrison is perhaps the richest and the sharpest, but then he is a very feeble and very old man."

"Do you see now, after all the tests which you have made, any practical difficulty in the way of a successful operation on a scale equal to that of gas, of the electric light?"

"Not the slightest difficulty occurs to me. There is not a single detail, however small, which gives me the slightest anxiety to-day. As we have progressed with the introduction of the system, however strange it may seem, the amount of money to be invested diminishes, the life and economy of the increase, and the margin for future improvement is so infinite that there is no telling how low lighting by electricity may be brought down to within the next ten years."

LIFE AND COST OF THE ELECTRIC LAMPS.

"What is now, after your very latest experience, the life of the lamp?"

"The average life of the lamp which we use for general distribution (allowing eight lamps of sixteen candles each per horse power) is about eleven hundred hours. The same lamp, one year ago, did not last six hundred hours."

"How would that practically work in New York?"

"The average burning time of a gas jet in New York is four hours per day, and at that rate a lamp would last 275 days."

"And where there are several lights?"

"Well, I have five gas-lights in this room, for instance, and if it were lighted by my lamps instead of these gas jets and I burned them four hours per day, I should have to put in a fresh lamp every fifty-five days. Of course in some places the average burning time is as much as five hours per day, and perhaps even more."

"Will you charge separately for your lamps?"

"No, we shall sell electricity by the meter, and the supply of lamps will be simply regarded by the company as an expense of the business. We shall give each consumers a box with a dozen lamps all complete for screwing on their burners whenever they should want them."

"Do you think you will increase the life of your lamps?"

"Within the next year I am confident I will get my lamps to average a life of 2,500 hours. I have had lamps last 9,000 hours of exactly the same make as those we are using, thus showing that it is possible to get all my lamps to last that time."

"This would make the light very cheap?"

"Certainly. Manufacturing these lamps by the million, as we shall—we have already made a quarter of a million of them—we can make them very cheaply indeed. The whole lamp, carbon, globe and socket tip for screwing on the burner, all complete, can be furnished by us at a small cost to the company. They shouldn't cost us, made on that great scale, over 50 cents a piece, though at retail we charge $1 for them now to people having isolated plants."

"You will manufacture the lamps at Newark in the future?"

"Yes, we shall start our manufactory at Newark in two weeks. We moved from Menlo Park for want of room. Here in Newark our building covers six acres, and we shall employ 1,000 men there when we are running at our full capacity. At the beginning we shall put 250 men on. When I started there were only three glass-blowers in the country who could be obtained. I have now taught already from forty to fifty, and shall have to teach the art of glass-blowing to several hundred. The making of these lamps, which embraces thirty-five processes, is an entirely new industry, and it is no small task and requires a great deal of patience to teach all these men how to do the work." With a quizzical humor Edison added: "I tell you, Job got too much reputation on a small capital; he ought to have been down at Menlo Park."

"How many lamps will you be able to manufacture there?"

"Forty thousand a day or 12,000,000 per annum, taking 300 working days in the year. At the start we shall, however, manufacture only 5,000 per day; that will be enough for the beginning."

"MR. SWAN MAKES MY LIGHT."

"Your light is practically the same as that of Mr. Swan, which has been so successfully introduced in London; is it not?"

Edison replied laconically and, at the same time, somewhat scornfully: "Mr. Swan makes my light." He added: "There are only two forms of electric lighting—the incandescent and the Arc light. The incandescent light is mine." These last few words were given with marked emphasis, and there was a wealth of pride and conviction in the word "mine."

"Well, Mr. Edison, you have undertaken a great work. A work of many years."

"Oh, I'm young yet," Edison replied gayly, "and I think I have a few years yet before me. My grandfather died at the age of 103; my father is 78, and the youngest of four brothers." And Edison rather gleefully snickered at the pleasant prospect of a long life of hard work and endless new inventions in electricity.

"Then you hope to be able to see out the battle between gas and electric light?"

"Yes, I hope to do that," was the energetic reply.

"Isn't there a good deal of popular disappointment, however, at the slowness with which the invention has been put into practical use?"

"I know there is," Edison replied, "but why? Because people in this country are so unreasonable. The moment I declared that I had subdivided the light, everybody thought they ought to see the light burning in every house in New York within a few months. It's ridiculous. The newspapers came out and said the electric light was a failure because within six months or a year I hadn't started yet selling the light to everybody in New York. And yet as late as '79 all the distinguished witnesses testifying before the English Parliamentary committee pronounced the economical subdivision of the light a visionary dream."

"How much time should you have been reasonably allowed?"

"If I had worked in the ordinary way? If the electric light had needed the time which the invention of gas, the sewing machine, etc., needed before the public could use them? Ten or fifteen years. It is only our people who work eighteen or twenty hours a day, without ever taking a holiday."

"How much time have you really had already?"

"Well, my invention was not really completed till July, 1879, so that I haven't had three years yet, and here is an industry with $350,000,000 invested in it to be supplanted and driven out: a new industry to be established, in which the vast majority of employes had to be taught as apprentices. Why, it was ridiculous to conjecture to light up any part of New York before 1881 at the very least, and that would only have given me five years. I don't suppose there are over 100 glass-blowers available for our work in the world, outside of those I have taught myself. Up to last March, when I came to New York, I have certainly averaged twenty hours of work per day, Sundays and holidays included."

"What do you usually take when you are worn out with work?"

"A glass of water or a glass of milk," was the dry reply. (This is no pun.)

"And your favorite sustenance?"

"Pastry, particularly apple pie," Edison said, looking up eagerly at Mrs. Edison, who at this moment entered, smilingly with her pretty little girl. Edison's eager glance seemed to ask, "Is there any pie, my love?" But her pleasant shake of the head and irresponsive blank look gave the doleful reply, "None." And so Edison was left to muse on his glorious future, with millions of electric light profits dancing before his eyes, and on the delightful prospect of the next, good apple pie.

WHAT EDISON WILL DO IN ST. LOUIS.

The plans of Edison for St. Louis I have ascertained to be as follows: As soon as his first district in New York is lighted up—which will be a couple of months—he will be prepared to have a sub-company formed in St. Louis, which, he says, can put down the plant and light it up within six or nine months after. St. Louis, he says, will be a splendid field for the electric light, because it is such a smoky, dark town. The gas company there, he says, is a perfect bonanza, charging $2 50 per thousand feet. He fully expects to see the offices and houses of St. Louis lit up with it early next year.

PHIZZ.

The Profits on Gas.

The manufacture of gas has proved, in St. Louis at least, one of the most profitable industries which human ingenuity has yet found to busy itself with. The whole story is told in a paragraph when it is stated that the St. Louis Gas Light Company pays annually on a capital of $600,000 dividends amounting to $360,000, or sixty per cent of the investment. The Laclede Company, not so favored by Providence, pays ten per cent on its capital of $1,200,000 besides paying the eight per cent interest promptly on a bonded debt of $800,000, and the six per cent interest on a further funded debt of $300,000. In other words, profits enough are collected from the people in the Laclede Company's district to pay $180,000 dividends and $28,000 interest, a cheerful total of $208,000, netted after all the expenses of manufacture, clerk hire, collection and repairing are paid for. The $50 shares of the St. Louis Gas Light Company command in open market $315; the $100 shares of the Laclede are held at $117@120. These figures tell the whole story.

Assuming that the total production of the St. Louis Gas Light Company for 1882 will be 271,000,000 cubic feet, and of the Laclede 211,000,000 cubic feet, which are the figures given by the authorities, it is not a matter of much difficulty to understand how these great profits are produced. In the first place much of the manufactured gas is wasted, no matter how well the connections may be made. Leakage is admittedly an important offset, and a long series of careful experiments has convinced both companies that any calculation which does not allow 15 per cent for leakage will be erroneous.

Sixteen cents is paid by the St. Louis Gas Light Company for Pittsburg coal, but higher class coal is used, and in his careful investigation of this subject Col. Flad has assumed twenty cents a bushel as a fair price for the coal used. To make a million cubic feet of gas requires—

General office expenses	$ 20
Coal	490
Lime	36
Labor	370
Station works repairs	46
Coal expenses	15
Water license	8
Taxes	57
Repairing mains	10
Sundries	14
Total	$496

From this, however, must be deducted the incidental proceeds of gas making, which are, to a million feet:

Coke	$133
Tar	22
Ammonia	10
Total	$165

This leaves the net cost of 1,000,000 cubic feet of gas in the holder $701. Deduct 15 per cent for leakage and only 850,000 feet can be sold, costing $701, whence 1,000,000 feet ready for sale costs $830, or each 1,000 feet sold costs 83 cents.

The cost of lighting and repairing each lamp in the city is $4 80 per annum, and each burns 13,000 feet; hence 37 cents must be added to get the cost of delivery of this light in the lamps, making it $1 30 per thousand. It costs the company $16 90 to light a lamp a year. The city pays the company a profit of $20 10 on each lamp. The whole cost of delivering gas to the consumer, including collection, meter repairs and meter service, is 13 cents per 100 feet, hence the total cost of the article sold the consumer is $1 06. Deducting this from $2 50, the amount charged, we find a profit of $1 44 on each thousand feet sold. A discount is given for prompt payment, which is very variable and hence cannot be estimated as a constant factor, but which certainly strikes at this profit. In 1880 the St. Louis Gas Light Company made $74,370 profit on lamps and $375,500 profit on gas sold to consumers, a handsome total of $401,870 profit. The total profits of the Laclede Company for the same year were over $300,000.

Times and Expositor.

ADRIAN, SATURDAY, DEC. 15, 1883.

The Electric Light.

It is the opinion of most citizens that the electric light is coming. I have an idea that it will be here before long. In talking about electric lights, it will greatly simplify matters if one will remember that of all the electric light companies in existence in this country there is only one that at once on its adoption renders the use of gas entirely unnecessary. That is the Edison light. It can be placed on street lamps, it makes a magnificent indoors light, soft, white and steady. It has not the glare, the fizzing noise, nor the fluctuations of the Brush light. It is of uniform brilliancy—16 candle power—and it can be measured with absolute accuracy. In the distribution of territory among the various Edison light companies, Michigan fell to the New York company. This company has agents now in Detroit, who have already begun work. Hillsdale and Ypsilanti, I hear, have formed companies and will at once proceed to put in the Edison light. I understand that to five Michigan cities extra inducements will be offered, and after that the terms will not be so reasonable. Adrian may be one of the fortunate five. There is not much use in changing the light unless the change is made entire. The Brush, and several other electric lights, furnish a fine illumination for large spaces, but are totally unfitted for use in houses, offices, etc. If either of these systems should be adopted by the city for street lighting, the gas company would be compelled to charge private consumers much more than they do at present, in order to make their business at all profitable. But an Edison light is suitable for streets, houses, offices, shops; anywhere and everywhere that gas is used, and in many places where the use of gas is impossible the electric light can be used with safety. There is no danger of accident from the Edison electric light wires, and the light, with all its manifold advantages, can be furnished the consumer cheaper than gas. In city lighting the lamps are all connected, and are turned on and shut off simultaneously all over the city, by turning a switch at the central station. The advantages of being able to turn on all the lights in the streets in an instant would be appreciated some of the dark evenings when the moon is advertised to shine, but fails to do so.

Sentinel, Milwaukee, April 10, 83.

CHICAGO.

Successful Introduction of the Edison Light Into a Theater.

Condition of Speculation on the Board of Trade.

Important Suit Involving the Lake Shore Front.

Serious Charges Made by a Boston Broker Against the Police.

A Lady's Luck—Dissatisfied Laborers—Other Matters.

THE EDISON ELECTRIC LIGHT.

[Special Dispatch to The Sentinel.]

CHICAGO, April 9.—A successful private exhibition of the Edison incandescent light, just introduced into Haverly's Theater, was given this afternoon under the direction of P. D. Johnson, engineer for the Western Edison Light Company, Gen. Anson Stager, president of the Western Telephone Company, H. R. Jacobs, general manager of the Wisconsin Edison Company, and representatives of the dramatic and newspaper professions were present. The praise of the gentlemen familiar with electrical matter was lavish. The actors present were particularly pleased with the electric light, for the reason that the light given from the lamps was clear, and the unpleasant smell arising from gas was obviated. The effect of the light on the stage and in the vestibules and auditorium was charming. The motive power is supplied by one Lawrence engine of seventy horse power, and the current of electricity is made by two "K" dynamo machines, giving 250 lights each, and one "Z" dynamo, giving sixty lights. Of the former, one is used to supply the lights for the stage, the other for the halls and vestibules." The total number of lights in the theater is 637. In the basement are resistance boxes, which are used to regulate the candle power of the separate lamps and give the engineer control over the

ENTIRE SYSTEM OF LIGHTS

used, enabling him to maintain the normal candle-power. The lines of wire pass from the dynamos through boxes to a point under the stage, thence being distributed to both sides of the house. In connection with the resistance boxes is an indicator which shows at once the power at which the lamps are running. A most ingenious appliance is used to show the engineer instantly whether or not the lights upstairs are burning at their proper power. Hung to the indicator is a bell and two lamps, one red, the other blue. Should the lights upstairs burn one or more candle-power above sixteen, the red lamp is brought into circuit automatically, and the bell is rung violently, notifying the engineer that the current must be reduced. Should they burn one or more candle-power below sixteen, the blue lamp is brought into circuit and the bell again rings violently. But should the power be normal, the lamps are out and the bell only gently vibrated. The "fly" or border lights on the stage are swung from the rigging aloft in the same manner as the old gas jets, and are connected by flexible conductors made of very small copper wires scarcely larger than a coarse thread. By this means the fixture can be raised or lowered at will. There are five borders—two of thirty-five and three of twenty-eight lamps each. Footlights numbering fifty are placed in the same position as formerly. The "bunch" and ground light, used for illuminating special parts of any scenery are connected with flexible conductors, which run from outlets in the stage and can be carried to any part of it, no matter where wanted. The regulating apparatus for the stage and auditorium lights is situated at the prompter's stand, all within a space two feet deep, four feet wide and four feet high, so that everything is within easy reach of the operator. Five switches are used for the auditorium, one completely

TURNING OFF THE BALCONY LIGHTS,

the others turning off respectively the lights of the large central chandelier, boxes, gallery and main floor. For controlling the candle power of these lamps small wheels are used for regulating the brightness of all the lamps in the auditorium system. The stage lights are supplied with seven switches controlling the footlights, the five borders, and also one for the ground and bunch lights. Just above these switches are six hand-wheels by means of which the system of stage lights is regulated as regards brightness. By means of this perfect regulating apparatus, all the lights in the house can be turned from the most brilliant white light to the faintest red glow, or put entirely out at will, and as the light passes from bright to faint, the most delicate shadings are obtained. The auditorium lights are covered by delicately-tinted lily-shaped shades. Placed in the ceiling of the dress-circle and balcony are single lamps with lily-shaped shades tinted in delicate tones of pink and green, giving a most charming effect. The central chandelier, hung from the dome, has been made expressly for the theater at a cost of $500. A temporary chandelier has been hung from the flies, being placed expressly for a scene in the second act of "Heart and Hand". It is a most elaborate affair of twelve lamps in vivid colors, representing a bunch of lilies, and gives a beautiful effect to the scene. The visitors were favored with a complete exposition of the workings of the system, and the success of it seems to be beyond doubt.

Should any accident occur, however, the system of wires has been so placed that it does not interfere at all with the gas, which can be utilized at any moment. Only two other theaters in the country have so far employed the electric system of lighting, the Bijou of Boston and Shelby's Academy of Music, Chicago, but they are not so complete as the system at Haverly's.

N. Y. Times, Dec, 11, 83.

Edison's Electric Light.

Among the unlisted securities, few are so little traded in now as the electric light stocks. This is doubtless almost wholly due to the unfortunate experience of those who bought these stocks at fabulous prices when they first came on the market, and have since seen them go, comparatively speaking, almost out of sight. Of course the Edison companies, and their stock issues, made the market for this class of securities—and ruined it again also. A one-hundred-dollar share of the Edison Electric Light Company once sold on the Street at $4,000. The same stock can now be purchased for $170, and the well informed doubt if it is worth even the latter small sum. Were it not for the prestige of Edison's name, which gave the stock its first boom, but could not save it from its final collapse, the stock would probably have no regular market price. It has never paid a dividend, and were it not for the auxiliary companies, which are simply construction and manufacturing companies, we doubt if it could pay its expenses. The light furnished has fallen below the expectations of the company's partisans, and is regarded as a failure by the disinterested. An inspection of its light in many of the buildings where it has been introduced will satisfy any one that it is far inferior to the light supplied by two or three other companies whose names are but little known to the public. Less than 20 per cent. of the tenants of the Mills Building are said to be using the Edison light, and from no lack of desire on their part for a superior light either. The other evening we were invited by a friend to view his handsomely appointed offices into which he had just moved—the principal feature of which he hoped would be the electric lights. He must have been greatly disappointed, however, for although there were a half-dozen illuminated wires in each cosy room, in our judgment a chandelier hung in the centre of each, with a similar number of gas jets, would have given a more satisfactory light. We do not believe that electric lighting generally is a failure. Indeed, we see ample evidences in various offices that it is being successfully used; but Mr. Edison must either perfect his system soon, or consumers will have to look to other companies for their light.—The Daily Stockholder.—Advertisement.

THE TIMES, THURSDAY, APRIL 13, 1882

THE EDISON ELECTRIC LIGHT.

After some experimental trials during the last few weeks to assure the smooth and perfect working of every part of the arrangements, a demonstration of Mr. Edison's system of lighting the buildings and streets of a district may now be seen in London. From Newgate-street westward, across the Holborn Viaduct, to Hatton-garden, the street and most of the buildings on either side of the street are now, and for the next two months, will continue to be lit by Edison incandescent lamps. For the purpose of street lighting two of the incandescent lamps of 32 candle-power each have been placed in every lamp-post in this section, and it had been hoped that last night permission would have been obtained from Colonel Heywood for the gas to be turned out in order that the effectiveness of the Edison incandescent lamps for street illumination might be proved the more satisfactorily. Application will be made to-day with this view, and it is hoped that to-night the public will have an opportunity of judging on the matter for themselves. Those who can obtain permission to see the machinery and appliances by which the electricity is generated and distributed will find a satisfactory answer to the question which has often been asked during the last four or five years—What is Mr. Edison doing? At his laboratory in Menlo-park, where his experiments have been made, a staff of some 200 assistants has been continuously engaged in carrying out investigations on various subjects suggested for inquiry by the inventor, whose object has been, not merely to demonstrate a scientific possibility of providing a beautiful light, but to devise a practicable and economical system of supplying electricity to the inhabitants of a town from various centres, just as at present gas and water are supplied by public companies. To this end districts of New York and other towns have been canvassed and statistics carefully collected and tabulated, and, to give an instance of the nicety of the adjustment of results to cost, the greater or less thickness of the conductors would vary with the price of coal in different districts, the calculations being based on the consideration that although by increasing the sectional area of the rod the waste of electricity would be diminished, there is a point beyond which it would not be really economical to increase its size on account of the greater cost of the copper. Where, as in the north of England, coal is much cheaper than in London smaller conductors would be used. One of Mr. Edison's objects in making this trial of his system in Holborn is, indeed, to obtain such further and exact information on the requirements of a given district in London as may enable a company adopting his system to make their contracts with the businesslike certainty of results. For the first time in the history of electric lighting, he would claim, there is here perfected a system of electrical supply, consisting of means for manufacturing, regulating, distributing, and measuring electricity by meters for purposes of general consumption by all the inhabitants of a town, and not by a few individuals, whether for lighting, for driving machinery, supplying electric bells, working telephones, or for any other purpose to which electricity is now or may hereafter be put. First, as to the manufacture. There is in the basement of the premises of the Edison Electric Light Company (Limited), No. 57, Holborn-viaduct, the large dynamo-machine, by which all the lights in the district, nearly 1,000 in number, are supplied. It is called a thousand light machine, but is capable of supplying more. That is to say, as with the machines at the Crystal Palace, Mr. Edison prefers that, as a matter of economy, the machines shall be worked considerably below their power. One noticeable point in the system is its safety. The electric pressure, to borrow a term from the system of gas distributors, is so low that a child may hold the electrodes without danger; and with regard to the safety of the lamp, a handkerchief being placed over one of the globes and the glass being shattered, the instantaneous extinguishing of the light by the destruction of the vacuum is all that happens. The handkerchief is not even singed. The dynamo-machine is worked by a Porter-Allen high-pressure engine of 150 horse-power indicated, causing the armature to make 350 revolutions per minute. Generator and steam-engine are firmly fastened together on the same cast-iron bed-plate, the engine driving the armature, which is mounted on the crank shaft, directly and without the use of belting. Steadiness of speed is further insured by a sensitive governor, and as lights in a circuit are turned out, say when a theatre performance or a church service is over, the safety of the lamps remaining alight is provided for by a resistance regulator under the care of a man in the photometer and dynamometer room, the engineer proportionately diminishing the work of the engine. The armature is kept cool by a small blowing fan, driven by the engine. The method by which Mr. Edison effects the practically equable distribution of electric force throughout a district is one of the most important features of his system. The principle is explained on the premises of the company by an arrangement of wires stretched on a partition wall and presenting the appearance of a large check pattern, with four distributing stations fed from a central station, the mains being supplied from these stations by conductors placed at regulated distances apart. Small plugs, each containing a piece of lead wire, which will fuse and break contact should the current become too strong, serve automatically to protect the carbon filaments in the lamps from any sudden and accidental rush of electricity to one point in the system. The conducting mains are copper rods insulated in prepared wood and enclosed in iron tubes to prevent leakage. Another remarkably ingenious piece of apparatus is the meter for measuring the quantity of electricity consumed by each customer. This is a bottle containing two plates of zinc in a solution of zinc sulphate, the current in passing causing the one plate to increase in weight at the expense of the other. As, however, if the whole current passed through the bottle this change would go on too rapidly, a properly-proportioned shunt wire allows just 1-870th of the electricity going into the house main to pass through the meter. The estimate of the quantity consumed is made once a quarter, or as often as may be convenient, by weighing the plates in the bottle, a second bottle being supplied, the plates of which the consumer may weigh for himself as a check upon the company. The installation of the system on the Holborn-viaduct has been made by Mr. Edison's representative, Mr. E. H. Johnson, assisted by Mr. Hammer. Mr. Johnson will now return to the United States and leave the control of the working plant to Mr. Arnold White, the manager, and Dr. John Hopkinson and Dr. J. A. Fleming, the electricians of the English Edison Electric Light Company (Limited).

The district lighted is supplied by four circuits. In the first circuit there are 66 street lights and 78 lights, of 16-candle power each distributed in 11 buildings; in the second circuit, 40 street lights and 49 lights in seven buildings; in the third circuit, 24 street lights, 26 lights in the Imperial Hotel, six in a shop, 63 in Messrs. Spiers and Pond's Hotel, of which 20 are in the restaurant, nine in front of the London, Chatham, and Dover Railway station, and 52 in six warehouses; and in the fourth circuit 31 street lamps, 147 16-candle and 14 8-candle lamps in the City Temple, seven 16-candle and four 8-candle lamps at No. 31, 210 16-candle and 16 8-candle lamps in the company's central station, and nine 16-candle and 22 8-candle lamps in the Viaduct Tavern. In this circuit also will be placed 50 16-candle lamps, which are to be tried in the General Post Office.

August 5, 1882.

THE STATIST.

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT COMPANY.—An extraordinary general meeting was held on Thursday, for the purpose of confirming a resolution passed on July 18th, altering the articles of association, and providing that "the directors may from time to time, of their own authority, pay to the members in proportion to the amounts paid up, or credited as paid up, on the shares held by them respectively, such bonus and such interim dividends as in the judgment of the directors, the position of the corporation justifies." The chairman formally moved that the resolution be confirmed, and said its object was simply to enable the directors to distribute the sum of £245,000, which they held at the disposal of the shareholders, and for which warrants had been prepared. That sum would furnish them with the very satisfactory interim dividend of 100 per cent. upon all they had subscribed in the undertaking. Mr. Sellon seconded the resolution. Mr. Hammond hoped the chairman would give the shareholders an assurance that there was no foundation for the statement that the company had made no profit on its manufacturing business, and that its only source of obtaining money was by the sale of sub-concessions. The chairman said that a rough balance-sheet had been prepared, and it was found by that means that there was a profit on their manufacturing business during the first six months of the year of £30,000. He regretted the amount of speculation which had taken place with regard to the sub-concessions. There had been too much speculation going on and too little real manufacturing work performed. The shares of the company, he also thought, had risen to a higher price than was justifiable. The directors could not control the speculation which was going on, but he would not encourage it by making any prophecy as to the future of the company.

[Continued from first page.]

dry is especially important, as by this means the company not only receives its castings more promptly than heretofore, but also secures a better and purer quality of metal, a factor of prime importance in electrical work. On the ground floor of the main building are finely fitted and appointed offices, shipping-room, scales, driveway and everything pertaining to the forwarding department, all under cover, the driveway being between the shipping-room and offices.

The second floor is occupied wholly by the experimental work department, where all the new devices and appliances are first modelled, tested and perfected before being turned out in quantity. On this floor is a "K" dynamo, which furnishes light for the factory at night, attached to the main shaft by means of a friction clutch pulley. The dynamo is controlled by means of an automatic regulator, which keeps all the lights at a uniform candle power, whether there happens to be in use the whole number—two hundred and fifty—or only one light. If there are more or less lights in use, an arm in the regulator passes back and forth over a commutator, which throws in or lets out resistance.

Ascending one flight we reach the third floor where are made the safety cut-outs, plugs, sockets and switches. The latest and most improved kind of machinery is used throughout, so that a large proportion of the work can be done by boys and therefore very cheaply, as to cost, the quality of stock used being of the best. On this floor, likewise, all appliances, whether plugs, cut-outs, sockets, switches, electroliers or brackets, are thoroughly tested, singly, before leaving the building. The distinguishing feature of the Edison system is the safety catch, as by means of the instantaneous operation of the same, absolute safety from fire is secured.

On the fourth floor, as also on parts of the third and fifth, are made the electroliers and brackets. Passing upward to the fifth floor we find that here are manufactured, principally, meters and regulators.

We would call special attention to the meter, which, like the safety catch, is used only by the Edison system; by means of this device the amount of light used by the consumer is accurately measured, and bills are rendered in accordance with the regularity of the same. All other systems charge a fixed price, no matter what quantity of electricity, more or less, may be used. The show room, a space of 100x50 feet, occupies half of the fifth floor, and is so arranged that any fixture may be lighted up at will.

Contained in this room are many rich and unique designs of electroliers and brackets, of Bergmann & Co.'s own manufacture as well as handsome devices of fixtures imported by them especially for the Edison light. Comprised in this list are beautiful hanging baskets, bouquets and bunches of flowers perfectly counterfeited in hammered and beaten brass, in which the graceful bulbs of light are enclosed in vari-colored cut-glass flowers. Here we find every possible and desirable appliance for office, store, desk, steamboat, railway station, hall, theatre, billiard room, library, study, chamber, bureau, ladies' boudoir, dining-room and whatnot, for there is seemingly no end to the uses to which this favorite light can be put. The effect is pleasing in the extreme, and one instinctively thinks of Aladdin and his lamp when in this apartment, and wonders if the author of the "Arabian Nights" did not in imagination forecast a nineteenth century scene like this. Be this as it may, the effect of the soft, mellow, but brilliant and steady light on and in the innumerable shades, colors and devices embraced in these many electroliers and brackets is a continual revelation of what "civilized electricity" will do at man's instant bidding.

The distinguishing characteristic of the Edison lamp is that it may be placed in any position or angle, but it is generally used downward, as in that way no obstruction is afforded to the free passage of the light. The sixth floor of the factory is used as a laboratory. The help employed in this establishment is of the best skilled German type, bright, clear-eyed, keen-witted, thoughtful, intelligent men and boys, the style of work prosecuted by Bergmann & Co. requiring the best "brain" power obtainable. The impress of genius is everywhere, the utmost system and nicety prevails, and the feeling that "electricity educates" as well as illuminates obtains. Bergmann & Co. have issued, within the last sixteen months, four editions of their illustrated catalogue, the fourth, just out, containing more than 200 additional styles of fixtures and appliances, which is remarkable as showing the unprecedented progress of the Edison system of incandescent lighting. The accompanying cuts represent a few of the numerous styles of brackets and electroliers produced by this company. No. 900 is a cluster globe for display, suitable for use where a powerful light is desired either for indoor or outside lighting. This "cluster" is made with five, seven or nine lamps, and will be found a very acceptable substitute for the trying arc lights. No. 140 represents a sliding student-lamp, including key socket and holder, an excellent device for the desk or reading table. The three-light electrolier here shown, with its flower-shaped shades, is a particularly beautiful fixture. The four-light electrolier on is less elaborately gotten up, but is decidedly handsome. The uses to which the light wall bracket may be put will readily suggest themselves.

MANUFACTURERS' GAZETTE

VOLUME 4, NO. 10. WEEKLY. | BOSTON, SATURDAY, MARCH 10, 1883. | $3 PER YEAR. SINGLE COPIES, 8 CENTS.

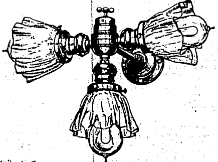
EDISON'S ENVIRONMENTS.

The Electric Light Industry.

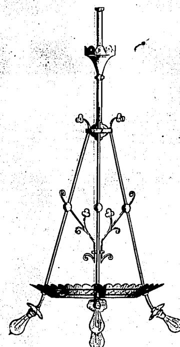
BERGMANN & COMPANY'S WORKS.

Superficial thought, tinctured with prejudice and colored with ignorance of the man and his methods, has, though rating Edison as a "marvellous man," regarded him as an "enthusiast," a "dreamer," "no scientist," etc., but time and the logic of events are removing these erroneous impressions, proving him to be what has ever been clear to those who have known him, namely, a systematic scientist, a thoroughly-posted electrician, a close and persistent student and a very practical genius. He is, withal, a genuine benefactor, in that he has created an industry of increasing importance, the results of which contribute alike to the comfort and welfare of society, and to the improvement of affairs in general.

All invention is measurably revolutionary, but when the history of the "Edison epoch" is complete it will be realized how great a "revolutionist" was the genius of Menlo Park. Events are daily demonstrating the superiority of the Edison incandescent light, and the utility of his system is almost limitless. This system is the only complete one, embracing, as it does, not only a dynamo, a regulator and a lamp, but also meters, motors, conductors, underground mains, junction boxes, sockets, electroliers, brackets and all other indispensable devices. In this connection the Edison Company is the only one that uses underground conductors, Mr. Edison having from the outset carried the currents in this way. Having lately treated in "Civilized Electricity," in the GAZETTE of Jan. 27, of the Edison light for factories, in comparison with gas, we shall here deal with some of the inventor's "environments," as inspected by us during a recent round of them in New York. The offices of the company are at 65 Fifth avenue, the lamps are all made by the company at Newark, N. J., the dynamo machines and motors at their machine works at Goerck street, New York, the street tubes or mains are produced by the tube works, also in New York, while Messrs. Bergmann & Co., 292 to 298 Avenue B, N. Y., sole manufacturers of fixtures and appliances for the Edison light, make every device used in connection with this famous illuminator save those above mentioned.



Three-Light Wall Bracket.



Four-Light Electroller.

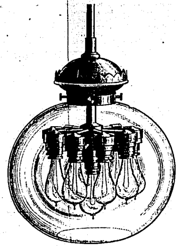


Fig. 900.

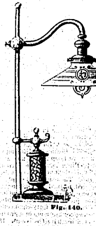
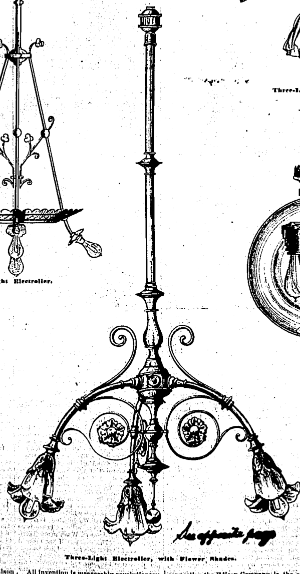


Fig. 140.



See opposite page

Three-Light Electroller, with Flower Shades.

Bergmann & Co. occupy a large and handsome brick factory building at the corner of Seventeenth street and Avenue B, covering 100 feet square and having a height of six stories. They employ at the present writing nearly 300 hands, engaged exclusively in manufacturing to meet the requirements of the Edison electric light installations, and the force is daily increasing. Their whole factory is wired according to the rules and requirements laid down by the Edison Electric Light Company and is lighted entirely by their lights, gas being used only for manufacturing purposes. A 150-horse power Harris-Corliss engine supplies power alike for light and machinery, the dynamos used being "K" and "Z," machines, with 250 and sixty lights capacity respectively. The engine is supplied from two boilers, each having 75-horse power nominal.

Bergmann & Co. have recently erected a new building alongside the main factory, wherein are the cabinet shop and foundry, the former being separated by an iron door from the latter. The addition of the foun-

[Concluded on the fourth page.]

Newburgh Journal
July 14, 83

GAS AND ELECTRICITY.

Some Electric Shocks from President Adams of the Consumers' Gas Company—What He Knows About Electricity—Some Gas Light on the Subject—Strong Argument in Favor of Gas—Brief History of the Electric Light in Some Cities—The Cost of that Light—A Disgusted Canvasser.

During the past few days, as the result of announcements of the proposed introduction of the electric light system in this city, there has arisen a fitful interest as to the respective merits of the electric light and gas light when applied to small cities of the size of Newburgh. The electric light light men have presented what they claim to be the advantages of their system, and repeat the words of Edison, that with regard to the electric light, nothing more can be invented or required. The gas men admit that Edison has evidently exhausted his inventive genius, and ascert that for practical purpose and every day use it falls far short of gas light.

"I see that an effort is being made to organize an electric light company here," remarked a JOURNAL representative to President Adams of the Consumers' Gas Company this morning. "Do you know anything about it?"

"Nothing more," remarked Mr. Adams, "than that I have at times seen notices in our papers that such was the case, and I have heard some talk about it."

"Have you any fears of such an opposition?"

"None whatever. We may, should a company be established, lose for a time consumers, but the people of other places say that an increased desire for gaslight always follows."

"Have you taken the trouble to keep yourself posted on the rise and progress of the electric light?"

"I should certainly be a very poor President of a gas company did I not watch closely all improvements in light, be they electric, gas or oil."

"Do I understand you, then, as feeling quite sure of your knowledge of electric lighting?"

"I feel quite sure that I am posted on its workings and its payings," said Mr. A.

"What, then, do you think about its paying here?"

"Why, certainly our city can be no exception to other places. Not one cent of dividend has been paid. What lighting is done is for advertisement to sell the plants. The gentleman who is now attempting the thing here, of course, only comes to sell the plant. He then goes for another city or village and attempts the same. A man capable of introducing and of successfully carrying on such a company, especially in a place like Newburgh, must have a gentlemanly name, must be easy of conversation, must be gifted and able to talk well on the subject—like in this case, where he comes here and tells of the wonders it has done elsewhere and says that a return of from 25 to 40 per cent. is sure. People are jumping at such tempting bait. They do not stop to consider if there was any such profit, that the men who are so anxious to dispose of it would never let it slip through their grasp. Now," said Mr. A. emphatically, "the real facts are these. The electric light cannot compete with gas in cost. It is not reliable. This gentleman ... his printed circular speaks of many places in which the light is in successful operation. Just what he means by successful I do not know. I have not had the opportunity to hear from all the places, nor have I made the attempt. But when I find his statement is absolutely false in some cases, I fear it may be in many, and perhaps in all."

In what particular have you found the gentleman's statements incorrect?"

"Well, to illustrate," said Mr. A., taking from his pocket a package of letters, "he says in his circular that in Watertown, in this State, after naming many public places and business houses that are using it, that it is run very satisfactorily. Now, what is the truth? The light is not there at all. It was there but failed; and they took out the machine and wires and left. Again, at Williamsport, Penn., one would think from reading this circular, that the town was alive with electric lights. What is the fact? Only six business places took it, and one has already given it up, and another is on the fence; so now after persistent canvassing the system is about done for in that place. Take Cleveland, O., where of all places the electric light should prosper, Mayor Farley telegraphs that they will probably discontinue its use, as it costs five times more than gas. Take Albany, where the ring did work through the project and bought the plant. The *Albany Times* says that 'for once this conservative town has gone too fast. It costs five times what gas does.' Stocks and bonds of the electric light are offered on the market constantly. If it pays so well, why is this? A very amusing message of Mayor Manning, of Buffalo, but a short time ago, said, 'That in refusing to sanction an extension of electric lighting, I do so because gas can be had for 60 per cent. less.' In a recent interview, Mr. Edison said he had promised to light a district in New York to keep up the canvassing of his stockholders, and he wound up with this remarkable statement: 'If I show that electric lighting (incandescent system) is an exceedingly profitable business, when done on a large scale, the public would be dissatisfied with the prices we ask. On the other hand, if I say we can compete with gas and have to sell the electric light for about the same, then the investing public will put no money in it.' "It has been demonstrated," continued Mr. Adams, "by use and experience that in all its branches it is too expensive and unreliable for general purposes, and the business is one of speculation on the part of those who have patents and apparatus to sell. The business is not being extended where longest in use. Four years ago the holders of gas stocks were frightened by the promises they made and stocks fell. Now they are on the rise. The report of the New York City Gas Commission says: 'One electric light at 70 cents a night costs the city $255 50 a year. It displaces 6½ gas lamps which at $17.50 each cost the city $110.83.' So we see that what can and may be done is one thing, and what is being done is another. The *Boston Transcript* says that there are two classes of companies there—one has stock for sale and care little for electric lighting, and the other is managed by men of means who offer no stock for sale but are charging off to profit and loss, and confess that the more they do the more they lose."

"Well, Mr. Adams, is not your statement, may I ask, somewhat biased, considering that you are deeply interested in the gas business, and are you positive in your statements?"

"To be sure, I am interested in the gas company and watch their interests, but I have the right to make a statement so long as it is a fact, just as the electric light men have a right to make their statement, and by making this statement some people may be influenced to withhold from what I claim would be an unfortunate speculation. Furthermore, the local agent of the Electric Light Company claims that 1,600 lights will earn the company $24,000 at a cost of $7,452, claiming a percentage of 40 per cent. In this he assumes a great deal. Some of his assumptions are beyond all reason. He estimates his taxes at 75 cents a day. He will be more fortunate than other people if they are less than $1,000 a year. I notice that he estimates his expense for coal will be $1.45 per day and an additional 25 cents for carting away the ashes each day. How can there be so much ashes from one hundred and forty-five cents worth of coal? He proposes to put in a 120 horse-power engine, and it is generally considered that an engine will consume about six pound of coal per horse power each day, which would largely increase that amount. I notice no estimates in his statements, by the way, for bookkeeper, office rent, or anything of that kind. This statement, like other statements on paper, is made to attract investors' attention and show as good an investment as possible. But then this is nothing more than what every one does to secure investors, therefore I have nothing to say. I see also that he only claims to light half a mile. That is another fact to show that they must go into the very thickly settled parts of the city—they don't pretend to give light on the limits of the city. The experience of the past is conclusive that the electric light does not seem to increase in use where it has been in use. I am not surprised that an attempt is being made to introduce it here, for the attempt is being made all over. The United States Electric Light Company had a canvasser here. He went away fully satisfied that this town was not adapted to the electric light—that is he said he could not make the electric light pay."

Electric Light vs. Gas Light.

NEWBURGH, July 16th, 1883.—*To the Editor of the Newburgh Daily Journal.* In your Saturday's issue there appeared an article in which the President of the Consumers' Gas Co. made the assertion that some of the statements made by us were false. Will you kindly allow me space in your JOURNAL to give your numerous readers my side of the story?

The President of the Gas Co. says that not one cent of dividend has been paid.

The fact of the matter is that the Edison Co. for isolated lighting, with a capital of $250,000, one half of which amount they gave to the Edison Electric Light Co. for a franchise, paid a 10 per cent. dividend on the whole amount, $250,000, the first year of its existence, has since increased its capital to $500,000, has the necessary machinery and appliances sold and established for lighting, and is at present lighting 65,145 Edison incandescent lamps, and has just closed a contract to light the Louisville Exposition with 4,000 of the same kind of lamps, said contract amounting to about $100,000.

The gas President says that my object is to sell the necessary plant. It might be well to state right here that the Edison Electric Light Company does not furnish the plant and has no more interest in its sale than he has. Their only interest is a five per cent. cash payment on the capital stock and the balance is taken in the stock of the Newburgh Company.

The gas President don't know what I mean by successful lighting.

This is what we call successful lighting. For further particulars apply to James Taylor or James Harrison of West Newburgh.

As to the places named in Saturday's JOURNAL where the light had been tried and failed, we have never attempted public lighting in either of the places named and so couldn't very well fail. The light used in all of the places mentioned is the large, unsteady outdoor light with which we have no connection and of which it is unnecessary to speak.

As for Mr. Edison's remarkable statement in regard to incandescent lighting being an exceedingly profitable business, I have yet to learn of a gas company giving a detailed statement of the actual cost of production, and amount of leakage, and I believe it is not customary to do so in any business.

The President in comparing electricity with gas says that one electric light costs the city of New York $255.50 a year and only displaces six and one-half gas jets, which at $17.50 each would only cost $110.83.

If he named the figures on the basis of $83.50 per lamp, (which I believe is the lowest price at which he can afford to furnish the City of Newburgh) he will see that the difference is not so great after all.

Now as to our statement of daily running expenses.

We allow 75 cents per day for taxes, as our investment will but slightly exceed $30,000 and not $200,000 as I believe is the case with the new gas company.

We do not estimate our coal consumption at $1.45 per day.

We know just what it is, and should not attempt to do a commercial business if after a three years' trial we were obliged to guess at the cost of anything pertaining to the production of electric light.

Unconsciously the gas President comes very close to the correct figures when he says that it is generally considered that an engine will consume about six pounds of coal per horse power per day, and if he will multiply 120 by 6 he will find that the amount consumed is 720 lbs., or about one-third of a ton, which would be $4.35 per ton, at which price we can no doubt procure coal even in Newburgh. The gas President sees no allowance made in our statement for a bookkeeper, office rent, etc.

The reason for this is that we don't propose to have either. Our offices will be at our station.

Our electrician will be our bookkeeper.

Our President will no doubt have an office of his own. He will not expect or receive any salary and what the business earns will be fairly divided among the stockholders and the business generally will be conducted on a strictly commercial basis.

The gas President is mistaken when he says that we only claim to light half a mile. We have been lighting more than a square mile of the heaviest business district in the City of New York since Sept. 4th, 1882, supplying between five and six thousand lights.

There has never been a failure for a single second in that time.

What we do in New York we can do anywhere.

Our customers are entirely satisfied both with the light and the price.

It would be a useless waste of time for me to continue a newspaper controversy with a man who plainly knows nothing of the subject of which he speaks.

It looks very much like the boy who didn't know and was not very anxious to learn.

By giving this a place in your valuable paper you will confer a favor upon

Yours truly,

CHAS. T. HUGHES,
Special Agent Edison Electric Light Co.

The Hartford Courant

Friday Morning, June 8, 1883.

THE BERNSTEIN ELECTRIC LIGHT.

Exhibition at Henry Ensign & Son's.

An exhibition of the Bernstein electric light (an incandescent light) was made last evening in the store of Henry Ensign & Son, COURANT building, the power running the dynamo being furnished by the COURANT'S engine. The store was brilliantly lighted by twelve of the Bernstein lamps, attached to the ordinary gas fixtures. The effect was good, the amount of light being large, and the light perfectly steady—a soft, pure and white light. The incandescent light, as is well known, is obtained by passing an electric current through pieces of carbon which are enclosed in a small glass globe. These globes either contain a vacum, or, as in the case of the Bernstein lamp, an artificial atmosphere, full of oxygen, so that no combustion of the carbon can take place. In most lamps for the incandescent lights the carbons are in the form of slender filaments; in the Bernstein lamp the light-giving carbon is a hollow tube, which has a large light-giving surface, and is therefore capable of giving a large amount of light. It is said that these lamps have been made up to 350 candle power, and have been placed in circuit with arc lights, and the Bernstein Manufacturing company claim that their large lamps give an equal amount of light and at a lower price than can be obtained by the arc lights. The Bernstein lights have been in use in the Boston post office for the last two months. All exhibitions and tests of the arc or the incandescent light are interesting. The exhibition of the Bernstein light at Henry Ensign & Son's last night was certainly so. The dynamo which furnished the current was manufactured by the Bernstein company of Boston, the company which furnished the lamps. The progress of this and all systems of electric lighting will continue to be watched with interest, and every improved method of lighting hailed with satisfaction. The lamps shown last evening were of about fifty candle power, and seem well fitted for interior lighting.

July 22, 1882.

THE STATIST.

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION.—The chairman, at the meeting on Tuesday last, stated that the meeting was called to get them out of a little difficulty. They had a large sum of money to distribute amongst the shareholders, but were debarred from doing so by the articles of association. To meet this difficulty it was proposed to adopt the following resolution:—"That the 85th of the articles be repealed, and that in lieu thereof the following be henceforth the 85th of such articles,—'The directors may from time to time of their own authority pay to the members, in proportion to the amounts paid up, or credited as paid up, on the shares held by them respectively, such bonus and such interim dividends as in the judgment of the directors the position of the corporation justifies.'" This sum was £245,000, and it was proposed to pay it about the middle of August. When the company was incorporated they had no idea of the extraordinary success which would attend it, and the sum to be distributed was entirely out of the profits. Their position justified that they should divide the sum he had mentioned. The chairman, in reply to objections raised, stated that the articles of association stipulated—and it was in accordance with common sense—that the profits should be distributed among the shareholders in proportion to the amounts paid on their shares. The shareholders had all had an equal option of paying up in full, but some had neglected to do so—a circumstance which could hardly be regarded as accidental, as Mr. Brooksbank contended. After making the proposed distribution, their capital would remain intact, and they would have a very large margin in addition. The resolution was carried with two dissentients.

CYNTHIANA DEMOCRAT

CYNTHIANA, KY.

FRIDAY, OCTOBER 12, 1883.

THE ELECTRIC LIGHT!

Shall Cynthiana Have It?

A COMPANY FORMED AND A LARGE PART OF THE STOCK ALREADY TAKEN.

The Old Town Waking Up—"Let us Have (Electric) Light."

For several weeks the subject of forming a company to introduce in Cynthiana the Edison incandescent electric light has been agitated, and when we visited Louisville we became satisfied it was no longer an experiment, and published a full description of the light, the manner of production, the cost, &c.

At our solicitation Mr. A. Stewart, of the Ohio Installation Company, a licensee of the Edison Company, came to Cynthiana on two occasions to work the matter up. A meeting was called on last Monday evening at the Council Chamber, which was attended by the principle business men of our town, such men as J. W. Peck, J. W. Megibben, D. A. Givens, Luther Van Hook, John Montgomery, J. T. Hedges, Prof. Brown, L. W. Whaley, J. W. Smiser, Wm. Addams, W. L. Northcutt, J. W. Renaker, and many others. Mr. Addams was made Chairman of the meeting, and R. V. Bishop was on motion made Sec'y. Messrs. Stuart and Story, of the Ohio Installation Company, explained the matter, and gave the terms on which they would install a plant in Cynthiana, and agreed to have the light burning by the middle of December if the company could be formed and the money subscribed in a reasonable time.

A subscription paper was started, which was promptly headed by T. J. Megibben with $1,000. J. W. Peck then followed with $1,000, William Addams $1,000, L. VanHook $500, W. J. Kehoe $500, making $1,000 subscribed in a few minutes. Subscribers have since secured as follows: Paul King $500, J. T. Hedges $300, Chas. Wilson $200, making $5,000 in all.

On motion the chair appointed W. J. Kehoe, W. L. Northcutt, J. W. Peck, Wm. Addams and J. W. Megibben as a committee to solicit stock.

The subscription paper is now in our hands and will be presented to everybody desiring to become a stockholder.

It is proposed to furnish the light at 1¼ cents per hour for each lamp of ten candle power. This would be equivalent to gas at about three dollars per thousand feet. Paris pays $3.50 for gas, and Mt. Sterling pays $1.50. The electric light, however, has so many advantages over gas that it is really worth 25 per cent. more. There is no cleaning, no smell, no dirt, no danger with the electric light. There never has been a fire caused from the Edison incandescent light, and the company has never had a plant rejected. In addition to furnishing light, power and heat can be furnished at the same price.

The following letter was received in reply to an inquiry as to the success of the Edison Illuminating Light Company of Sunbury, both financial and otherwise:

OFFICE OF FRANK S. MARR,
ATTORNEY-AT-LAW,
SUNBURY, PA., Sept. 28, 1883.

W. J. Kehoe, Cynthiana, Ky.:

DEAR SIR—Yours at hand. You desire to know something of the profit in the Edison Electric Light Company. Our plant is a new thing here and we are obliged to combat the prejudices against other systems of electric light and also a local gas company. We have been quite successful. It is beyond all question the best system of lighting.

As to the profits of the company, it is so far only estimated. We have gone so for that we feel that we will be handsomely remunerated for our trouble. We estimate that 250 lights will pay all of our expenses. We now have 300 lights in, with sufficient promises to put in all of our plant—500 lights. We estimate a dividend of 20 per cent. I do not think we will fall far short of it.

Respectfully, FRANK S. MARR, Treas.

Later information from Sunbury indicates that the stock of the Elecric Light company there is paying handsomely and is worth a premium of $25 and none to be had at that. Similar favorable reports are heard from Shamokin.

The following letter has been received from Shamokin in reply to an inquiry:

OFFICE OF W. H. DOUTY,
DRY GOODS MERCHANT, &c.,
SHAMOKIN, PA., Sept. 27, 1883.

W. J. Kehoe, Esq., Cynthiana, Ky.:

DEAR SIR—Your favor 24th inst. received. In reply would say that we have just started our plant, which is the Edison, and cannot say in positive terms as to what we can do. As for the light, there is no doubt about it being the best in the world for general lighting. I am fully satisfied that we can run our plant with 340 lights and pay all expenses, labor, electrician, insurance, taxes, water, depreciation of 5 per cent., fuel, &c. Our plant in capacity is 1600, that would leave us 1260 lights for dividend. We will sell the light, ten candle power, for 1 1-4 cents per hour.

Yours truly, WM. H. DOUTY, Pres't.

IT IS A THING OF BEAUTY.

A Reporter Interviews the People of Sunbury Who Are Using It—How They Like It.

[Williamsport (Pa.) Breakfast Table.]

Certificates of stock are or about to be issued to the members of the Edison Electric Light Company of Sunbury. This new enterprise is in a flourishing condition, and is conceded by everybody to be a thorough, practical success—so much so indeed, that the Sunbury Gas Company here, which has reduced the price of gas light 25 per cent., on account of the inroads made upon its business by the new light, says through its heaviest stockholder that it will lose $1,000 this winter if necessary to run out the Edison party. No more potent index of the significance of the electric light can be had than just this cry of distress from the gas company. It is sufficient advertisement for the electric light that it stands entirely on its merits and is on those merits adjudged by the people of Sunbury to be a prettier and cheaper light than they ever had here; although the gas company's additional booster, in the shape of their ill-concealed mortification and extravagant threats to run it out, will be appreciated by the men who are directly interested in the new light. It seems to your correspondent, too, that the gas company's $1,000 would be but a drop in the bucket that would be required to down the new light. Thos. A. Edison, of New York, the inventor of the light, and his millionaire New York constituency, hold a large amount of stock of the Sunbury company, and as Mr. Edison has some $5,000,000 backing him in his enterprises it is reasonable to suppose that he is in a position to stand firm with refractory gas companies anywhere.

Boston Globe, Sept 28, 83.

[illegible] electric lighting business in Boston has received a decided impetus since the organization of the Merchants Electric Light and Power Company, which assumed the lighting business in Boston so successfully established by the parent organization—the American Electric and Illuminating Company. The Merchants is making rapid headway and is already outstripping all competitors in the number of its lights and new business, which already exceeds that of any of the other companies. The earnings already assure a ten per cent. dividend on the outstanding capital, and when the plant and other facilities for business are doubled, as they soon will be, the directors are confident of greatly increased dividends, as the future possibilities of the business are great—in fact, can hardly be estimated.

In order to keep pace with the rapidly increasing business it is found to be necessary to establish a new central lighting station with greatly increased facilities in the business centre of the city. And the management have partially concluded arrangements for a four-story building which will have ample room for a central lighting station, workshop, and supply rooms, and it is now very probable that an incandescent lighting plant will be added, and the floor occupied by electric motors for supplying power to different manufactories, which of itself is destined to become a very profitable branch or department of the electric business. It is said, upon authority which is considered reliable, that the general combination and business alliance is now being discussed by the executive of the American company, which, if carried into effect, will make its franchises of great value, and place it and all its subsidiary companies in a position far in advance of any of the other electric lighting companies, and practically make their position impregnable. In view of these facts it is understood today that a meeting of the directors of the Merchants company has been called to discuss the advisability of immediately advancing the price of the treasury stock to $12 or $15 per share. Those who have heretofore tried to create a feeling of distrust in electric light stocks are liable to find the stock of the companies working under the American system numbered among the most popular and remunerative securities on the market.

Utica Morning Herald

AND DAILY GAZETTE.

SATURDAY, SEPTEMBER 29, 1883.

The Maxim Inc[illegible]

The yarn mill of the [illegible] Cotton company in East Utica [illegible] by electricity for the first time last evening [illegible] and more the wiring of the mill and the placing and adjustment of the [illegible] been in progress. The plant is supplied by the Central New York Electric Light [illegible] company, of which H. [illegible] is president. The work is done by workmen of the United States Electric Light company from which the local company receives its rights. F. P. Little had charge of putting in the plant and starting it running. He has for some time been in the employ of the United States company, his last work before coming to Utica, having been in seeing to the exhibit made by the United States company in the new capitol at Albany. This company has received a contract for 300 lamps to be placed in the different parts of the building, with the machinery needed to generate electricity to supply them.

The Skenandoa mill has been wired in the ordinary way for electric lighting, with wires graded as to size, just as [illegible] piping for the transmission of a liquid. The largest wire is about a quarter of an inch thro' and there is not much of that used. The lamps are attached to the gas fixtures with which the mill had previously been equipped. The lamp drops down below the gas burner. Porcelain shades are used of such shape that they reflect and distribute the rays. The Maxim incandescent lamp differs from the Edison in the way it is attached to the burner, in the size and shape of the globe and in the form of the carbon. The lamp is oval rather than pear shaped, is smaller than the Edison, and the carbon which hangs *in vacuo* is M shaped, and made of the best writing paper, carbonized, rather than of bamboo. When the lamp glows at full capacity it is not as easy to distinguish the outline of the carbon as with the Edison lamp. The more compact the surface of carbon heated, seems to be about the same as with the Edison lamp of the same candle power. The heat given out is about the same.

The equipment of this mill is one dynamo with a capacity of 150 lamps, and 148 lamps. The lamps are distributed [illegible] on the first floor, including two in the office, three in the engine room, and three in the boiler room, and 86 on the second floor. For the carding and speeding machinery not as much light is needed as for the mule spinning which is carried on in the upper story. Two lamps are hung in each alley-way of the speeding machinery [illegible] room [illegible] mules [illegible] lamps are allowed to each [illegible] of mules and the others hang convenient to the work of boxing the yarn, which is carried on in one end of the room. The light [illegible] last evening and Mr. Little believes it will prove so.

The dynamo, which is a compact and manageable machine, stands at the east end of the mill, near to the door into the engine room. It takes its power from the main shaft, a wheel having been attached a few feet from the heavy main belt which runs on the fly wheel of the engine. The adjustment is such that the dynamo when running properly will make [illegible] revolutions a minute. [illegible] yesterday by more than one hundred revolutions [illegible] with new belting [illegible] In spite of this and some other defects of a new thing, the lamps [illegible] Nearly the whole set [illegible] first and gave probably [illegible] of the light which [illegible] lamps of eight sixteen [illegible] power. All in this [illegible] will be required to drive the dynamo at its full capacity. This is a horse power for every twelve and one-half lamps. Mr. Little was much pleased with the way the machinery started off in the Skenandoa mill, and Mr. Scott, the superintendent of the mill, said he saw nothing to complain of. [illegible]

In conversing with Mr. Little, some facts were learned about the United States system of lighting with incandescent lamps. "The company," said he, "has so far done most of its business with isolated plants, thro' I do not see why its system and lamp are not just as good for central station lighting as the Edison. It has had a great deal of work in New York city, some in New England, but yet more at the west, where nearly all the principal cities have local companies using the Maxim light, and where it has been extensively introduced. Except the plant just started at New York Mills, I do not recall any about here. The job at the Albany capital is quite a large and important one. With the general advantages of incandescent electric lighting, especially in a place like a cotton mill, the public is familiar. There will be no damage to goods, the lamps give off little heat, and there is none of that stifling feeling which is noticed when air tainted by numerous gas jets is breathed. The lamp is safe. Over each is an automatic cut-off, which provides a pin of fusible metal thro' which the current passes, and which is so sensitive that it will melt in boiling water. If the current should become too strong, and endanger woodwork, or fuse the wire, or burn out the carbon of the lamp, if it should reach that, the pin thro' which the whole current for that lamp passes would instantly melt, and break the connection, and the lamp would go out uninjured. Insurance men believe in this light, and there was no difficulty in getting a certificate for equipping this mill. In speaking of the claims of this system, I do not want in any way to slur any other. I am familiar with the Edison light, and it is a good light. The greatest advantage which we think we have is with a dynamo which is completely automatic. If I should turn off 147 lights in this mill, leaving only one burning, the dynamo would adjust itself to that condition and would send just the right amount of electricity to that lamp, and if it could be so arranged, that current could without danger be carried to that lamp on the finest wire, without danger of fusing. The lamps in one room of the mill, for example, might not be needed at any one time, and without being touched the dynamo would adapt itself. You can not perceive, by looking at it, whether it is supplying many or few lamps, but in reality it is calling upon the engine for only the amount of power which it needs to do the work which is laid upon it. Theoretically, the power would be almost zero when only one lamp or only a half dozen lamps are being used. Practically it would be more than that, but it would be very much less than if half the lamps or all the lamps turned on. Of course it is just like any other of the machines in the mill. When it is running the engine has to do more work, and requires more steam, then when it is not, but in addition it has this automatic power I speak of. In this case the engine here is not being used to nearly its capacity and is running very perfectly, so that the dynamo will cause no trouble. We claim, their is no other dynamo which does this. There are others which give a signal to a man to adjust the resistance box, but none which work entirely without attention. This dynamo will require next to no attention. When the engineer starts it going, he will need to give it little or no care, unless it be to see that it is properly oiled, and even that is largely done automatically. It will last longer than you or I will. The brushes wear out gradually, but that amounts to little. Our lamps last 1,000 hours, and the cost for them is small. The current is harmless. I can let it all go thro' my body. I shall leave here within a few days and I have perfect confidence that with a few directions as to what to do in certain emergencies there will be no trouble whatever in running the light."

In illustration of what he had said about the self-adjusting capacity of the dynamo, Mr. Little kindly had the lamps on the upper floor turned off. No one touched the dynamo [illegible] before, and the lights below did not [illegible] volume and no one of them was [illegible] to show the low point at which the fusible metal introduced [illegible] current of [illegible] will melt [illegible] it to the cylinder of the engine [illegible] lighted. Mr. Scott stated that the automatic sprinklers which are distributed thro' out the ceilings of this mill would start streams of water, even at a much lower temperature than this. [illegible]

It is understood that, if it works well, the plant will be purchased by the Skenandoa company, so that the only cost of furnishing light to the mill will be the cost of running the machine, the expense for the renewal of lamps and for brushes for the dynamo. What with its excellent arrangement of boilers and engine, its full equipment of the finest cotton working machinery, its almost perfect protection against fire and now its electric light, this mill is one of the best equipped in the vicinity. What is still better is that its yarn is steadily gaining a place in the market, is being used in some of the best knitting mills in the state, and has been widely complimented by the trade. Some of its workmen, who have had experience elsewhere, say they never saw machinery work smoother, now that it is well running, and express the belief that no mill in the country is able to make better cotton yarn than that made in the Skenandoa mill, in Utica.

Evening Farmer

THURSDAY, SEPTEMBER 27, 1883.

ELECTRIC LIGHTS IN BRIDGEPORT.

A bright fire burned cheerily in the old-fashioned stove which stands at one end of the Board of Trade's room in Wheeler's building when, at 8 o'clock last night, about forty gentlemen sauntered in and ranged themselves solemnly against the wall on all sides of the apartment. They represented the Common Council, the Board of Trade, the Board of Education and our most solid and substantial manufacturing concerns, and had come in response to the invitation sent out, to consider the subject of electric-lighting in this city. After they had sat around and warmed their hands for a time and talked over the prospects of the fall trade, Major D. M. Read arose and called the meeting to order, and then everybody hastily availed themselves of the opportunity to nominate and elect him chairman. Mr. Henry Atwater, of the Bridgeport Malleable Iron Company, was chosen secretary. Mr. Read noted the fact that as President of the Board of Trade he had been continually besought to introduce electric lighting here. He had looked into the matter from various standpoints and given the subject thorough consideration, but, as a private citizen, he had never until the present time been satisfied that this mode of lighting possessed sufficient advantages to warrant its adoption. He had made a trial of some of the systems, but they did not fill the bill. He was very desirous of using the light in his own store, and knew of others in the city who also wanted it; but none of them could find just exactly what could be used conveniently. "However," he continued, "two gentlemen now come forward and say that they can illuminate our streets with better and cheaper lights than we now have, and I told them that if they could do as they promised they would find plenty of our citizens to help them along." Mr. Read then stated that sometimes he was inclined to think that our city was a little behind others in progress, for in many places the electric light was in constant use. New Haven people had tried it and not made it work successful, it is true, but now we were assured that it can be made to pay and will be satisfactory. Continuing upon this theme, Major Read remarked, "We have the most miserable street lights in this city that I ever saw, and I am ashamed—actually ashamed to have strangers come here and remain over night; if this can be improved, I think we all might do all in our power to help it along." He then called upon Mr. E. F. Strong, who is familiar with the Brush system, to explain some points to the meeting. The gentleman remarked, as introduction, that he wished to be understood as only speaking in explanation, and not in favor of the Brush system especially. This system has, he said, first an arc light, used principally for outdoor illumination, and indoors for large buildings only. This arc light has become known throughout the world and been lately adopted in Europe, while recent arrangements have been made for its introduction into Australia. Some time ago the Brush Company purchased the Swan lamp, an English invention, at considerable expense, in order to be properly provided with a light for indoor illumination as well as outside lighting. The Swan is an incandescent lamp, having many advantages over the arc light. Mr. Strong, taking one from his pocket, proceeded to show its construction. It was of 16 candle power, and intended to take the place of an ordinary gas-jet, which is probably, in an ordinary burner, about 12-candle power. It was a small glass globe, made a vacuum, and at one end was fixed the horse-shoe of linen thread, reduced to a carbon. When the current is turned on, he explained, this carbon thread becomes illuminated, shedding a soft, steady clear white light. This Swan lamp has become very popular on the large steamships plying between this country and Europe, and Dr. Warner, of this city, who has crossed a number of times, told Mr. Strong that he considered the Swan light the best in the world. Rev. Dr. Powers also endorses it in the highest terms. It has many advantages over gas, Mr. Strong said. The light being in a vacuum, it gives out no heat. The globe can be removed by the hand when the light is turned on, and it will not be unpleasantly warm. It does not raise the temperature of the room, and fire from an incandescent lamp is impossible. Even if the globe were covered with cotton or gunpowder and then crushed, the light would be extinguished before the inflammable substance could ignite. The use of the incandescent lamp has been hampered to a degree because they have been fed directly from the dynamo machine, and this causes a slight trembling of the light or a flicker which corresponds with the workings of the machine, which becomes unpleasant after a while. But now the storage battery, which is controlled by the Brush Company alone, is used to feed the incandescent, and the illumination is steady. These accumulators are not used with the arcs, however. Mr. Brush took out his first patent for this storage battery in 1879, and last fall brought the first perfected one to New York and put it on exhibition. It gave the greatest satisfaction, and Col. Barrows, President of the Willimantic Thread Company, gave the first order for an accumulator. An invitation has been sent, Mr. Strong remarked, from that gentleman to be present at the immense works of the Thread Company next Wednesday evening and witness the illumination of the place by the Swan lamps, fed from a storage or accumulator. The Brush company claim to have, with these batteries, a complete system of electric lighting. Every machine is guaranteed by the strongest guarantees. Upwards of 75 cities are lighted by the Brush system, and handsome dividends have been declared to the stockholders of the local societies in some places. In Albany, to meet the demand of residences, wires were attached to those feeding the arc lights in the streets, and the dynamo machine was kept running during the day, which filled the accumulators in the various houses, so that, at night they fed the incandescent lamps without drawing on the supply furnished to the arcs. Mr. Strong was heard with the greatest attention and his thorough familiarity with the subject made plain his explanation. Mr. Powell, who directly represents the Brush Company, was present, and the next hour was devoted to questions by various people, all of which were satisfactorily replied to by that gentleman. In answer to these queries Mr. Powell said that one accumulator for 5 lights to burn four hours in a house would be about 6 feet in length, 9 inches in height and 8 inches wide, and that it was generally placed in the garret or cellar or other out-of-the-way place. It is provided with an automatic switch, and when the supply is exhausted the magnets of this switch raise themselves and allow the current to flow in on the wires; when filled, the magnets shut down. The electricity is turned on in the same manner that gas is, and is measured by the thousand feet, through a meter, like gas. There is no danger from the wires unless they should be cut and each end taken in one hand, as the Brush Co. uses only the No. 8 English gauge wire, which is so heavily insulated that no harm can come from it, and it cannot cause fire. The Brush Company rents the rights of the system for cities and towns to a local company which can be formed and profitably sustained. The accumulators are held by these local organizations, as metres are by the gas companies. After the plant is established, the only expense is the power and the men to take care of the machinery; in all places, the light competes with gas in price. If a local company is established here, the Brush Company has no right to put in a plant in opposition. Eighty arc lights are fed from a 40-horse power engine, and 1,000 incandescent lamps to burn four hours, may be fed from 22-horse power running 23 hours.

Major Read arose and suggested that a committee be appointed to visit Willimantic next Wednesday, view the lights at the Thread Company's Works and report at the next meeting. The committee as named consists of Messrs. Read, M. W. Seymour, and Henry Atwater. The meeting was adjourned, subject to the call of the Chairman. Mr. Atwater took a lively interest in the discussion, and intimated that the light was just what he wanted for the Malleable Iron Company's immense factory.

THE TIMES, WEDNESDAY, OCTOBER 3, 1883.

An extraordinary general meeting of the SWAN UNITED ELECTRIC LIGHT Company (Limited) was held yesterday at the City Terminus Hotel, to consider the terms of an agreement about to be entered into between the Edison Electric Light Company, the Swan Company, and a trustee on behalf of a company intended to be registered under the name of the Edison and Swan United Electric Light Company (Limited), "being a conditional agreement for the sale to the last-mentioned company of certain of the business, goodwill, patents, rights, privileges, and other property" of the Swan Company, and to empower the directors to take all necessary steps for carrying the agreement into effect. Mr. J. S. Forbes presided, and reminded them that at the first meeting of the company they suggested the possibility and the wisdom of bringing together diverse interests in the new and somewhat difficult enterprise in which they were engaged, and there was a very general concurrence of feeling on the part of the shareholders as to the wisdom of such a course. The directors had therefore steadily kept the matter in view. He thought that both companies had acted prudently, before considering an amalgamation, in waiting to see what the tenure would be upon which they would proceed under Acts of Parliament or provisional orders—a stage at which, he said, they had now happily arrived. He hoped the wisdom of the principle of fusing two interests like Swan and Edison would be admitted without much discussion. With regard to the terms of the amalgamation now proposed, it was of no use raising the question whether the Edison Company or the Swan Company had paid too much for their patents. It was now proposed to fuse the British business of the two companies, but over and above the British business the Swan Company had paid a considerable price for foreign and colonial patents, and as the Edison Company did not possess a similar asset, the Swan Company had reserved these patents from the arrangement now under consideration. Eliminating from their books the purchase price of their foreign and colonial patents, and the outlay they had incurred in advertising and conducting them so far, they found that they had spent £183,847, and the Edison Company had spent £100,000. There was also the further difference between the two companies that this company's purchase of the Swan patents was "out and out," while in the purchase of the Edison patents there was a deferred interest to Mr. Edison—a percentage of profits. After the £100,000 had been covered by 5 per cent., the Edison Company and Mr. Edison were to participate half and half in the surplus. They came to the conclusion, after considerable discussion, that they had better get this half share of future profits over 5 per cent. attaching to the Edison Company, as distinguished from Mr. Edison himself, out of the way by a payment of £25,000 in shares. Mr. Edison had elected to remain as he was. He was entitled, under his original agreement with the Edison Company, to one B share, bearing deferred interest, for every two Edison Company's shares. The Swan Company proposed to make over all they possessed, with the exception of their foreign and colonial patents, for £183,847, and the Edison Company would transfer everything they possessed, including their half share of the contingent profits under their agreement with Mr. Edison, for £125,000. For every £100 of capital as it existed under the fusion, or as it would exist when it was increased from time to time, according to the requirements of the business, Mr. Edison would take one B share—for every £75 issued Mr. Edison would get £25 in the nature of a share not bearing interest until the other capital received 7 per cent. For this Mr. Edison was paid his contingent interest in the Edison Company, and the new United Company would have the benefit for five years of his services, and of anything new which he might discover in that period as regarded the electric light. The chairman then referred at some length to the agreement in detail, observing that the sale was to take effect as from the 30th of June last. The United Company would allot to the Edison Company 45,000 A shares (part of the original capital of the United Company), of which 40,000 would be issued as having £2 10s. each paid, the other 5,000 shares being issued as fully paid—£5 each. That made £125,000 in all. With respect, however, to the £5,000 fully paid-up shares, the option might be exercised of taking the amount represented in half-shares, with a liability of £2 10s. on each. The idea was to broaden the base of the new company and to have such reserves of credit as would enable them to raise money in the future. The unpaid capital in both the Edison and the Swan companies would be carried over into the fusion, and that was why the shares were issued as £2 10s. paid. Mr. Edison would receive one fully paid-up B share for every 15 paid up, or credited as paid up, in the United Company, and the B shares would only receive dividend after the payment of a dividend on the A shares of a sum equal in the aggregate to a preferential cumulative dividend of 7 per cent. There would be one vote for every A share and one vote for every two B shares, and in the event of such a catastrophe as a winding-up the A shares would be satisfied before the B shares received anything. The Swan Company would receive £183,847, part of it in shares with £2 10s. paid, and part in fully-paid shares of £5. Powers were taken to raise shares of a preferential character. Supposing the new company should have a business paying them 7, 8, or 10 per cent., and they required capital to extend it, they would thus be able to raise new capital of a preferential character, but at a much lower rate of interest. It was also provided that resolutions were to be passed confirming the agreement at meetings of the Swan and the Edison Companies, to be called for the 2d of October (that day), and that if they refused to do so before the 31st of October the bargain was off. All the directors were of opinion that the amalgamation would be wise, and that the terms were reasonable and just to both sides. He concluded by moving a resolution approving the agreement. General Trevor seconded the motion, and after a brief discussion the resolution was carried unanimously.

An extraordinary general meeting of the EDISON ELECTRIC LIGHT Company (Limited) was held on Monday at the Cannon-street Hotel, Mr. John Stewart in the chair in the absence of Sir John Lubbock, M.P., to consider and agree to the terms of an amalgamation with the Swan United Electric Light Company (Limited). After explaining the reasons which had induced the directors to recommend the amalgamation to the shareholders, the chairman put the following resolution to the meeting:—"That the agreement dated the 1st day of October, 1883, between the Edison Electric Light Company (Limited), of the first part, the Swan United Electric Light Company (Limited), of the second part, and George Black, on behalf of the Edison and Swan United Electric Light Company Limited), of the third part, be, and it is hereby approved, adopted, and confirmed, and the directors are hereby empowered to do all such things as may be necessary for carrying the said agreement into effect." The Right. Hon. E. P. Bouverie, in seconding the resolution, which was carried unanimously, observed that a great impediment to the success of electric lighting would be removed by the fusion of the two companies, as the Swan Company was practically the only dangerous competitor they had to face. The chairman stated that the company had been doing very successful ship-lighting business during the past half-year, the turn-over during that period equalling that for the whole of the previous year. Mr. Arnold White, a director of the company, observed it might be interesting to know that the first ship in the world which had been lighted by electricity without any subsidiary form of lighting being employed was the Guion Line Oregon, which was to sail on Saturday next. This vessel was lighted throughout by the Edison system.

July 15, 1882.]

THE STATIST.

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION.—Notice is given that an extraordinary general meeting will be held at the Cannon Street Hotel, London, E.C., on Tuesday, July 10th, 1882, at 2 o'clock, when the subjoined resolution will be proposed:—"That the 85th of the Articles of Association be repealed, and that in lieu thereof the following be henceforth the 85th of such Articles:—85. The directors may from time to time of their own authority pay to the members in proportion to the amounts paid-up, or credited as paid-up, on the shares held by them respectively, such bonus and such interim dividends as in the judgment of the directors the position of the corporation justifies."

FEBRUARY 10 1883.
THE GAZETTE, MONTREAL.

PROGRESS OF ELECTRIC LIGHTING.

Our readers, especially those who have to complain of excessively heavy gas bills, interested to learn the progress of the « Dia- lighting apparatus, suits were commenced against mond » Electric Light Company, which was both, parties—against Maxim in France, established by Edison in New York, where where a seizure of his lamps was made at the Electrical Exposition in Paris, and against Swan in England. Both suits are now down for hearing, and will probably be decided within a very short time.

"THE CRAIG ELECTRIC LIGHT."

TO THE EDITOR OF THE GAZETTE.

Sir,—On the 12th inst. the following statement appeared in the *Daily Star*, concerning "The Craig Electric Light;" of which an exhibition had been given the evening previous at the repair shops of the Grand Trunk Railway at Point St. Charles:

"The apparatus had been examined by the Chief Engineer of the Post Office Telegraphs of Great Britain, and a certificate given that it is the best yet invented; and Professor Morton, Principal of the Stevens Institute, Hoboken, although on the Advisory Board of Directors of the Brush Company, has certified that it is the only perfect system in the world."

Being interested in the development of electric lighting, I determined at once to forward the above statement to the gentlemen referred to, in order to ascertain its truthfulness or otherwise.

Mr. W. H. Preece, engineer and electrician in chief of the postal telegraphs, London, England, called me as follows:

—London, 19 April, 1883.

"I know nothing of Mr. Craig or his dynamo, and have not given any certificate to any one."

Wells Professor Henry Morton, of Hoboken, New Jersey, telegraphs my assistant, Mr. H. M. Byllesby (who was one of the professor's pupils), as follows:—

—Honesdale, 17 April, 1883.

"No such statement as you report was ever made by me."

The above disclaimers speak for themselves, and in the public interest I beg to ask the insertion of them in your journal.

Yours faithfully,

THOS SWINYARD.

Hamilton, Ont., 19th April, 1883.

OCTOBER 24 1882.
THE DAILY NEWS.

ELECTRIC LIGHTING.

TO THE EDITOR OF THE DAILY NEWS.

Sir,—I see by the papers that Edison claims that both the Swan and Maxim inventions are infringements of his patents, and, after obtaining the opinion of eminent counsel and scientific experts, both English and French, that they are unfounded

I have been asked to give a brief history of the matter, which I have given; considering it of some interest to the general public. Should you consider it worthy a place in your columns, I shall be pleased to have it inserted.

Edison's claim to the "subdivision of the electric light" is based upon the fact that under the head of preliminary estimate, he estimates a "plant" for lighting a district containing 1,000 lamps, with engine, boilers, dynamos, leads, &c., complete, at $130,000, or $130 per lamp; and that under the head of "preliminary estimate" based upon "subdivision," he estimates a plant for lighting the same district with 10,000 lamps, with engine, boilers, dynamos, leads, &c., complete, at $300,000, or $30 per lamp; and argues that the saving effected by the latter estimate is the result of his invention of subdivision. Now, this is absurd on the face of it, as the saving is effected entirely by the use of a larger plant, and not by subdivision at all. Edison's claim is based upon the assumption that a certain number of lamps can be run from a certain sized plant, and that by subdividing a larger plant into smaller ones, the same number of lamps can be run from the smaller plants. This is absurd, as the number of lamps that can be run from a plant depends entirely upon the capacity of the plant, and not upon the subdivision of the plant. Edison's claim to the subdivision of the electric light is therefore worthless.

Edison's claim to the invention of the carbon filament is also worthless, as Swan's patent, which was granted in 1860, and which is now in force, covers the use of carbon filaments in vacuo, and Edison's patent, which was granted in 1879, covers the use of carbon filaments in vacuo. Edison's claim to the invention of the high resistance lamp is also worthless, as Swan's patent, which was granted in 1860, covers the use of high resistance lamps, and Edison's patent, which was granted in 1879, covers the use of high resistance lamps. Edison's claim to the invention of the parallel system of distribution is also worthless, as Swan's patent, which was granted in 1860, covers the use of the parallel system of distribution, and Edison's patent, which was granted in 1879, covers the use of the parallel system of distribution. Edison's claim to the invention of the regulator is also worthless, as Swan's patent, which was granted in 1860, covers the use of a regulator, and Edison's patent, which was granted in 1879, covers the use of a regulator. Edison's claim to the invention of the automatic cut-out is also worthless, as Swan's patent, which was granted in 1860, covers the use of an automatic cut-out, and Edison's patent, which was granted in 1879, covers the use of an automatic cut-out. Edison's claim to the invention of the safety fuse is also worthless, as Swan's patent, which was granted in 1860, covers the use of a safety fuse, and Edison's patent, which was granted in 1879, covers the use of a safety fuse. Edison's claim to the invention of the electric meter is also worthless, as Swan's patent, which was granted in 1860, covers the use of an electric meter, and Edison's patent, which was granted in 1879, covers the use of an electric meter. Edison's claim to the invention of the electric motor is also worthless, as Swan's patent, which was granted in 1860, covers the use of an electric motor, and Edison's patent, which was granted in 1879, covers the use of an electric motor. Edison's claim to the invention of the electric light is also worthless, as Swan's patent, which was granted in 1860, covers the use of an electric light, and Edison's patent, which was granted in 1879, covers the use of an electric light. Edison's claim to the invention of the electric lighting system is also worthless, as Swan's patent, which was granted in 1860, covers the use of a lighting system, and Edison's patent, which was granted in 1879, covers the use of a lighting system. Edison's claim to the invention of the electric lighting apparatus is also worthless, as Swan's patent, which was granted in 1860, covers the use of lighting apparatus, and Edison's patent, which was granted in 1879, covers the use of lighting apparatus. Edison's claim to the invention of the electric lighting system is also worthless, as Swan's patent, which was granted in 1860, covers the use of a lighting system, and Edison's patent, which was granted in 1879, covers the use of a lighting system. Edison's claim to the invention of the electric lighting apparatus is also worthless, as Swan's patent, which was granted in 1860, covers the use of lighting apparatus, and Edison's patent, which was granted in 1879, covers the use of lighting apparatus.

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THE EDISON SYSTEM OF ISOLATED LIGHTING.

When the writer of this was running the reportorial quill on a daily paper in New York city, some three years since, he was detailed more than once to visit the "Wizard of Menlo Park" and had pleasant interviews with him. He has also lived to see the abuse, which has been heaped upon Mr. Edison's head—by a set of know-nothing journalists, who, unless they are scientificists are nothing, and as scientificists are never reliable—turned into admiration of his merit and acknowledgment of his complete triumph.

The rapid stride made in electric lighting has been a matter of astonishment. It is safe to say that no man more than Thomas A. Edison has achieved success, or what is more gratifying to manufacturers, has achieved so signal a success that the electric light of to-day is free from the incidentals that have always attended gas and the accidentals that are to too close fellowship with kerosene oil. The Edison light is as far superior to any other light for manufacturing purposes as first-class kerosene is to moonlight. This is our own private experience. We have looked with much interest at the adoption of the electric light; we have seen it in the old world and the new; and it is only after some months of careful investigation with respect to its adoption by the manufacturing interests—and by manufacturing we mean everything as well as textile—that we are rather proud to say that the Edison light of to-day is the light, in its perfection for its advance of any and all others.

The Edison light is unlike any other electric light, and after Mr. Edison had thoroughly studied all that related to electric lighting, the circumstances under which it must be used, the purposes for which and the place in which, instead of pleading the invention of others, making up arrangements which should neither be one nor the other man's system or invention, he made a most radical departure from any one who had preceded him, and invented a system of lights and of the appliances which were necessary to make that system successful and capable of adoption. This, as a matter of course, required time. How successful he has been, only those who have been most closely connected with him during all this work, can say.

It is true that during the time that through the delays caused by lengthy experiments he has been heard by the press, but on those who laugh last laugh longest, so Mr. Edison can afford to forgive those people for their ignorance, from the fact that he now offers the only thoroughly practical isolated light, and the only light that is completely applicable to the manufacturing or mechanical establishments where a natural light, one that does not glare the eye, and one which in case more of a blindness than a help, is demanded; where a light has a natural and pleasing softness rather than the pale, ghastly white; where a light of small capacity, like eight or twenty-candle power, is furnished without that peculiar and almost intolerable flicker, jumping motion, or whatever term may be applied. While he has accomplished all this, he has also accomplished what was most important and essential requisite—that of proportioning his power to the lights required, so that one, three, or all the rooms of a large establishment can be lighted perfectly; and if all the lights are required it is only a matter of momentary attention to graduate the power of the engine to the work required; and if, on the other hand, only a portion of the work is required, it takes but a moment both to diminish the volume of the current and the work of the engine with a velocity that nothing approaches in comparison more completely than the microscope attachment of the telephone of a fine watch. These points will all be considered by the manufacturers.

Mr. Edison has also accomplished other and important changes which are set forth further on in this article. He has astonished closest scientists by his seeming contempt for positively acknowledged laws in relation to electricity; he has ignored old and adopted standards,—which indeed had to be set up sooner or later—he has adopted standards of his own, seeking out first by careful calculating and empirical experiments the basis or the foundation which he was to adopt. He has proved that he can accomplish more with the same number of power, and more times money; he has given us a better light, and he has magnificently accomplished the task which he set himself, without adopting the too prevalent practice of swindling either his patrons or those who have interested in a business manner with him.

We have sought in this article to avoid all theory, to make only statements of fact, and to give to be such as shall interest our readers who have a wish to acquire such authentic information in reference to this new child of invention, with a view to its adoption into their family. It is not a matter whether these families are large or small. Some of our manufacturing concerns have disseyled one to two thousand gas burners, and introduced seven to nine hundred Edison isolated lights, and we shall now show what those lights are doing by facts taken from the current expenses' sheets of those institutions. We are promised these facts and we shall very shortly give them publicity.

We have sought, in this article, to discard all biased statements of comparisons, and to confine ourselves simply dayly to fact, and we bespeak from our readers careful attention while figures are given. Those who have not, should by all means visit the New England Manufacturers and Mechanics' Institute, where the several systems are now to be seen; on each of the days of the week, in full operation, and where any man, with good average ability, can make his own comparisons and deductions, with perfect satisfaction to himself, from a basis of business, which is the only tangible or satisfactory one.

In the Edison system no arc lights are used, the originators of that system believing that for the same power expended at the engine, or wheel, small lights, *distributed* over a given space, would give a far more effective illuminant; for, by the Edison system (the sun) with open, shadowy must inevitably ensue. Edison uses what is known as an incandescent lamp, in which there are no moving parts and no mechanism; the light, therefore, is absolutely steady, provided the power is so. This lamp consists of a pear-shaped glass globe, about six inches in length. Within is the "carbon" about the size of a small ascending a horse hair, is made of bamboo fiber from which all volatile matter has been removed and is nearly pure carbon. This carbon is fastened to a small copper strip by holding the wire like a clamp about the enlarged ends, and the contact is rendered more perfect by electroplating. This in turn is attached to the platinum wire, a piece of platinum in fig. 2. These lamps are of no such length as those in the "carbon" system, but of no such length as those in the "leading in" wires. The platinum part is hermetically sealed in the end of a glass tube which also contains the copper wire. The reason of this is that the platinum's coefficient of expansion is almost exactly the same as that of glass, and consequently the two expand equally; therefore, the glass is not broken and the vacuum mentioned below is maintained. The base of the lamp is made of plaster of paris. At its bottom terminals of the lamp, and to which one of the "leading in" wires is soldered to a socket, which fits into the plaster into the form of a screw thread. This forms the other terminal. The air is now exhausted from the globe until a practically perfect vacuum is obtained. The light is produced by the current passing from the bottom plate contact screw, and base to the second plate. As the carbon is of very high resistance, the mechanical energy furnished by the engine or water wheel is transformed first into electrical energy, and then into the energy of heat. Below is given (fig. 1), a cut of the lamp. A represents the glass globe, B the carbon, C the plaster base, D one terminal, and E the other terminal. The average life of these is guaranteed to be at least 1000 hours, but they have proved immediately below the cut of the lamp, is represented the socket. O is a plate fitted to receive the plate, D. Below (out of sight in diagram) is a plate, T, connected from first, on which rests the plate, E. The socket is attached to lead ceiling (in factories and workshops) by means of a 1 inch pipe, which screws into the plate H. The top wire lead down inside of this pipe, one being attached to the plate, O, and the other by means of a small lead wire to plate, F. This lead wire serves as a safety guard; for since lead has about thirteen times the resistance of copper, if any short circuit or cross is accidentally produced, thus setting up an extra current, the lead will melt and the wire be broken, stopping the flow at once before the copper is heated. The key, K, enables us to break the circuit at pleasure, thus "extinguishing" the light. Each lamp is thus entirely independent of all others, and can be turned on or off at will. Fig. 2 shows the lamp in position in the socket, being secured in this line at the screw threads, D and O. The lamps can be used in a gas fixture, but in industrial work it is better to suspend it globe down, as by means of a metal or porcelain shade, attached to the socket and over the lamp, all the light is thrown down to the work in hand. This shade also serves as a protection to the lamp. If it is desired, however, to have a lamp whose position can readily changed, swinging brackets, with one, two, or three arms, are provided as a matter of fancy. These brackets can be attached to the wall or suspended from the ceiling, as mentioned above. At the circuit between the wire in which the current is to be made through brushes in the box A, and not by means of switches of wire, there is no danger of breaking this circuit by turning the arm B, which may be revolved indefinitely. At the junction of the top wires with the mains carrying the current from the generator, is interposed the "cailing cut out" or safety catch, represented by Fig. 4. This consists of two posts, the blocks, A and the plate, B. The main wires are led through the grooves, M, and the top wires through the grooves, T. At the base of the plug is a plate of copper, in which about the width of the plug is pressed, as in the base of the lamp, into the form of a screw. These are connected by means of a lead wire, C. When the plug is inserted into the block, A screws over O, and D upon P. The current enters at S, passes through the lead wire to O, thence up the top wires to lamp and back to main at X. This safety catch serves an analogous purpose to the automatic sprinkler in a factory. In the latter case, an abnormal heat melts the fusible metal, thus allowing the water to flow; in the safety catch, an increased current melts the lead wire, for the reason mentioned above, thus breaking the circuit. This current might otherwise dangerously heat the copper wires. This device is a distinctive and the noteworthy feature in the Edison system. As the means of a lead wire, C. When the plug is inserted into the block, A screws over O, and D upon P. The current enters at S, passes through the lead wire to O, thence up the top wires to lamp and back to main at X. This safety catch serves an analogous purpose to the automatic sprinkler in a factory. 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When the machine is first started there is no perceptible magnetism in the pole pieces

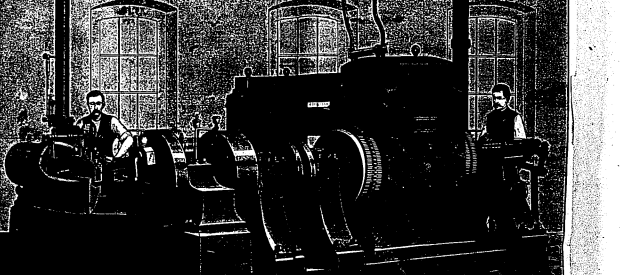

FIG.2.—EDISON

sented the socket. O is a plate fitted to receive plate, D. Below (out of sight in diagram) is a plate, T, connected from first, on which rests the plate, E. The socket is attached to lead ceiling (in factories and workshops) by means of a 1 inch pipe, which screws into the plate H. The top wire lead down inside of this pipe, one being attached to the plate, O, and the other by means of a small lead wire to plate, F. This lead wire serves as a safety guard; for since lead has about thirteen times the resistance of copper, if any short circuit or cross is accidentally produced, thus setting up an extra current, the lead will melt and the wire be broken, stopping the flow at once before the copper is heated. The key, K, enables us to break the circuit at pleasure, thus "extinguishing" the light. Each lamp is thus entirely independent of all others, and can be turned on or off at will. Fig. 2 shows the lamp in position in the socket, being secured in this line at the screw threads, D and O. The lamps can be used in a gas fixture, but in industrial work it is better to suspend it globe down, as by means of a metal or porcelain shade, attached to the socket and over the lamp, all the light is thrown down to the work in hand. This shade also serves as a protection to the lamp. If it is desired, however, to have a lamp whose position can readily changed, swinging brackets, with one, two, or three arms, are provided as a matter of fancy. These brackets can be attached to the wall or suspended from the ceiling, as mentioned above. At the circuit between the wire in which the current is to be made through brushes in the box A, and not by means of switches of wire, there is no danger of breaking this circuit by turning the arm B, which may be revolved indefinitely. At the junction of the top wires with the mains carrying the current from the generator, is interposed the "cailing cut out" or safety catch, represented by Fig. 4. This consists of two posts, the blocks, A and the plate, B. The main wires are led through the grooves, M, and the top wires through the grooves, T. At the base of the plug is a plate of copper, in which about the width of the plug is pressed, as in the base of the lamp, into the form of a screw. These are connected by

system is always installed by competent men, no short circuit can occur except by accident, in that event the safety catch is on the alert to provide an instantaneous and effectual remedy. In a factory or other shop building where it is desirable to have an arrangement whereby a number of lamps may be shut out simultaneously (as for instance, in the separate rooms or separate bays in the same room), without turning the keys in the individual lamps, a "switch" is inserted in the line at the generator, which is a central feeder coming from the generator. On a dark or cloudy day the globe nearest the windows not require the light as soon as those in the center of the room. The former can be shut off by the switch itself required, when the lamps are all turned on at once.

Where a large number of lights are distributed over several stories of a building, or where the light is required at some distance from the generator, the "electric tube" replaces the central feeders mentioned above. The tubes are the same as used by the Edison Illuminating Company of New York, in their "First District." These tubes consist of a series of gas piping in which are placed two small-gutticinal copper rods, separated from each other and from the containing pipe by means of incombustible washers; the interior of the pipe is filled in with dry sand, dried having run times the insulating properties of gutta percha. These tubes may be connected to a junction box at any point where it is desired to use the current. These junction boxes are constructed similar to the generators or governors. These machines are of three sizes, known as "Z," "K," and "Y." Fig. 5 is known as a "Z" machine, and is capable of producing a current sufficient to furnish from 45 to 65 lamps at 16-candle power, or 120 to 130 lamps at 8-candle power. This will perhaps be more readily comprehended when it is stated that 16 candles represent the light furnished by an ordinary argand burner consuming 5 to 6 feet coal gas per hour. Fig. 6 represents the "L" machine with a capacity of 150 to 180 16-candle power, or 300 to 320 8-candle power lamps.

Fig. 7 is the "K" machine, with a capacity of 250 16-candle power or 500 8-candle power lamps. In each of these cuts A represents the arms of the electro magnets, B the pole pieces between which the armature, B, revolves, and K the keepers. The brushes, O, collect the current generated in the armature, B, from the commutator, T. The current passes from one brush along the conductors shown on side of magnet arms to the top of the machine where it divides, part passing off by conductor, C, to the feeder through the lamps back to D, and part passing about arms of magnet, joining the return current in the conductor C to the other brush. When the machine is first started there is no *perceptible* magnetism in the pole pieces

There is present, however, what is known as "residual" magnetism. This is sufficient to induce a slight current in the armature, by what is known as "mutual accumulation," and this, a reciprocal action between the armature and pole pieces, this slight current is increased until the limit of magnetism in the pole pieces is reached. In practice, instead of connecting the main leading from brush directly to the magnet wire, it is customary to connect through the "resistance box." By means of these magnets depends in part upon the number of turns in the helix on the arm, and in part upon the strength of current passing, less current making the magnets weaker. As the magnets are connected in "shunt circuit" or "multiple arc" to the main circuit, resistance inserted in the magnet helix will weaken the current of electricity passing about the magnet. This is the object of the resistance box, which increases resistance but outside of the magnet arm. Thus the strength of the magnets, and consequently the power of the lamps, can be varied at will. As the magnets are shut off, or are "turned down," the resistance is cut out. These machines are particularly decreased and the life of the lamps is greatly increased—two very important items to be considered in the running expenses of the system. Regulators for the engines are also required which automatically adjust for a change in load. They are not positively required where the load is constant, as in cotton factories. The generators are connected to the engine are in the same manner, and therefore each machine can be shut out at will. At the exhibition made by the New England Manufacturers and Mechanics' Institute fair, the three sizes of dynamos, and also five different sizes of lamps, are so connected. The power is applied from the countershaft by means of a belt on P. The dimensions of these three machines are as follows:

Machine.	Length.	Width.	Weight.	Pulley.	Speed.
	Inches.	Inches.			
Z	30	20	2000	6x10	1200
L	40	30	3000	8x10	1200
K	48	36	4000	8x10	1200

Fig. 8 represents the "Edison-Sawyer Dynamo." The crank shaft of driving pulley

(Concluded on page 8.)

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[Continued from Page 5.]

is lengthened out and forms the armature shaft. This machine is capable of maintaining 1200, or, in an emergency, 1000 lamps of 16-candle power each. Six of these large machines are already installed and in operation in the "First District" in New York. The current produced by all the Edison machines is perfectly harmless to the person as well as to property and can be taken by a child with perfect impunity. The reason for this is that the electromotive force (analogous in some measure to pressure in a steam system) is extremely low and is very nearly constant and independent of the number of lamps burning; it is the same on the various sizes. The quantity varies very nearly in

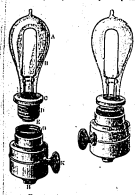


FIG. 1.

FIG. 2.

proportion to the lamps in use. On the arc system, on the contrary, the quantity of current is very nearly constant, while the electromotive force varies nearly as the number of lamps in circuit. Moreover when the two brushes on the arc machine are touched simultaneously, thus forming a complete circuit, a "counter electromotive force" is set up, which is many times the original. Thus a nervous shock is produced causing death. This "counter electromotive force" cannot be set up in the Edison system, as the circuit was already complete through the lamps; one more path was simply opened to the current. It is a separate power, but it is not necessary, as the power can be applied by means of countershaft from engine or wheel already in use. The power required to drive the various dynamos is as follows: 2, 9 horse power; 1, 30 horse power; 8, 32 horse power.

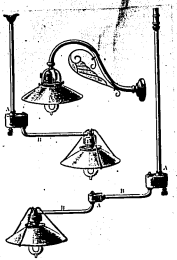


FIG. 3.

A very valuable feature in connection with the system, is the fact that by means of a flexible cord attached to a lantern, repairs can be made about any machine. At the end of this flexible cord is a plug which resembles the base of the lamp; by removing the lamp from the socket and placing the plug to which the cord is attached in its place, the current can be carried to any desired place.

The gas burners used in factories consume about four feet of coal gas per hour. One of these 16-candle power lamps is equivalent in illuminating effect to about two such burners, and in ordinary work will replace about that number; as, however, this would give about the same illumination as at present, some manufacturers, believing "that it does not pay to work in the dark," increase the number. It has been found by experiment that abundant and ample light is provided by using one 16-candle power lamp to four forty-inch looms, or by two wide looms (say 96 to 110 inch reeds) on wide goods, or the same for two ginghum looms. In woolen mills, the swinging bracket mentioned above, is found especially valuable. On this class of work one of these is suspended over each end of the loom, and so arranged as to swing in between the frames and the harness. This allows the weaver to keep run of the yarn on the bobbin in the shuttle box, and to "draw in" the yarn through harness, by swinging the lamp over the warp beam. On white or light colored woolens, two 8-candle power lamps per loom are sufficient. On dark colors, two 16-candle power lamps are used. The expense of lighting by the Edison system, as compared with gas, is much in favor of the former. Let us assume, for an example, a cotton mill of 35,000 spindles or about 900 40-inch looms, manufacturing sheetings and shirtings. This mill will require about 500 16-candle power lamps; the cost of installation will depend upon the length of mill, and also upon the position of the dynamo in relation to the work; but assuming an average mill, the plant will cost in the neighborhood of $6000. For this purpose we shall need two "K" (250 light) dynamos, requiring in the neighborhood of 64-horse power. Assuming that, in an ordinary engine, 21 lb. of coal

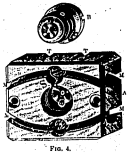


FIG. 4.

is the average hourly combustion per horse power, at $3 per short ton ($2000 lb.) the expense for fuel would be in the neighborhood of 32 cents per hour. The depreciation on the system is found first in the lamps, second in the commutator, and third in the brushes. The Journals run in Babbitt metal, and when properly oiled will show no appreciable wear. The lamps are renewed at a cost of $1 each. With an average life of 600 hours, as guaranteed above, the expense for lamps will be about 831 cents per hour. The commutator, composed of bars of copper about an inch thick, closely bound together and insulated from each other, with ordinary care will last 1500 to 2000 hours, say 1500, and can be renewed at a cost of $50. The depreciation on the two commutators will be about 6⅔ cents per hour. The brushes consist of copper wires bound together in the form of a spiral; these will last 100 to 200 hours, say 100, and cost $6 per set. The depreciation on brushes thus amounts to 10 cents per hour. Tabulating the above, we have for the hourly expense for running 500 Edison 16-candle power lamps, as follows:

Power—8-horse power, at $3 lb. coal at $3	.32
Depreciation—Lamps	.83½
" Commutator	.06⅔
" Brushes	.10
	$1.32

Let us now make a similar estimate on the cost of running 500 4-foot gas burners. At $2 per 1000 foot, this amounts to $4 per hour. Estimating 300 hours as the "lighting time" in factories in Massachusetts, we have a yearly cost for gas of $1200. At $1.50 per hour the Edison system will cost $474, showing a saving of $726, equivalent to a little more than 9 per cent on the investment. This does not take into consideration the interest on the gas-piping, nor the fact that the Edison system is furnishing twice the light of the gas. Assuming $50 (5 per cent. of $1000) as the interest on gas plant, and $480 as interest on Edison plant, the former, furnishing but half the light, costs 351 per cent. more than the latter.

In ordinary manufacturing work, the above 500 lamps will replace at least 750 4-foot burners. On this basis the Edison system can furnish a far steadier, safer, and more healthy light, and one which does not heat or vitiate the air, at a cost of 50 per cent. original gas bills (interest on gas piping being figured at $120—at 4 per cent. on $3000). The above basis of 300 hours is the average period of illumination per year where the ten hour law is in force. It is obvious that, where light is used for a longer time, the saving by the Edison system is correspondingly increased. In Rhode Island, Maine, and some other States, the annual period of illumination is about 400 hours. Under the above assumption that 500 Edison

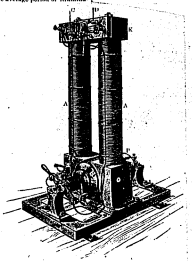
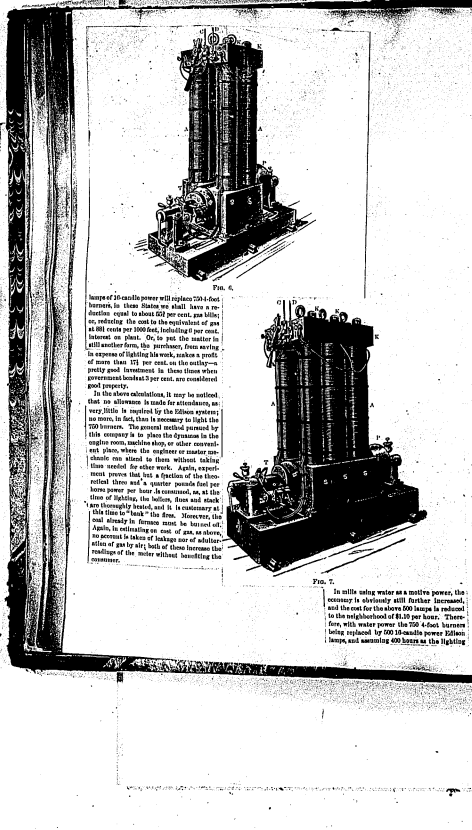


FIG. 5.



lamps of 20 candle power will replace 750-5 foot burners, in these States we shall have a reduction equal to about 62½ per cent, sss bills; or, reducing the cost to the equivalent of gas at 60½ cents per 1000 feet, including 6 per cent. interest on plant. Or, to put the matter in still another form, the purchaser, from saving in expense of lighting his work, makes a profit of more than 171 per cent. on the outlay—a pretty good investment in these times when government bonds at 3 per cent. are considered good property.

In the above calculations, it may be noticed, that no allowance is made for attendance, as very little is required by the Edison system; no more, in fact, than is necessary to light the 750 burners. The general method pursued by this company is to place the dynamos in the engine room, machine shop, or other convenient place, where the engineer or master mechanic can attend to them without taking time needed for other work. Again, experiment proves that but a fraction of the theoretical three and a quarter pounds fed per horse power per hour is consumed, as, at the time of lighting, the boilers, fires and stack are thoroughly heated, and it is customary at this time to "bank" the fires. Moreover, the coal already in furnace must be burned off. Again, in estimating on cost of gas, as above, no account is taken of leakage nor of adulteration of gas by air; both of these increase the readings of the meter without benefiting the consumer.

FIG. 7.

In mills using water as a motive power, the economy is obviously still further increased, and the cost for the above 500 lamps is reduced to the neighborhood of $1.10 per hour. Therefore, with water power the 750 4-foot burners being replaced by 500 16-candle power Edison lamps, and assuming 400 hours as the lighting

New Zealand Times, May 25, 88.

PARLIAMENT AND THE ELECTRIC LIGHT.

It is intimated that the Parliamentary Buildings will be lighted this session by Swan's incandescent electric lamps and Siemen's dynamo generator. The new lights are not expected to be ready for the opening of Parliament on the 14th June, but may be got into operation during the second or third week in the session. Swan's patent electric lamp, known as the Incandescent, differs somewhat from the lamps which the agent of Edison's Company has just fixed in the Government Printing Office, where they have been inspected by Ministers and other persons of note, and pronounced to be a successful application of the electric light to workshop purposes. It is remarkable that two different systems of electric lighting have been adopted by the Government, not as the result of careful consideration made by Wellington, but for other reasons. Edison's Company recently entered an action in the Supreme Court against the Swan Company, for alleged infringement of patent rights, and we understand the latter is now due for hearing. The allegation is that Swan's incandescent lamp is an infringement of Edison's lamp as patented in America, Europe, India, and the colonies; that the principle of both lamps is the same, any differences being in details that are not essential. The dispute between these rival Companies has been going on many months, without either side consulting the public; and now the Edison Company are seeking to compel the Swan Company to pay damages and make an apology. During this dispute it has been claimed for the Swan Company that any resemblance between the two lamps is accidental coincidence, and that the Swan lamp is the product of independent experiment. It is stated, on the other side, that none of the Swan lamps have been sold in America, where the question would be tested according to American patent laws. As to the point we have no independent information.

The lighting apparatus ordered for the Parliamentary Buildings is expected from London per the next direct steamer (the Arawa is the next), which leaves the docks to-day fixed for the opening of Parliament. The apparatus has yet to be tested, and a week or two days will be necessary to fit and test it experimentally. The new brick building which the motive engine and the dynamo generator are to be fixed is already finished, and a tube is laid to carry the electric wires from the engine room to the main building. The first temporary failing of the wires and lamps will be a slight but rapid operation, requiring only a few days, and as the incandescent can be readily placed, which is the engine-room, the House of Representatives and the Legislative Council Chamber may be illuminated with the new light within ten days or fortnight after the electric plant is landed at the wharf.

All the numerous rooms in the Parliamentary Buildings are not to be fitted with electric lamps in the first instance. Only those actually used for legislative purposes are to be first fitted with the Swan lamps, also the large new corridor, better known as the members "lobby," and probably also, the bookcase and new dining room. Other rooms will have to wait their turn, the first consideration being to get the main state of the building. The mode of illuminating the Council Chamber is to be by a number of skylights placed about central glass reflectors radiating downward, but by a number of small lamps fitted rather low in modern pendants thereby resembling gas-jets, and producing an ease of eyesight, no intense central glare. Not only the customary arrangement of jets, more brilliant than gas, and diffusing a pleasant whitish illumination in all parts of the large chamber. This convenient distribution of the electric light in small jets or "glow lamps" is the perfection of quality which Edison, Swan, and other inventors sought so long to

Hims per year, the annual cost of the electric light, including interest on original outlay, will be equivalent to gas at 75 cents per 1000.

For domestic lighting the Edison system commends itself especially to the attention of householders; for, with the electrolizers and the brackets manufactured by this company, the wires are entirely concealed, and there are no noxious gases given off to vitiate the air and tarnish the metal bangings of the room, and no smoke to blacken the walls and ceilings. Table lamps are also manufactured and in use, which are connected by means of a flexible cord to the chandelier, and can fill any purpose now occupied by the drop light. Meters are also used; these are virtually electrolitic cells. Each meter contains two cells, in each of which are suspended two zinc plates. One one-thousandth of the current used in the house is diverted through the first cell and one six-thousandth through the second. By the laws of electrolysis a current of a given strength will deposit a fixed amount of zinc per second. As the zincs are carefully weighed before using, the accumulation of zinc on the negative pole shows the exact amount of current used in the house. The second cell is a check upon the first. As these cells might be placed in position where the sulphate of zinc solution would be frozen, an automatic arrangement is provided which will meet this difficulty. It consists of a bimetallic spring made of brass and steel. This spring is set at 100°; the coefficient of expansion of brass being greater than that of steel (that is, the brass expands or contracts more quickly than steel), any change of temperature will tend to produce a curve in this spring and thus force the coil against a contact piece, throwing into circuit an Edison lamp beneath the cells; by the slight heat produced from the lamp the mixture in cells is heated above freezing point; this heat also acts on the spring, which gradually straightens and thus shuts the GO? is reached contact is broken and the lamp thrown out of circuit. Thus no part necessary to the completion of the Edison system, appears to have been overlooked by its originators, and the system now stands before the public perfect and complete in all its parts.

Hartford Daily Courant, Aug 3, 83.

The American Electric light system which is in use in this city is to displace the Westinghouse. Messrs. Rowland and Harris, who are attempting to introduce the Edison Incandescent light in this city, have had a canvass of the city made to ascertain the probable amount and distribution of the light required. The necessary data are now being worked out and will shortly be ready for the examination of those intending

which, and now that each separate lamp can have its current turned on or off with a small key, without affecting the other lamps which the same connected circuit, every condition of safety seems to be satisfied. The new light is, in fact, simpler to control, is certainly safer, and is cheaper than gas. It is also steadier, and a glare is as subdued as not to be unpleasant, even when the eyes are near, as when the light is used for nice operations in a workroom or at a writing-desk.

Siemen's dynamo machine is to be used as the electric generator in connection with Swan's lamps. The generator differs from Edison's dynamo, now used on the premises of the Government Printing Office, though it is on the same fund with mechanism for regulating the balance of light when any one-half the lamps in a connected circuit are suddenly put on, or shut off the main current, thus producing a jump until the regulator restores the average degree of illumination. Suppose 20 lights to be used in a building, that only a few are "lit," and that suddenly the whole number are turned up for immediate requirement, the result would be to diminish those few which were being first used, and to reduce the intensity of light required for the whole, just as if the main tap at a gas-meter were turned half down, thus reducing the pressure connected with it. The regulator applied to a dynamo will control the strength of an electric current in the same degree, or shut it off altogether. This can be done without varying the speed of the engine which drives the generating force, and which must be kept up to a certain speed so long as any lamps are in use. It is well understood that the electric force, or energy, supplied to a circuit is not consumed, but that it is not usually done; because of the imperfections which in theory exist, a waste which cannot be prevented with the present comparatively low efficiency of electric mechanism.

It is a pleasing fact in this connection that Mr Leonard has had a small electric apparatus fitted in his private residence, this being the first application of the new light for domestic purposes in this colony. He has adopted Swan's lamp and Siemen's generator, the motive power being a small gas-engine. The engine just placed in the Government Printing Office for the new light is driven by steam, and is 12-horse power. We believe the Gas Company offered to supply gas to Ledges for the use of the engine, but Mr W. J. Rowe, the agent for Edison's Company, has absolutely refused to supply it. Many lights are required, because, as he puts it, the engine's resistless power is applied to more than if driven by intermittent explosions of gas.

Boston Advertiser April 17.

Electric and Gas Lighting.

An interesting meeting of the Society of Arts was held last evening at the Technology building. The subject of electric light as compared with other artificial lights was considered in its practical and economical aspects, so far as scientific principles might illustrate it. Professor Crocker, of the institute, delivered a lecture, with a large number of illustrations, on the subject. Mr. Edward Atkinson, 20 Broadway, Messrs. Hayes, and Nie, Julius of Pall Mall, spoke, the two latter gentlemen representing the Edison Electric Light Company. Mr. Atkinson claimed that the price of gas light as one of the indispensable lights of the world was to be reduced one-half. Mr. Julius, in a paper read by Professor Crocker, claimed that each lamp in special use and chemical action was necessary. The great difficulty which was said was favorable to the incandescent, was the breaking of the carbon in the vacuum, and it was claimed that wires, both for arc lights and incandescent lights, may save, ingeniously be carried under ground.

Hartford Post, June 9. 83

THE EDISON LIGHT.

Meeting Last Evening to Consider the System in Relation to Hartford.

Some twenty-five or thirty gentleman met by invitation in the Charter Oak building last evening, to consider the Edison incandescent light with special reference to the possible formation of a company for its introduction in this city. Mr. L. J. Hendee was made chairman and Mr. G. B. Hubbell clerk, and at the suggestion of Mr. G. M. Bartholomew Mr. F. S. Hastings, treasurer of the Edison company, was invited to explain the system.

Mr. Hastings began with a statement of the difference between the arc and incandescent light laying particular stress on the absolute steadiness of the latter and its economy of distribution of light. The matter of safety was discussed, and it was said that the fire risk was less than on buildings otherwise lighted, and that as far as danger of personal injury was concerned the full force of the current might be received without injury and with no more than a moderate shock. The possibility of fire comes only from a short circuit and this is first prevented by the manner in which the wires are run and secondly by the insertion of fusible plugs which on receiving the force of the current are instantly melted and the current interrupted. To those who have seen the lights in operation the description of the lamp itself and the light furnished is unnecessary. To those who have not it may be said that it consists of a pear-shaped glass globe about 4½ inches in height, exhausted of air, into which is sealed a filament of carbonized bamboo slightly thicker than a horse-hair. This filament, becoming incandescent by the passage of the current of electricity through it, emits a beautiful, soft, white light, absolutely steady and constant, and equalling in intensity, or exceeding if desired, the illuminating power of a gas jet of the best quality. The lamp is screwed into a socket which is permanently attached to a gas or other chandelier or bracket, and contains a key whereby the light in the lamp may be turned on or off. The lamp, once screwed into the socket, needs no further attention or care until the carbon breaks, when the old lamp is unscrewed from the socket and a new one screwed in, the work of a few seconds. The lamps vary in the number of hours which they will burn, but their average life, at sixteen-candle power, exceeds 600 hours of actual burning. Each light is entirely independent of the others, and may be placed in any position whatever, inverted or otherwise. Each may be turned off separately without any damage, the dynamo being provided with an automatic regulator which controls the flow of the current to the demand made on it. In the earlier forms the same object was secured by using a resistance coil at the dynamo, and tell-tale lamps which indicated the demand made on the current, so that the engineer could throw on the amount of resistance needed.

Much of Mr. Hastings address was given to the commercial aspect of the question, and was supported by exact figures taken from actual practice, which apparently made a very favorable impression. The method of furnishing the light was also explained at length. Where a central station is used the first step is to make a close canvas of the district to be lighted, so as to ascertain the amount of light needed. The arrangements are made on this basis, the wires run usually to every house, and then light is furnished to whoever wants it. The charge is about the same as for gas, but sometimes less. It is made solely according to the actual consumption which is determined by a meter. Wherever such a station is established all supplied from it have a steady, beautiful light that is not trying to the eyes, that can be turned on or off exactly like a gas burner, that does not heat or corrupt the air, and that is paid for not at a fixed monthly rate but according to actual use. The lamps can be put on existing gas chandeliers or brackets in such a way that either light can be used.

Mr. Bourn, of Smith, Bourn & Co., who have had the light in use in their shops for the past season, was present and spoke very strongly in its favor both as to economy and quality. Dr. J. Hammond Trumbull, Mr. Bartholomew, Mr. A. H. Olmsted and others of those present made statements or asked questions in regard to the light, and after some general discussion and a vote of thanks to Mr. Hastings for his address the meeting adjourned.

Metropolitan (London) April 5, 81.

Electric Lighting for Domestic Purposes.—On Thursday afternoon, an interesting exhibition of electric lighting took place, under the auspices of the British Electric Light Company (Limited), in the large hall of the Palace Chambers, Bridge-street, Westminster, the object of the gathering being an inspection, with the aid of practical illustrations, of Mr. Lane Fox's system of lighting and apparatus applicable for domestic use. The visitors, who were received by the directors of the above company, including the chairman (Mr. Joseph Hubback), were numerous, and included Mr. Shaw Lefevre, M.P., Lord and Lady Penrhyn, Lord Rae, Sir Charles Bright, Lady Frere, Lady Allen, Sir James M'Garel Hogg, M.P., and Lady Hogg, Sir Henry and Lady Green, Mr. Barty Mitford, Mr. Street, R.A., Sir G. Dasent, Lady Stanley of Alderley, Mr. Fitzroy Campbell, Admiral Sir E. Sotheby, Admiral Sir E. Inglefield, Sir A. Borthwick, Mr. P. W. Clayden, Colonel Peters, Dr. Leigh Adams, Major Harding, General Hyde, Colonel Woodhull, Mr. and Mrs. Spottiswoode, Mr. Ponsonby Fane, Professor Frankland, Professor Adams, &c. The hall was pleasantly lighted by groups of small incandescent lights, altogether 15 in number, worked by a Gramme machine; and the system was explained minutely and with great perspicuity by Mr. Lane Fox, many questions being interposed and replied to during the progress of his remarks and experiments. The "Lane Fox" lamp, it may be added, is almost identical with that of Edison, Swan, and Maxim, having several important additions on the method of distribution and regulation, the result of many years' labour. The British Electric Light Company have the sole rights in Mr. Fox's patents. We hope to be able to allude at greater length to this subject on a future occasion.

JULY 7, 1883.

THE METROPOLITAN.

Gas, Water, and Electricity.

House-Lighting by Electricity.—An exceedingly able and instructive article on the subject of electric lighting appears in the current number of the *Nineteenth Century*, and for all practical purposes affords the ordinary reading public a vast deal more information than they would ever be likely to obtain from nine-tenths of the host of so-called text-books which, in the course of the past three or four years have been published on every side. Now that electricity has forced itself upon public notice in so practical a shape, most people will desire to make some acquaintance with its principles; indeed, those who claim in any way to belong to the educated classes, will scarcely be able to avoid the necessity of acquiring, at any rate, a general elementary knowledge of this very interesting, but most complicated science. It is for the information and instruction of such that the present paper has been prepared. The author (Lord Bury) has written not for experts, but for householders, and has dealt with his subject in a singularly competent manner. The article consists in the first instance of an account of the model provisional orders devised by the Board of Trade, with such explanations of the same as seem to be necessary, and a very concise summary of the inquiry before a Committee of the House of Commons, which preceded the passing of the Electric Lighting Act of last year materially facilitates a correct appreciation of much which follows. A man can go down into his cellar and read off upon his gas meter the number of feet of gas that he has consumed. This at present is by no means the case with electricity; manipulation of an electrical meter and even the reading of it cannot be efficiently checked by the ordinary consumer unless he elects to tax his brain for the defence of his pocket. In plain, simple English, and without resorting further than is absolutely necessary to any of those "crack-jaw" words which amateur electricians especially are so fond of introducing, Lord Bury describes the conditions on which the electric light is to be supplied, and the mode of measuring and charging for the same. The terms "volts," "ohms," "amperes," &c., are clearly and intelligibly explained, and seeing that these expressions occur in stating the "unit" of measurement as defined by the Act, the desirability of a proper understanding of a phrase which so touches the consumer's pocket will be at once apparent. The article deals also in a very impartial spirit with the question of the cost of electric lighting, and includes some valuable notes for the guidance of those who may be deliberating whether they can advantageously set up at their country houses separate installations of electrical machinery.

Metropolitan, (London), Sept 8, 1883.

The Sun Electric Lamp.—Several references have appeared in these columns to an installation that was recently completed at the South Kensington Museum by the Sun Electric Lamp and Power Company. The installation consists of forty sun lights of 1,200 candle-power each, which have been fitted in seven of the picture galleries in the two Jones' Bequest rooms and in the reading-room. The Lampe Soleil was fully described in this journal in the course of last year, but it has since undergone at the hands of M. Clerc, the inventor, a considerable amount of modification and improvement, and of the lamp now used at South Kensington, we are enabled to give two illustrations. The lead-

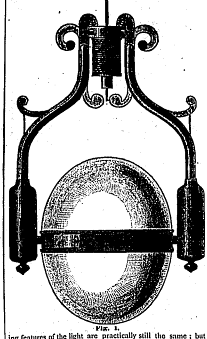


Fig. 1.

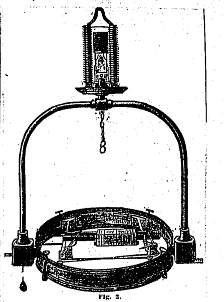


Fig. 2.

ing features of the light are practically still the same; but in respect of several important points of detail, most material alterations have been made. The extent and nature of these alterations can only be seen by comparing the lamp of last year with that which we now describe and illustrate. An important portion of the light is, as before, derived from the intense heating of the marble by the arc between the carbon points. Two short pieces of carbon, about three-quarters of an inch in diameter, are inserted, one on either side of the block of marble. The ends of the holes into which they are fitted approach each other within a distance of a little less than an inch. Into this intermediate space a short conical hole is bored, across the apex of which the electric arc passes, heating the surrounding marble into a bright incandescent glow. On starting the light, contact is made between the two electrodes by a small carbon rod inserted through one carbon, which is hollow. As this small rod is drawn back, the arc follows it until the entire arc plays between the two large electrodes. In the reading-room the light is inverted, and thus reflects from the wall and the ceiling. In this way a very comfortable, agreeably soft, and shadowless light is obtained. The Sun lamp, in the opinion of many competent judges, surpasses in steadiness any system in which the voltaic arc is employed. This result being due to the fixed and invariable position of the carbon rods, and to the additional constant light derived from the incandescent block of marble. The horse-power necessary to produce a given candle-power in the "Sun" lamp may be higher than that required for other arc systems, but the great economy in the consumption of the carbon should be a set-off against extra engine-power. Of the accompanying engravings, Fig. 1 is a general view of the lamp, and Fig. 2 shows the mechanism. The carbon rods one of which is solid and the other drilled—for the purpose as already explained, of allowing a small rod of carbon to be passed through, which makes contact with the end of the solid carbon, and which being withdrawn, either by hand or automatically, forms the arc between the two carbon rods—are placed horizontally, and as they consume they are gradually pressed forward by means of springs (easily traced in the figure) and which make short-circuit in the

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lamp when the carbons have been pushed to their distance limit. A safety switch is mounted on the upper portion of the lamp bracket, which comes into use in the event of any accident occurring to the working parts of the lamp, such as an entanglement and being unable to relight, the circuit is completed, and the remainder of the lamps on the same line are unaffected. Fig. 3 is a sketch of the carbon rods and the carbon pencil, which passes through the hollow one for the purpose of igniting and relighting. As mentioned above, this is either accomplished by pulling a string, lifting a weight or automatically by electrical means, and therefore it is quite unnecessary to enter into minute details as regards this portion of the apparatus. It is to be hoped that the illumination of a portion of South Kensington Museum with the forty lamps will terminate successfully, and that through this means the Sun Lamp and Power Company may be enabled to bring this very effective and attractive light into greater prominence than heretofore. The type of lamp devised for workshop and factory use is most simple, and must necessarily be extraordinarily cheap. It should therefore attract more attention amongst engineers, shipbuilders, mill-owners, and others of like pursuits, than it has yet had recorded.

Fig. 3.

The Electric Light.—A very considerable amount of interest appears to be manifested on the part of the general public in regard to this subject. We cannot say that there is anything particularly new to announce in addition to what has already appeared in these columns, but there are two or three matters having reference to the general question which may be of some interest at the present juncture. Concerning Edison's invention, the subjoined paragraph appeared in Thursday's *Times*:—

> THE ELECTRIC LIGHT.—A correspondent writes: "Electric lighting appears to have taken a decided step in advance—namely, the possibility of obtaining the brilliancy of any particular light in the circuit without waste of energy in doing it. I understand that a telegraphic intimation of this fact has been received from Mr. Edison, and is communicated to Monday's *News Letter* (Dublin) of to-day (Thursday). The telegram states on Mr. Edison's authority that each electric burner can be independently devised and brought to the utility of its element is obvious."

We can, of course, say nothing as to the grounds upon which these statements are based. We give the cutting for what it is worth. While referring to Edison's discovery, we may state that we have been favoured with a copy of the *New York Sun*, which contains an account of an interview with the inventor. Implicit reliance must not, of course, be placed upon statements made at interviews of this character; but they are occasionally of use, as indicating the nature of the particular experiments with which further information is desired. The following is an extract from the article in question:—

> "In being mentioned concerning the articles of incorporation of the Edison Electric Light Company, recently filed with County Clerk Anderson, of this city, Mr. Edison said that they proposed to light the city, public buildings, and private residences with electric light, and the electricity would be made by an or more factories on the Edison system of the city. Instead of manufacturing electricity at one central point, as gas companies make gas, there would be a number. Each station would have an engine and several electric generating agencies. "You know," put back and forth. Therefore, each station will have one grand return wire, with separate wires will connect, thus forming the complete electric circuit. I think that the engines will be powerful enough to furnish light to all houses within a circle of half-a-mile. We could lay the wires right through the gas pipes, and bring them into the houses. All that will be necessary will be to remove the gas burners and substitute electric burners. You may have a bright light or not, just as you wish. You can turn it down or up, just as you please, and can shut it off at any time. No match is needed to light it. You turn the cock, the electric connection is made, the platinum burner catches a proper degree of heat, and there is your light. There is neither blaze nor flame. There is no escaping nor discharging. I do not pretend that it will give a much better light than gas, but it will be softer and steadier than any known light. I do know now that it will be cheaper than gas. It will give no fumes nor smoke. No carbonic acid gas will be thrown off by combustion. It will be a great thing for composition, engravers, and all forced to work during but summer nights, for it will there not hardly any heat. Shades may be used the same as shades were employed, but these will be for use not necessary for heat. The wind cannot blow it out. There can be no gas explosions, and no one will be suffocated because the electricity is turned on, for it cannot be turned on without lighting the burner. A person may go to sleep with a gas flame lighted, and never awaken except in eternity." "How long since the conception of the idea?" I asked. "Well," Mr. Edison replied, "I have made no attempt to discover a name. I know that it can be measured, but it may take some time to find out how. I suppose that a man pays so much for so many burners whether he uses them or not. We find that this works an injustice, why I shall try to get up a meter, but I fear it will be very hard to do it." Mr. Edison says that electric generating machines could be placed upon steamboats and locomotives, and the boats and cars lighted by the action of the engines, but the instant that the machinery stopped the lights would go out. He thinks that it may be necessary to have an extra engine in each station in cities, to be prepared for accidents. If the first engine should break down, the second one could be used to feed the lights. Country towns, with the use of the electric generating machines, could be lighted by water power. Any power could be used, provided it was strong enough to turn the shaft of the machine with the necessary rapidity.

Later on, in the same article, the reporter says:

> The Professor then exhibited an electrical generating machine. It is what is known as a Gramme machine. A knot of engineers crowded the cylinder facing each other. Wires were attached to it. Mr. Edison turned the crank with his shoulder, and the engine moved. In his manipulations he began to turn the cylinder. He touched the point of the wires, and a small piece of metal near the cylinder caught, and there was a flash of blinding white light. It was repeated at each touch. "It is the most intense power I ever saw in an electric light," he said. "But how do you utilise the light? was the next inquiry. "Oh," replied the Professor, "that's a question with a pleasure. In an adjoining room a single key was placed in one of the three ordinary keyholes in one of the walls and turned a little. Two of the burners attached to a hanging chandelier in the centre of the room immediately glowed faintly, and as the key was turned still further around the glow increased, until a brilliant and perfectly steady white light was obtained, equal to the light of twelve ordinary gas-burners. The key was then turned in the reverse direction, and another of the lamps was lighted up. In the same way the fourth and fifth burners were lighted, and there resulted an exceedingly brilliant white light, yet so soft and steady that it did not pain the eye. The lights were easily turned to any desired degree of brilliancy—from that of a mere spark to that of a light ten times the intensity of the common gas jet, that being the maximum power of the lights in use. The experiment of the facility to easily fit up lights with a thirty gas burners. By a very simple "switch" in the wall the current of electricity is divided and subdivided to supply any number of burners desired, the electricity reaching the switch from the generator through a single wire. The switch has the faculty also of regulated to any degree, merely by turning a key, which operates upon the switch in the wall. Mr. Edison, in explaining the working of a number of patents, one of which is the points of their new electric switch now in use, the property of a joint-stock company, recently introduced into Paris, and which is in use in the Grand Opera House. He explained the establishing of central stations in various parts of the city, from which powerful electric generators will supply the necessary electricity. The company claims to be able to supply the electricity at one-fourth the cost of ordinary gas. The difficulty of a meter has been overcome by the invention of a meter which will record the number of burners used in any given house, and the number of hours each burner is lighted. The measurement of the electricity used would involve such complicated and delicate instruments that the time plan has been adopted.

As we have before remarked, the Government appear to be devoting considerable attention to this subject, and accounts reach us of trials at Woolwich and Portsmouth, accounts which are rightly informed, have yielded results which, to say the least of them, are eminently encouraging. Information of importance also reaches us from the provinces, all tending to show the desire that exists in all quarters to render the electric light an article of practical public utility.

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Sept. 15, 88.

Improved Street Lighting.—information reaches us from Bristol of a most interesting experiment of carrying out in that city on Tuesday evening last, for the lighting of the streets by the employment of reflectors for the gas lamps, the result, as we are informed, being the production of 50 per cent. more light with a less consumption of gas. It appears that, owing to a suggestion from the Corporation when the scheme of electrical lighting was under discussion, Mr. R. Kirk, the gas engineer to the Corporation, turned his attention to the means of improving the present system without involving any extra consumption of gas; and, as we understand the particulars furnished to us, he has succeeded in obtaining the object in view by the following means:—Dealing with the present burner, which consumes five cubic feet of gas per hour, and is in general use throughout the country, he divides the light into two jets, each consuming 2½ ft. of gas per hour, and thus leaves the actual consumption unchanged. Between these two jets placed in each street-lamp, he suspends a double convex lens, forming a powerful reflector, and, by competent calculation, the result is found to be an increase of lighting power to the extent of 50 per cent. Ordinary bat's-wing burners are used, and the only care required to insure a perfect light is a nice adjustment of the suspended lens, so as to get the right focus and the full reflection of the light. When this is obtained, we are assured that the jets, even at a distance, are very brilliant, and have the appearance of globes of light. We are told that they illumine the footpath between each lamp with much of the effect of the electric light, while the divided jets give ample light also to the roadway. A special feature of the system is the long distance to which the light is thrown from each lamp, and at 150 yards, it is asserted, the light backed by the reflector is very powerful: compared with the ordinary street lamp, while a slight increase in the size and capacity of the burners has a surprising effect. In two or three instances Argand burners were tried; the light was more steady, but showed little improvement on the ordinary bat's-wing burners which, it appears, are found sufficient in all practical purposes. We understand that the gas engineers of Corporations in other provincial cities have been more slow—waiting the result of the bristol scheme, and several letters had been received from their engineers asking for information of its practical adoption. The plan was considered undoubtedly a success, and will probably be adopted very largely in the streets of the city.

The Electric Light at a Distance.—A correspondent informs us of an interesting and successful practical experiment that was recently carried out at Saratoga Springs, New York, for testing the extent of the illuminating power of the Maxim Electric Light, and if the particulars forwarded to us are only approximately correct, the results obtained, to say the least of them, are eminently encouraging. It appears that the experiment was made in operation over the Grand Union Hotel. An open parabolic reflector was used—no lenses—and care was taken by Mr. Maxim to set the points of the carbons a little on one side of each other, and to adjust them exactly to the focus of the reflector. After having been accomplished, the light was turned toward a spot in Bulmer Spa, New York, 74 miles distant, where, by previous arrangement, a group of several hundred persons were assembled to witness the experiment, which the result, as we are informed, that the place was instantly illuminated in such a way that ordinary print could be read, the time seen on watches, &c. The night, it is stated, was clear, still, and dark. The experiment was made at about half-past nine o'clock in the evening.

The Metropolitan, London, February 19.

Electric Lighting on Waterloo-bridge.—Last evening, the experiment of lighting this now much frequented thoroughfare by means of electricity was carried out with most successful results. Shortly after six o'clock, Mr. Drummond Brady, the Metropolitan Board of Works' Mr. Keates, the consulting chemist to the Board, and several other gentlemen more or less interested in the progress of electric lighting, assembled at the temporary shed on the Embankment adjoining the Charing-cross Railway Station, where the apparatus is fixed; and, after inspecting the arrangements made for the employment of the additional lamps on the bridge, exactly at half-past six o'clock when in popular language may be termed the day was applied, and instantly the roadway of the bridge was brilliantly illuminated. An electric light was provided alternately with the gas-lamps, and additional lamps were brought into use and placed at a considerable height in the centre of the roadway. The effect was most satisfactory in every particular, and the crowds that assembled loudly testified their appreciation of the improvement on the old mode of things that the light effected. It was particularly noticeable that the *façade* of Somerset House came out in quite an artistic style. It may be mentioned that the engine now employed in the shed at Charing-cross is the same one of 20-horse power supplied by Messrs. Ransomes, Sims, and Head, of Ipswich, as was used at the commencement of the experiment on the Embankment for only 10 lights. It now supplies the motive-power for no less than 55 lights, and when the arrangements have been completed for lighting up the offices of the Metropolitan Board of Works by this means will serve 60 lamps.

Metropolitan, July 80.

Electric Lighting on Shipboard.—A very successful application of the electric light has been exemplified in the Gravesend on the 24th ult. for Australia. The installation consists of a Gramme machine, generating the current, by which seven incandescent lamps are worked. Four of these are fixed in the main saloon, and the remainder in the steerage, where this mode of lighting is a great desideratum. The lamps are placed in series, but a resistance coil and automatic switch renders each independent of its neighbour. Several spare lamps are carried, which can be worked from one to a Gramme arc lamp, which is contained in a special lantern fitted with a reflector. This will be used when intimating power of the large lamps is 2,000 candles, while each of the small incandescent lights is about 20. The superintendence of Mr. Killingworth Hedges, C.E., the installation has been carried out under the auspices of the British Electric Light Company. The extension of the lighting to the other parts of the ship, we are informed, will be completed on her return.

Electric Lighting at Railway Stations.—Progress is slow, but in our opinion none the less sure, towards that perfection of the electric light which most people would desire to see. The value of the light itself for lighting large spaces has been fully established, and chiefly to extensive areas its use has hitherto been confined. At the present time, however, the attention of a large number of illuminating railway stations is on its trial at the Aldersgate-street, on the Metropolitan Railway; and should it prove satisfactory to the directors it will lead to a great improvement, inasmuch as similar means of illumination will be employed at several of the other underground stations in London. A number of gentlemen interested in the experiment met on Tuesday evening at Aldersgate-street Station, where the arrangements for producing the light were shown and explained to them by Mr. M. Fenton, secretary to the railway company; Mr. R. Godfrey, engineer to the Electric Generator and Light Company, Mearnsie-street; and Mr. C. F. Varley, whose firm (Messrs. Harding and Co., Paris) manufacturing the apparatus for producing the Lontin light. That is the light used at Aldersgate-street, where eight lamps give a light vastly superior to the old gas system. In this respect the railway authorities are quite satisfied, but they wish to know the comparative cost of the electric light as cost as compared with gas. The Electric Generator and Light Company state that the present brilliant illumination of Aldersgate-street Station can be maintained for as little cost as was incurred by the old-fashioned flare gas lamps, and should the railway company be satisfied with less brilliancy, than the cost would be less than that of gas. The engine which works the electric machine, however, is of much greater power than is actually necessary for its present purpose; but the Electric Generator and Light Company have hopes that it may be utilised to help in producing electric lights, not only for Aldersgate-street Station, but also for Moorgate-street and Farringdon-street Stations, for Smithfield-market, and the Great Western Goods Station under it, and for the Midland Goods Station. Our readers will remember that a few months ago the Lontin light was applied at the Coiety Theatre, but since that time, we are told, it has been improved in various details. Its chief advantages are the low speed at which its machinery works, thus reducing wear and tear, risk of accidents, and overheating; the readiness with which the light can be divided; and the production of alternate currents. The number of different circuits which one machine can generate, and the number of separate lights obtainable from each circuit are only limited by the size of the machinery. A valuable feature in the invention is that each light can be regulated or put out without affecting the others. The lamp is an important part of the apparatus. It is also known as the Serrin, with Lontin modifications. Those at Aldersgate-street Station need the carbon renewing every four hours, but by an improvement lately made carbon sufficient for 8 hours can be supplied. In two respects, at least, these lamps are commendable. They neither show changing tints nor cast the shadows of the carbon sticks within. It is claimed, moreover, that the light they give is steadier than any other. As the light was seen on Tuesday night at Aldersgate-street, certainly little remains to be desired as far as brilliancy, steadiness, and softness are concerned. The exhibition indeed was very interesting. The electric lights were extinguished and the gas turned on to the customary extent, and it is hardly necessary to add that the contrast was very striking. Then—the electric lamps having been re-lighted—the gas lamps were lowered without any perceptible difference in the brightness of the premises. Next a circuit was extinguished, the remaining lamps being left burning, and then one lamp was lowered, each other member of the circuit shedding its light undimmed. It was stated that the eight lights cost 1s. 2½d. an hour, although we presume that this is only an approximate estimate. There are thirty-six gas lamps burning at the station when the electric light is not in use, each consuming 5ft. an hour; that is to say, costing roughly 9l. an hour. The Metropolitan Company, however, appear to be of opinion that the increased brilliancy cast over large areas would make up for the extra expense, and that a larger diffusion of the light would render it relatively cheaper; and, moreover, improvements are now in progress aimed at cheapening some of the appliances, and which may, it is thought, reduce the cost of production. Our readers will see from the particulars above detailed that this subject continues to occupy the most earnest attention of scientific men. On every occasion when an experiment of this kind is undertaken, further improvements of some kind are shown bringing us on every occasion, it is fair to presume, nearer the result so devoutly wished for.

Metropolitan, Feb. 5th.

The Brush Electric Light.—We had intended this week to give a full description, with illustrations, of the Brush system of electric lighting, but pending the receipt of certain statistics with reference thereto, with which we had hoped to be favoured before now, we are compelled of postpone any further reference to the subject until our next issue.

tion at one or more lamps, or, indeed, their removal altogether, does not affect the others except (if the machine be driven at the same speed) to make them brighter, but by driving the engine slower, and therefore using less steam, the same initial degree of illumination can be maintained in each of, say, fourteen lamps, as if all the sixteen were in operation. The great simplicity of the Brush lamp consists in the fact that the feed is actuated by gravity alone, while it is controlled solely by the influence upon a bar of iron of a magnetic field, the intensity of which varies with the strength of the electric current passing through the lamp circuit. The general external appearance of two forms of Brush regulators is shown by the accompanying engravings, for which we are indebted to our able contemporary, *Engineering*. Fig. 1 represents the single

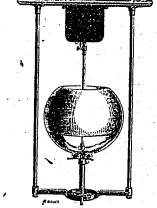
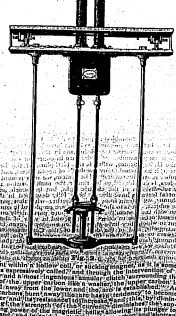


Fig. 1.

carbon or eight-hour lamp; and Fig. 2 the double carbon or sixteen-hour lamp, with the glass globe removed. In both these lamps, which are designed for general illumination, the lower carbons are fixed, and as they burn away the upper carbons follow them, so the arc gradually descends; but for certain special installations, such as lighthouses, or for purposes of projection, a focus-keeping arrangement has to be applied. Like most of the modern electric lamps, the upper carbon descends by its own weight until it sets the lower carbon, and the circuit is thereby completed; the effect of this in the lamps we are describing is to cause a soft iron plunger to be drawn to a more or less



in position. The foregoing description is necessarily given in somewhat general terms, but it is probably sufficient to convey an idea of the nature and purposes of the lamps in question. All who are familiar with the great difficulties which hitherto have appeared to be almost insuperable from the burning of several lights in a single circuit, will know that a number of regulators constructed in the manner described, and with no other complication or contrivance, would scarcely be capable of burning uniformly in a single circuit, and it is on account of the simple and ingenious method by which each lamp controls itself independently of the action of all the others in the circuit, and yet dependently on the strength of the current in that circuit, that constitutes the merit of the originality and the great perfection of the Brush regulator. The carbon points employed are, being solid rods, about 8 in. long, and are electro-plated with a thin covering of copper; they are, in fact, about eight times as heavy as those used for the ordinary arc lamps, which weigh about 9l. in. of the positive and about 4 in. of the negative carbon are consumed. When, however, the lamps are required to burn for a longer period double carbon lamps are employed, fitted with two pairs of carbon holders, as shown in Fig. 2, and each is controlled in the same way as in the single carbon lamp, but the controlling apparatus is not duplicated. When the lamp is put into action the arc is formed between one of the pairs of carbons, and when they have burnt out the other pair automatically starts into action and continues to burn until it is in turn consumed; in this way the time of burning is doubled, and in order to extend the period of burning, it is only necessary to employ a lamp with a third pair of carbons, when it will be capable of illuminating for twenty-four hours, each additional pair of carbons extending the period of burning for another eight hours. The Brush system of electric lighting, we may add, in conclusion, is remarkable as being, we believe, the only one which is capable of maintaining a large number of large arc lights in a single circuit, and it would be difficult to over-estimate the great value of this distinctive property for the purpose of public illumination. Under other large arc systems each lamp must have a separate machine, and there must, of course, be as many regulars of leading wires as there are lamps and machines. It possesses also another very special advantage, and that is that a series of lights may be maintained by the Brush system at a great distance from the machine, and with a remarkably small loss, and this is of especial advantage where several lights have to be employed, because if there are as many long conductors as there are lamps, then the whole of the loss of current due to the resistance of the cables must be borne by each lamp; whereas if a number of lights can be included in a single circuit, the loss of current from the resistance of conducting cables is equally divided among all the lamps in the series. With respect to this part of the subject, it is an interesting fact that the sixteen lights which are now in regular use for the illumination of Charing Cross Railway Terminus are actuated by a machine working in the Anglo-American Company's works in Lambeth, and that within a few weeks a large area of the City of London will be illuminated by the same system by four lamps, all actuated by one circuit by a machine working in the Lambeth works. On a future occasion we hope to be able to describe at length the arrangements for this important adaptation of the light for the lighting of our public thoroughfares; but from what is given above, in addition to what has previously appeared in these columns, we have our readers will consider us fully justified in the observation with which we opened—that this light, having successfully passed the experimental stage, has now asserted its right to be placed among the practical lights of the day.

MAY 6, 1882.

THE METROPOLITAN.

THE Gulcher System of Electric Lighting.—Although at the late Electrical Exhibition at Paris the system was awarded a gold medal, it has remained until within the last few days comparatively unknown. Mr. Gilcher, however, has since been engaged, we understand, in improving his system in various particulars, and now that it has been formally introduced to the notice of the public, we anticipate that its undoubted merits will speedily obtain for it that attention and recognition to which it seems to us justly entitled. A demonstration on this system has been effected at Messrs. Ransome's works, in King's-road, Chelsea, and, in the light his here been in operation for several weeks past, an opportunity is afforded of judging of its practical value. Messrs. Ransome—who, by the way, assure us that they have no interest whatever in the system beyond a desire to light their works efficiently but economically—report themselves eminently satisfied with the result of the experiment so far, and on the occasion of a private view on Monday evening, by a number of gentlemen interested in the subject, the lighting was unquestionably all that could be desired. There are altogether eight 100 lights of about 2,500 candles each, and they burn with extreme regularity, not the least flickering being perceptible. The current is supplied from one of Mr. Gilcher's improved dynamo machines, which absorbs nearly 14-horse power, and three of Swan's incandescent lamps are also introduced, with the view of showing the adaptability of the system to other methods of lighting. Mr. Gilcher's dynamo is of peculiar construction, the leading principle being, however, the production of a current of low tension and great quantity. The lamps in use are of great simplicity, and burns for over seven hours without the carbons being renewed. Among the advantages claimed for the Gilcher system are that the light produced is clear white, without the green tinge which peculiar to some lights, tension current; that the regulators, in consequence of their great simplicity, can be produced at a low price; that of the lamps inserted in circuit, any required number can be extinguished and re-lighted without influencing the working of the other lamps or requiring any other apparatus; that the required power of the dynamo-electric machine is proportional to the number of the lamps being lit at any time by it; that the insulation of the conductors may be simple, and, finally, that the service of the lamps while working, and also the teaching of the appointed parts of the conductors by inspectorial parts of the body, is found to be all designed. Mr. Gilcher apparently succeeded in satisfying all those assembled at Messrs. Ransome's works on Monday evening that his system really does possess these advantages.

ANOTHER ELECTRICAL EXHIBITION.—It is announced that an international electrical exhibition will take place shortly at Munich, in which all the appurtenances exhibited will be constantly at work in sight of the public. Gramme machines will be used, the machine power being obtained by means of a natural waterfall situated more than three miles from the Public Garden, wherein the exhibition will be held.

HOLMES'S ELECTRIC LIGHT AND MOTORS.—In the Common-room at the Capitol Palace, on Wednesday evening, Mr. Holmes, the representative in England of Mr. Edison, delivered a lecture, before a crowded audience, upon the subject of Mr. Edison's efficient light and motors. In doing so he illustrated with the aid of dissolving views the construction and working of the machinery necessary for the production of the electrical current by supplying light and power to dwellings. The experiments were made with a view to showing its simplicity, and also its perfect safety. Care is taken, it was pointed out, to keep the wires perfectly insulated, while if they should by any accident become partially subjected to the earth no damage would be done. The ballasting is entirely extinguished, and no harm would result. By a judicious distribution of the electric as well as by a number of incandescent globes hung from the balcony. At a given signal these lights were all turned down almost to vanishing point, like the sunlight at the theatres when a "dark" scene in a melodrama is to be presented. Again peculiarities these were not only turned on and off at will, but whole clusters were simultaneously lighted and relighted by touching of an ordinary electric switch. The perfect safety of the new illuminant was strikingly illustrated by the lecturer. Placing a piece of gauze over one of the globes containing a sixteen-candle light, he proceeded to smash the glass with a hammer, and the result was that the light was extinguished without scratching the material. The current itself, it was affirmed, could be safely applied to the eye-lights, might pass through the human body without the slightest harm being done. In many cases people who had tried the experiment were unable to feel the slightest shock. The working of Mr. Edison's motor for measuring the electricity supplied to houses was next explained. Mr. Edison's system of working machinery by electricity was shown in practical operation, and a clock log of wood was quickly sawn lengthwise in two in half. Proceeding to deal with the subject of Mr. Edison's electric railway, the lecturer showed a portrait of the locomotive in contemplation upon the three miles which have been completed. With the exception that no fenced was to be discovered, the engine was very similar to those in use upon the American railways, was carried on two-cabins and all complete. The inventor, it was stated, was engaged in perfecting the apparatus, and had expressed it as his opinion that in a few days it would be fully entirely experimental upon open railways. In conclusion Mr. Johnson said a few words upon the subject of Mr. Edison himself, and the kindly criticism of which he had been the recipient. Something had been said about his selling his shares in electric lighting and other companies and is only devoting in gas shares. It happened, however, that Mr. Edison had in such matters one of the most simple-minded of men, and had never bought or sold or had any interest in any gas shares. As to his selling his shares in electric lighting companies, it was not until the last few months that he had busied with any of them, and then he had given up those as he expenses of his great establishment that which he had undertaken to supply the whole world with electricity.

Metropolitan, Aug. 25, 83.

ELECTRIC LIGHTING AT THE FISHERIES EXHIBITION.—On Wednesday night some important and striking additions were made to the electric lighting of the International Fisheries Exhibition. The chief feature of the display was the Hockhausen lamps on the north end in the open ground of the gardens, and placed at an altitude of 120 feet, with an effective candle power of 50,000, the effect of the cluster of six stars was surprising, and is said to have established for a full harvest moon, being distinctly visible in many parts of London, even as far as Clapham-junction and Holloway-park. Another feature was the efficient lighting of the Canadian court, by a few lamps of 2,000-candle power each and of which are admirably suited for the study and library.

The Metropolitan (London) Daily, 88.

ELECTRIC LIGHTING IN THE CITY.—Much regret has been expressed at the announcement by the directors of the Maiden-Westall Company of their intention to discontinue for the present the lighting of that portion of the City which for some years past has been so successfully illuminated by means of Wetton arc lamps. The reason given by the company for this decision are based solely on the question of expense, it being very reasonably pointed out that it is but impracticable for an electric company to maintain a centre and staff to light a few arcs, and it would be for a gas company to do so profitably. Until, therefore, the Commissioners of Sewers extend their operations to allot of the City in less sections in accordance with the terms of their advertisement issued in October last, "the ordinary gas lamps are to be substituted for electricity in the area originally assigned to this company." Such a course can be dealt, however, but even a temporary suspension of the present mode of lighting will prove an exceedingly unpleasant and considerable alteration to those who have occasion so be in the City after dusk. Of late Queen Victoria-street has become perhaps the best lighted thoroughfare in all London, and it will be felt by most people that the present brilliant illumination should not be displaced by the more ancient but less efficient system of gas lighting. If by any reasonable means so undesirable a change can be avoided. We understand that the question will be raised at the meeting of the Court of Sewers on Tuesday next, and it is of course possible that arrangements may be made for a continuance of the electrical illumination.

DOMESTIC ELECTRIC LIGHTING.—Thurston House, Bromley, the residence of Mr. Swan, is lighted throughout with electricity, and forms one of the most interesting private installations yet made. It is, we believe, the first complete mansion, every room and corridor being lighted by the current: even the coal cellars, and the stables, have still been in use all commanded by small switches suitably placed so that a person entering a room, or leaving it, can at once light up or extinguish going and darken it on leaving again. The switches for this purpose are placed near the doors either outside or just within. There are between sixty and seventy lights on the premises, including two in the lodge-house. They are supplied by two Otto gas engines, each of 3-horse-power nominal, but capable of developing 5 horse-power. Each drives a Siemens continuous current dynamo of the smallest size, and from these Sellon-Volckmar accumulators are charged for an hour before the lighting begins. These accumulators serve to supply such lamps when wanted, the two dynamos only supplying thirty lamps when running on them alone. The accumulators can be kept partially charged by a bye circuit while the machines are running. They maintain the extra lamps required on special occasions, and also yield occasional lights during day. The engines consume 7 cubic feet of gas per hour, and this expended in gas lighting would give thirty gas jets of 15 candle-power; but the electric lights are rather over 15 candles (they are 20-candle lamps), and the light is far more pure, agreeable, and healthy.

ELECTRIC LIGHTING.—The Special Committee of the House of Commons, presided over by Mr. Holmes-Heath, to whom numerous provisional orders of the Board of Trade were referred, commenced its sessions yesterday, resuming on Thursday the consideration of Provisional Order Bill, No. 8, relating to the Brush Electric Company, including Sudeley, Mayfair, and Covent-garden districts. The question at issue was whether the Jablochkoff Company should be allowed to enter the district under a seven years' license granted to the Swan and Edison Companies, who are admitted by the provisional order. It was understood that the Board of Trade and the Local Government were in favour of the admission of the Jablochkoff, and that the two companies had come to an arrangement whereby they were to participate. —Mr. Jones, on behalf of the Jablochkoff Company, submitted to the committee that the local authority should have the right to determine how the district should be lighted. Evidence in favour of the admission of that company was given by Mr. Seaman, agent of the Duke of Bedford, owner of Covent-garden; Mr. Reeves, secretary and manager of the company, who stated that it is intended to light Covent Garden Theatre next week with the Jablochkoff and incandescent lights; Mr. Clarke, one of the managers at Messrs. Shoolbred's, who declared that the Jablochkoff light had worked extremely well since the establishment for two years, and was easily superintended; and Mr. Hill, the oldest member of St. James's vestry, who stated that all his colleagues whom he had spoken to were in favour of the admission of the Jablochkoff. The Telegraph Construction and Maintenance Company, evidence was given to show that were time given for the admission of that company, electricity could be supplied by them at the rate of 5s. for light equal to the illuminating power of gas, as compared with 10s. 6d. of the other companies.—Mr. Andrew Chubin, of the firm of Coutts and Winfrey, and Mr. St. Martin, secretary of the Junior Carlton Club, gave evidence in favour of that company. The committee adjourned.

The Metropolitan, April 21, 88.

ELECTRIC LIGHTING IN CLERKENWELL.—At a meeting of the Clerkenwell Vestry, held on Thursday evening a report was presented by the Special Purposes Committee stating that they had had under consideration a letter from the secretary of the Maiden-Westall Electric Lighting Company, a position of which letter was as follows:—"According to an interview our managing director, Mr. H. Watt, recently had with the Clerkenwell Vestry, we have pleasure in calling your attention to the lighting of your district with our electric system, and, judging by the favourable opinion then expressed that a change from the inefficient to the new lamps would be desirable, I am desired to request that you will kindly present to consideration at an early date of the incandescent ones you have now in use; these, being each of 20 candle power, would give five times more light than a wax candle of 4 to the pound. The charge for the 'size' would be 4d. per week for the incandescents, subscribers to use as long about 1s. Of course your lamp, the same as the company's expense, and could be turned on and off at will." In a reply to the company the chairman of the committee (Mr. Yates) had pointed out that, although the Vestry had sanctioned the laying of the St James's Company in the City of Portsmouth-road by incandescent lamps of specified power, the company had generally failed to comply with the terms of their agreement, and that, therefore, the committee would be perfectly justified in refusing the Vestry to sanction the extension where the company desired to open. The company, however, seemed to have recognised the failure of the present system, and now made an offer to supply to are lights of great power at 4d. per hour, in place of the incandescents hitherto used in Portsmouth-road. As this offer seems increased safety, and as the incandescent system had been generally a failure, and the lights had not united that the company should give the Vestry the benefit of the incandescent. The secretary of the company subsequently wrote stating that he was desirous to the substitution of "arc" for "incandescent" lamps now in use in Penton-street, and that "duplicates were quite prepared to make the change at once, and to charge the same rental as for the incandescents." At the meeting of the Vestry on Thursday evening, Mr. Yates, after expressing surprise that the Vestry was in no way pledged to the adoption of the system, after the expiry of the present one, moved that the proposal of the company be agreed to.—Mr. Bowyer seconded the adoption of the report, and the motion was agreed to unanimously.

ELECTRIC LIGHTING AT THE HOUSE OF COMMONS.—The electric lighting experiments at the House of Commons were the subject of much discussion in the House on Tuesday evening. Mr. Colonel Alexander Churchill, Mr. Shaw-Lefevre (the Chief Commissioner of Works), and Mr. Edison Holmes, M.P., had their say in light the Directors and Engineers of the House experimentally all the rest under at the same time, at a cost slightly above that of gas for the same period, and which worked out at something under £100, they supplying the plant. Mr. (Mr. Lefevre) thought that the interval of sessions was too short to offer without entering into any further obligation to the system, with respect to the future he would, towards the end of the Session, consult the wishes of members before making any permanent arrangement. In the present state of electric lighting he did not think it could be adopted by competition. After careful consideration, he did not think able to act on this principle when he introduced the 3-wire system of lighting into the Law Courts.—Lord H. Churchill, having also inquired whether, before the Law Courts were lighted by the Swan Company, tenders were received from the Siemens, Edison, and Swan Companies, Mr. Shaw-Lefevre said that he had invited the Swan Company to light the Law Courts, and had not received tenders from the other companies. He added in reply to Viscount Folkestone that it was not intended to introduce the electric light into the House itself.

Metropolitan, (London)
October 21, 82.

Electric Lighting Conferences.—In consequence of

communications having been received from various parties, light companies intimating their intention to apply for provisional orders to enable them to supply the electricity in the various districts in South London, the Vestry of Camberwell have just issued invitations for a conference of South London Vestries to be held in the Vestry Hall, Peckham-road, on Tuesday, the 31st inst.

Electric Lighting at Chiswick.—Mr. Woodhouse and Chiswick.—It will not be long before the electric light makes its appearance in most of the London suburbs. A deputation (Mr. Woodhouse and Mr. Rawlinson on the Solway Court Estate at Richmond are to be electrically illuminated, and the arrangements for carrying out the same will be settled in the same way. Bedford Park, in the neighbouring parish of Chiswick, will also be electrically lighted shortly.—*Local.*

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Metropolitan, Nov. 82.

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ingly regret that the exigencies of space render it altogether impossible for us to publish at any length to-day the very interesting and instructive address delivered by Dr. C. W. Siemens at the Society of Arts, on Monday evening, on the subject of electric lighting, but its general features may perhaps be briefly stated. After an opening allusion to the general principles which govern electric lighting, Dr. Siemens gives precise data for the belief that the establishment of electric lighting over the towns of Great Britain and Ireland would absorb a capital of £800,000,000 sterling; but that the manufacturing appliances required in order to produce work representing this value of machinery and, of what must necessarily be the result of many years of technical development. On these grounds alone, he believes that the ambition of the various electric lighting companies is in excess of their powers of performance; and that for some time to come they must be regarded rather as specific lative than as practical undertakings. He did not afford any information as to the scope for improvement which may exist in arc regulators and in the manufacture of carbons for incandescence; but he stated that the existing dynamo machines restore, in the form of electricity, ninety per cent. of the power expended in working them, and also that they will again restore ninety per cent. of the first energy in the form of motive power derived from the electricity. On the question of the probable cost of setting up a system of electric lighting, Dr. Siemens, who previously had been content to state his opinion, has now taken the opportunity afforded by his address to state the data on which it is founded, and thus to render it far more open to criticism than before. He believes that his conversion to a quarter of a square mile, densely populated, is as large an area as can be conveniently and economically covered by a single "installation." He selects St. James's Square as a type of such an area, and supposes that the central establishment should be situated in the open portion of Trafalgar-square. Proceeding on a density of occupation of the above nature, which would be required, of the number of lights the necessary conductors, of the cost of the engines and dynamos, of the expense of laying the conductors, and of sinking the mains, the author arrives at the conclusion that the annual cost of a sixteen-candle incandescent lamp would be just below 22s., its equivalent 20s. for the same amount of light from an Argand burner. On the other hand, he admits that the prime cost of the gas plant for providing the same amount of light to the same district would not amount to more than £80,000, as against £177,000 for electricity; and hence that, supposing the two systems to be equally efficient, the annual interest on the former would be a large advantage on the side of gas in the matter of prime cost, and a large advantage on the side of electricity in the matter of annual maintenance. He further admits, however, that none of the figures cited can be safely regarded as a panacea for the various requirements of things; and that in the face of the improvements, both in the manufacture of gas and in the use of electricity, which every day may be expected to bring forth, it is hardly possible to say more than lay down them. The data and calculations embodied in the paper are such as to render it eminently deserving of the most serious consideration of those interested in the subject, while the opinions and conclusions of so eminent an authority as Dr. Siemens on the above electrical topic will command attention.

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Electric Incandescent Lighting and Apparatus.—

We are informed that a special engraving of an incandescent lamp in respect of which Messrs. Paterson & Cooper have recently obtained provisional protection, with a few carbon filament of high resistance placed in a glass bulb from which the air has been exhausted, the ends of the said carbon filament being connected with platinum or other wire, leading to the terminals of the lamp, through which the electric current is conveyed to the carbon filament. Speaking of the disadvantages of the present incandescent lamps, Messrs. Paterson & Cooper state:—"The production of the vacuum in the bulb is a difficult matter, and causes the greatest part of the cost of the lamps used in the manufacture of these lamps. Moreover, an absolute or perfect vacuum cannot be obtained therein. A further disadvantage attending the use of carbon filament is the smallness of the amount of light which can be obtained therefrom, as it cannot in practice be raised to true incandescence or a white heat because of the volatilisation of the carbon which would occur at such a high temperature. And the intensity of the electric current employed for the production of the light must, therefore, always be comparatively present and to the endurance of the lamp, but not by no means satisfactory, as the lamp will be very quickly destroyed by any slight increase of the current. By this present such lamps cannot be worked in series, as the extinction of one lamp will break the circuit, and all other lamps in the same circuit will be extinguished at the same time." All of these difficulties Mr. Werdermann claims to have overcome in his improved lamp, which is constructed as shown in the accompanying drawing. Fig. 1 represents one form of lamp, in which *a* is the carbon pencil as it is kept in contact with a carbon of metal electrode of larger cross sectional area *b*, by means of a spring *c* or other equivalent device, or other suitable liquid, to prevent the combustion of the carbon pencil between the drained distance, upon the end of the latter a collar *e* of asbestos or magnesia, in such a way that the pencil can be conveniently and economically renewed by a single "installation." He selects St. James's Square as a type of such an area, and supposes that the central establishment should be situated in the open portion of Trafalgar-square. Proceeding on a density of occupation of the above nature, which would be required, of the number of lights the necessary conductors, of the cost of the engines and dynamos, of the expense of laying the conductors, and of sinking the mains, the author arrives at the conclusion that the annual cost of a sixteen-candle incandescent lamp would be just below 22s., its equivalent 20s. for the same amount of light from an Argand burner. On the other hand, he admits that the prime cost of the gas plant for providing the same amount of light to the same district would not amount to more than £80,000, as against £177,000 for electricity; and hence that, supposing the two systems to be equally efficient, the annual interest on the former would be a large advantage on the side of gas in the matter of prime cost, and a large advantage on the side of electricity in the matter of annual maintenance. He further admits, however, that none of the figures cited can be safely regarded as a panacea for the various requirements of things; and that in the face of the improvements, both in the manufacture of gas and in the use of electricity, which every day may be expected to bring forth, it is hardly possible to say more than lay down them. The data and calculations embodied in the paper are such as to render it eminently deserving of the most serious consideration of those interested in the subject, while the opinions and conclusions of so eminent an authority as Dr. Siemens on the above electrical topic will command attention.

Metropolitan, Oct. 82.

The Dangers of Electric Lighting.—The very pro-

fessional letter of Mr. Montague Hemming, Asst. of the Phœnix Fire Office, published in the *Times* a few days ago, should go far to remove any misgivings in the public mind as to the supposed danger of the electric light. In the course of the past three or four years, during which period this new means of illumination has been brought more prominently under the notice of the public, several fires and accidents have been reported from various parts said to have been caused by some employed for electric lighting purposes, and many persons, not practically acquainted with the subject, were not unnaturally impressed with the idea that any such use of electricity was necessarily attended with some danger. In certain quarters, and for obvious reasons, this idea was fostered and encouraged by every possible means, and the opposition were considerably helped by the announcements that were issued by some of the insurance offices as to the conditions under which they were prepared to accept what were described as electric lighting risks. Experience, however, has demonstrated that with ordinary precautions certainly no more danger is to be apprehended from the employment of electricity than from gas, and the nature of the precautions stated in Mr. Hemphy's letter to be necessary in order to reduce to a minimum the risk of life are typical of the facility with which all danger may be provided against. Indeed, some of the safeguards, suggested form just and parcel of more than one of the Home Insurance terms of electric lighting. But the concluding paragraph of Mr. Hemphy's communication will, perhaps, be deemed the most reassuring. After alluding in highly commendatory terms to the care taken to prevent fires by some of the electrical companies, he observes :—"In order to prevent any unnecessary alarm in the mind of the public, I may state that all my experience so far has not caused me to alter in any way the opinions contained in my former report, viz.:—That where systematic and proper precautions are taken there is less danger from electric lighting than from gas." My very fairly be trusted to look after their own interests, and when the confidential adviser of such an undertaking as the *Phœnix* publicly expresses himself in language so decided as to the safety of the new illuminant, if only employed under proper conditions, the public will be well able to estimate for themselves the value of any statements issued by interested parties to the contrary.

Electric Lighting in London.—We are informed that the Metropolitan (Brush) Electric Light and Power Company have sent notices under the Electric Lighting Act of last Session to every local authority within the Metropolitan Postal District, intimating their intention to apply to the Board of Trade for provisional orders to authorise them to supply electricity for public and private purposes.

Electric Lighting Conferences.—In consequence of communications having been received from various parties, light companies intimating their intention to apply for provisional orders to enable them to supply the electricity in the various districts in South London, the Vestry of Camberwell have just issued invitations for a conference of South London Vestries to be held in the Vestry Hall, Peckham-road, on Tuesday, the 31st inst.

Electric Lighting at Chiswick.—Mr. Woodhouse and Chiswick.—It will not be long before the electric light makes its appearance in most of the London suburbs. A deputation (Mr. Woodhouse and Mr. Rawlinson on the Solway Court Estate at Richmond are to be electrically illuminated, and the arrangements for carrying out the same will be settled in the same way. Bedford Park, in the neighbouring parish of Chiswick, will also be electrically lighted shortly.—*Local.*

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The Metropolitan, (London,) Oct. 82.

Gas Making in Paris.—The Gas Company of Paris are now laying in the principal streets of central Paris new gas mains, one meter in diameter. The process is peculiar, for the mains are composed entirely of sheet-iron tubes, which have been rolled in hot bitumen, mixed with fine gravel. When cold this covering is said to possess a very hard consistence, and protects the sheet-iron not only against deterioration, but against oxidation, even in the most humid soil.

The Cost of Electric Lighting.—We cut the following from an article, which appeared in the *Daily News* yesterday, on the cost of electric lighting :—

Without pretending to have plitched upon the very best system, we may confidently assert that the cost of estimate for supplying light by the new Pernnyl process is far from being the worst. If quiet can supply the light more cheaply, so much the better; but the following estimate for "house-to-house" lighting by the process named compares favourably with all others.

Estimate for electric lighting by Pernnyl system, with 2,000 incandescent lamps, each of one-candle power :

I.—Preliminary outlay—	
1. Dynamo machines	£1,200 0 0
2,000 lamps at 5s. each	500 0 0
2,000 sockets	100 0 0
Switches	25 0 0
Indicators	8 16 0
Fixing, packing, starting, &c.	300 0 0
Installation	25 0 0
Laying mains, and wire	£2,158 16 0
Station and machinery house	1,000 0 0
Engine of 200-horse power	500 0 0
Insulators, &c.	50 0 0
Total capital outlay	£3,708 16 0
2.—Annual cost—	
10 per cent. of this total for interest and depreciation	£370 17 0
Salaries of engineer and assistant	400 0 0
Engine fuel, 3lb. per horse-power per hour's work	150 0 0
Lamp renewals	100 0 0
Sundries	1,000 0 0
	25 7 0
Total cost per annum	£2,050 0 0

There is nothing so familiar as gas to take as a basis of comparison, and we may proceed to place this annual cost of £2,050 for the illumination. Reckoning the week at 25 hours, and giving the same per diem for each week, it appears that the 2,000 lamps five hours would require the consumption of 250,000 cubic feet of gas per week. At 3s. per thousand cubic feet, this would cost 37s. 6d. of sheet gas per week, or about £2,500 per annum, which is not as much as the cost of electricity is above specified. Hence, if gas is taken at its actual price, and the Pernnyl estimate of cost, cost to the Corporation, without address for officials, collection, and so forth. The electric light, nevertheless, gives an idea of economy can be done in the way of producing artificial light on a large scale. Were we to detail the estimate for the electric light on a large scale, few items, say 100 instead of 2,000, would be saved, for it is a rapidly diverging item. It is, on the other hand, the estimate would be additionally in favour of the new electric light were many more lamps served from a single source. If, indeed, we suppose that the total cost of popular electric light to be supplied hardly-paid out that the same as large as those which are now in use, when it is supposed to be, Until the gasometric principle is now light from a single station, the dynamo representing the central work in both cases (called "prime"), a fair understanding of the matter in the case of the electric light, but there will be difficulty to arrive at.

The Statist, May 19, 1883.

Electric "Sun" Lamp and Power Company.—The issue of £20,333 which has been paid up upon the 7,000 shares subscribed for by the public in this company has not proved sufficient to enable the Board to complete the central station at South Kensington, the Grosvenor Gallery, and Regent-street, which is being carried on by the Edison Electric Light Company. The Board, however, have decided to issue the remaining 3,000 shares at par, and the result is that the whole of the capital has been fully satisfied in issuing the company with ample capital for eight lamps on condition on the part of the Board to oblige the directors to hasten matters as far as possible. Of this the directors have called up £10,000, they had power to call £15,000 at their discretion, and they had also power to call £10,000 more if they should think it necessary. The directors have already been paid, £1,000 for their services, and they could compel the vendors to take shares to the amount of £5,000 in cash or shares. If not paid in cash by the vendors, they could compel the vendors to take shares. The Board have, however, shown them such liberality that they apprehended no difficulty from them.

Metropolitan, May 19, 83.

Opening of the Electrical Exhibition in Vienna.—The International Electrical Exhibition in the Rotunda at Vienna was opened on Thursday by the Crown Prince Rudolph, who was accompanied by the Count of Flanders, the Prince of Portugal, the Emperor's cousins, Philip and Albert, and many foreign and local princes. Although in the scientific section there was not much to see in broad daylight, a number of lamps had been lighted in it to show the manner in which the basement and the various rooms showing the applications of the electric light in household uses were prettily illuminated. Besides scientific displays, dining-rooms and bedrooms, there is a kitchen with an Electric range and oven, and a boiler-house, in which the engine represents a deep blue sky, upon which electric lamps shine as the stars, and where, by the way, Turkish pastilles are to be manufactured. Numerous features. The theatre, with its fover, dressing-rooms, and auditorium, is large enough for any provincial town. Opposite the stage is a box containing apparatus for producing any so-dead effect of lightning on the stage. The princes gallery are brilliantly lighted by three arc lights. O the pavilions in the Rotunda the finest are those of Siemens & Halske and Trenchi, with a complete collection of all the telegraphic apparatus in use, and a large plan of the telegraph system of Paris. The English fog warns have a very unsatisfactory exhibition. There is little beyond the simplest telegraphic instruments, and those not many of these. In the machine department there are fine specimens of dynamo-electric machines of every kind; and the Gramme dynamo for lighting purposes. Gaiu's enlosed machine, which combines a steam engine and a dynamo in one, is regarded as very powerful. The exhibition will not be opened at night until the 20th, when it is hoped all will be in readiness.

Metropolitan, May 26, 83.

The Electric Light at the Reform Club.—An Edmundson and Vincent dynamo is used to drive twenty Swan lamps, lighting one bay of the kitchen, hall, and fifteen bedrooms. Twenty-four Swans have a ground glass bulbs, lighting one end of the dining-room. The lamps are fitted with Edmundson's perfect swallows, and have to be to perfection the beautiful designs of the carved and richly-gilded cornices, centres, and walls of these magnificent apartments. The usual illumination is by oil and paraffin lamps, so that the contrast is marked. The motive power is supplied by a table engine, which rests merely from the foundation of the club, and has long been in use for the purpose of pumping water from the Club's cistern well in favour of a modern horizontal engine.

The Sun Electric Lamp.—Last week we mentio above we described the Sun electric lamp, which was then introduced to public notice. Since that time several improvements have been made in the detail construction of the lamp, and the manufacture and application upon a practical scale have now been fairly entered upon. The Electric Sun Lamp and Power Company have established a factory at Bloomsbury Mansions, Edgingham-street, Regent-street, where a large party assembled on Friday evening to inspect the works and the various processes of manufacture. The visitors were received by the chairman of the company, Mr. J. A. Berly, C.E., the engineer to the company.

The Australian Electric Light Company have extended its operations to North Melbourne and other suburbs of the Victorian metropolis. Two of the Brush-control arrangements, in addition to the Opera House and several shops, are now being worked by the company, and other contracts are in course of execution.

The Statist, (London,) May 26, 83.

Electric Sun Lamp and Power Company.—A general meeting of the shareholders of this company was held on Wednesday, when the chairman stated that the directors had been proceeding to distribute had previously decided with the committee of allotment had been fulfilled, and would justify operations which were at that time and which were now before them. He the licensee they had been fully fortified in launching the company with ample capital for eight lamps on conditions on the part of the Board to oblige the directors to hasten matters as far as possible. Of this the directors have called up £10,000, they had power to call £15,000 at their discretion, and they had also power to call £10,000 more if they should think it necessary. The directors have already been paid, £1,000 for their services, and they could compel the vendors to take shares to the amount of £5,000 in cash or shares. If not paid in cash by the vendors, they could compel the vendors to take shares. The Board have, however, shown them such liberality that they apprehended no difficulty from them.

Metropolitan, June 2, 83.

The Newington Vestry and Electric Lighting.—An estimate has been furnished to the Vestry of Newington by the Electric Carbon Carbrge and Apparatus Manufacturing Company of Scotland of the cost of the electric lighting installation. Commencing at the Angel, and although it does not so appear from the figures before us, we presume the company are prepared to provide the plant and carry on the lighting for the amounts stated. The estimate is for an installation, at Angel-corner, of 16-candle power and 50 incandescent lamps of 50-candle power each, giving a total candle power of 28,800 candles. The initial cost of the whole plant is estimated by the company at £10,140, and the annual cost of maintenance at £4,656. The reason, assuming that electricity was charged for at the same rate as gas, and assuming also only 5,000 lamps to be in constant use, is stated at £4,177 per annum, showing an excess of receipts over expenditure of £521, which would enable the loan for the plant to be paid off within 15 years. The Vestry's own estimate of the first cost of the installation was £20,000, and the annual receipts showed an excess over the expenditure of only £83.

Electric Lighting at the Fisheries Exhibition.—Some particulars have already appeared in these columns of the arrangements for the electrical illumination of the Fisheries Exhibition at South Kensington, and although we can tell the story before the lighting approaches completeness, there is no uncertainty that it will ultimately form one of the most extended and most interesting shows of the kind. Most of the well-established systems are amply represented, while on the other hand there is a total absence of unknown names from the list of exhibitors. The fashion which distinguishes this show from previous ones is, that instead of the various systems being massed in a large hall, where the effect of the whole was blended into one great glare of light, each will have its own special building, and can be there disposed in the best way to show off its special advantages. The exhibition is so extensive that this is readily possible, without sinking the mass afforded to each, while the great diversity in the form and dimensions of the building renders it easily possible to find suitable accommodation for the display of all sizes and varieties of lights. The main ventilate is to be illuminated by 500 incandescent lamps supplied by Messrs. Woodhouse and Rawson, and by Mr. Maxim. Elvinstone and Vincent from two of their dynamos. At the end of the vestibule, where a short flight of steps leads into the British Sea Fisheries Section, will be seen the magnificent exhibit of Messrs. Siemens Brothers, with their Swan lamps will be displayed upon the underside of the principals of a roof 600 ft. long. Messrs. Siemens Brothers also exhibit their dynamo machines, of which each of the two principal varieties, which were supplied in parallel circuit instead of in series as has hitherto been the case, will be employed being at the Alexandra Palace, and being most without any modification whatever. The range of refreshment rooms to the left of the fine gallery will be lighted by twenty-eight Lever are lamps, fed by two Ditgin and two Gramme dynamos. The passage leading to the right, past the shelter and the Palace of Water Pavilion, is to be occupied by Mr. Mattheson, whose lamp has lately been established at the Aquarium, where it was severely handicapped by the insufficient supply of steam. Branching from this passage to the left, the machinery will be running which will be illuminated by 85 Gulcher lamps, arranged parallel, and to the right the Edmundson and Vincent lamps will be supplied by the Electrical Power and Light Contract Agency by six Westinghouse dynamos of the same pattern as those at present in the promenade gallery, in which will be found the only striking specimen of the Anglo-American Brush Company's system. Mr. Mr. Edmunds, who further provides 500 incandescent lights in the western gallery, and 500 in the Conservatory, and on the upper terrace a light is to be seen at work, as also in Middle-square, where 20 hanging arc large lamps of 2,000 candle-power each, and 100 incandescent lamps, will illuminate the usual resort of the concerts of three owners in the States, and will be seen at work for the first time in this country. The Crystal Palace Company, which intends the garden at the side nearest Queen's-road, to be lighted by electricity, will probably be supplied by Messrs. Siemens Brothers dynamos, while the adjoining building will be supplied with eight arc lamps of the same pattern as those in the Conservatory in addition to the installation we have already mentioned, will have twelve lamps in the Spanish section, and four Crookes lamps in the building, in which are included the countries of the Eastern Pacific. The almost concludes the list, and we have only to note twelve Gerard lamps in the Russian Section, seven Lea lamps in the Fish Market, and two Hawkes lamps at the entrance to complete the catalogue, as far as it is at present determined. Messrs. Crosfield and Orlikd are to have twelve stations for the demonstration of their method of distribution by secondary generators, but at present their situation and extent are not fixed. There has been a great deal of holding back among the exhibitors to see what their competitors would do, with the result that the whole installation is behindhand.

Metropolitan, May 19, 83.

Electric Lighting in London.—The St. George's Vestry (Hanover-square) agreed, at their meeting on Thursday, to the application of two companies—the Swan Electric Lighting Company and the Metropolitan Electric Supply Company—for the use of the streets for the purpose of electric lighting. The committee appointed to consider the scheme (of which Sir Arthur Blomfield is the chairman) reported that the difficulty which had arisen with the Swan Company as to the indemnity had been overcome. They were also to state that the Metropolitan Company had made no applications for a fresh area (as shown on a plan, dated 9th May, by the clerk of the parish) to the west of Bond-street, to Park-lane, including Piccadilly, and down to the parish bound in St. James's-street; the applications being for a portion of Old Bond-street and the whole of Piccadilly within the area; portion of the latter to be lighted by the same system of electricity as that in parallel to the west of Berkeley-square. The amount necessary for the whole area of schedule A is estimated at £8,000, to cover all expenses, and of this the company will give security for £4,000 (50 per cent.).—Mr. Livingston, the surveyor, states that the Swan Company propose to light all the portions of the parish in the in-wards part of Grosvenor-square or Piccadilly, and from the south of Berkeley-square to Cubitt-street, Belgrave. Along the Hanover-square district, the company also included in their Schedules A and B the whole of the out-wards south of Berkeley-square, with the exception of a small portion between Lupus-street and Vincent-square, and that in the district about Victoria-station.—The report was adopted, and the clerks of Sir Arthur Blomfield were employed.

Miscellanea.—The new premises recently fitted up for the office of the *Pall Mall Gazette* in Westminster-street, Dublin, are to be lighted throughout on the incandescent system of electric lighting. The installation is to be erected by Messrs. Simmons, and will consist of 150 Swan lamps.

The Steamship *Tallyman*, belonging to the Union Company of New Zealand, is to be fitted throughout with incandescent lighting on the Swan system. This makes the fifth vessel belonging to the company electrically lighted; of the four previously fitted two are on the Aorangi and two on the Swan system.

Electric Light and Power Generator.—The report of the Board of Trade into the accident which befell the Maxim and Maxim systems of electric lighting; that the Maxim incandescent lamp had proved under experience all that the directors anticipated from it, in beauty, durability, and economy, while the Weston dynamo shows Mr. Crosbee, which were supplied to form a portion of the whole purchase under which only the Maxim patents for the dynamo and lamps could be secured, had, after thorough the practical tests, been proved to be equally satisfactory. In moving that the report be received, the chairman entered into a history of the company which was originally established for the purpose of working the Lontin patents, but the success of the Maxim had induced them to purchase the Weston and Maxim patents. The price asked for them was £100,000, but they succeeded in obtaining them for £70,000. The report stated that the advantages which had accrued to other companies from the arrangements they had at this moment thrown on their hands, and brought to might say that something like £500,000 would be saved to the company in a short time from these. Mr. Crosbee, their consulting electrician, had lately become a director of a new company which had secured a lamp, an invention of his. That lamp was offered to this company, but they were advised not to purchase it until they had had opportunities for testing its powers of endurance, and these opportunities were not afforded. They had been expecting his resignation. He was receiving from them a salary of £250 a year, and was engaged to them for two years. They proposed to establish small local companies, with or without convenience, as opportunities occurred, who would pay them a royalty for their patents. On the motion of the chairman of the company, the name was changed to "The Maxim-Weston Electric Company (Limited)."

Metropolitan, London, Dec, 82

Chelsea and the Electric Lighting Question.—This question was considered at the meeting of the Chelsea Vestry on Tuesday, amongst the members present being Sir Charles Dilke, M.P., Sir Henry Gordon, K.C.B., and the Hon. Conrad Dillon. The Vestry had under consideration the notices received from several electric light companies of their intention to apply for provisional orders for the district, together with an elaborate report upon the whole question by Mr. G. H. Stayton, C.E., their surveyor. The report dealt exhaustively with the recent progress in electric lighting, the Electric Lighting Act, the Board of Trade rules, the cost of the various systems, and suggested regulations and conditions. Mr. Stayton estimates the cost of a complete installation for Chelsea at £375,000, and of a limited but more practical installation at £85,000; but holds out no hope of the supply of electricity being at a cheaper rate than gas for some time to come, even if all the houses in the district were supplied, which is, of course, very doubtful. Mr. Stayton considers that local authorities would act wisely in pausing before committing themselves to a licence or provisional order, because the first outlay is necessarily enormous, and the financial risks and legal liabilities involved thereby are too great to be undertaken by a public body. The report concluded with the following recommendations, which were unanimously adopted:—1. That at present it is not desirable for the Vestry to apply for a licence or provisional order. 2. That it is not desirable to consent to any application for a licence until the draft shall have been submitted to, and has received the approval of, the Vestry. 3. That it is desirable to support the application of any company who may appear most likely to carry out the undertaking in a satisfactory manner, and who will agree to such of the suggested conditions as the Board of Trade may approve, and that the Electric Lighting Committee and the surveyor be empowered to enter into the necessary negotiations for effecting that object. 4. That the solicitors be instructed to watch the progress of the applications for provisional orders, and to take all necessary steps to oppose the same until satisfactory conditions are obtained.

The Newington Vestry and the Electric Light.—A numerously-attended meeting of ratepayers of St. Mary, Newington, was held on Thursday evening, at the Lecture Hall, Carter-street, Walworth, to protest against the proposed application to the Board of Trade by the Newington Vestry for a licence for the supply of electricity for lighting purposes, under the Electric Lighting Act of 1882.—Mr. R. D. Hilton presided.—Mr. Yates proposed the following resolution—"That it is the opinion of this meeting that the knowledge of electric lighting is not sufficiently advanced to warrant our Vestry in applying for Parliamentary powers to light the parish therewith at the ratepayers' expense, and that this meeting of ratepayers hereby calls upon the Vestry to rescind the resolution passed by them on the 1st of November, whereby they resolved to apply to the Board of Trade for power to adopt the electric light."—Mr. Robinson seconded.—Mr. Ivison pleaded guilty, as one of their representatives, to being one of the culprits in this matter, because he advocated the electric light. He had with him a report of the Sub-Lighting Committee of the Vestry, and in that report it was stated that the committee had found, on perusal of a report by the Vestry of Islington, that a proposition was submitted to that Vestry by an electric lighting company, when they invited tenders for lighting a mile of roadway in Upper-street, in which the company offered to substitute for sixty gas lamps of an illuminating power of 900 candles, twenty large lamps of an illuminating power of 10,000 candles, and to supply machinery, lay down the necessary wires, and bear the cost of maintenance on payment by the Vestry of a sum equal in amount to that paid to the gas company, provided the Vestry helped them to obtain a provisional order. This company he took to be quite as great an authority as Dr. Siemens. At present the Vestry had not decided how many miles they were going to light. They had only resolved to apply for the licence, and were not empowered to do more than this. Continuing at some length, amidst frequent interruptions, he asked whether they were satisfied with the present condition of the public lighting, and received a unanimous answer in the negative. He defended the action taken by the Vestry in the matter.—Mr. Maitland, as chairman of the Sub-Lighting Committee of the Vestry, pointed out that they proposed to apply for a licence only, not a provisional order, and this would cost them £200. Some half-dozen companies had given the Vestry notice of their intention to apply for provisional orders, and if the Vestry had not resolved to apply for the licence themselves, they would in all probability be put to the expense of attending by counsel before the Board of Trade for the purpose of getting proper clauses inserted in the orders, which would probably cost them £200 in each case. He contended that the Vestry were moving in the right direction, and were guarding the best interests of the ratepayers. The resolution was then put and carried with about seven dissentients.—Mr. High moved, and Mr. R. H. Cooke seconded—"That this meeting appoint a committee of the following ratepayers, with power to add to their number, to take such steps as they may think best in opposing our Vestry in their application to the Board of Trade for powers to adopt the Electric Lighting Act at the ratepayers' expense—namely, Messrs. Brazier, Dudley, Hawkey, Jenkins, Pullen, and Yates."—The resolution was unanimously agreed to, and the proceedings [illegible] closed with the usual vote [illegible]

Electric Lighting at the New Law Courts.—The contract for lighting the Courts of Justice by electricity was given to the Swan Company some time ago, but three weeks before the opening day it was decided that the light should be ready for the inaugural ceremony. As it was impossible to complete the original scheme of lighting it throughout with Swan incandescent lamps within the available time, six Crompton arc lamps of 3,000 candle power each were placed in the great hall instead. The fittings in the cloisters and approaches to the great hall on the ground floor, in the east and west spiral staircase, in the cross corridor, in the bar corridor, and in some of the courts, were so far advanced that the lamps were able to be placed in them. As the engines could not be supplied in time, a 60 horse power portable engine was fixed outside the main building. The whole installation is an example of extreme rapidity of execution. Within fifteen days a huge mound of rubbish was levelled, foundations laid, and the engine fixed. A line of 4-in. steel shafting, with all its bearings, couplings, and pulleys was manufactured and fixed in five days, five dynamos erected, and a house built over the whole. Inside the building four miles of main wires have been laid, and 300 sets of fittings for the Swan lamps made and fixed for the temporary lighting of the great hall and quadrangle. Nine sets of arc lamps and hoisting gear have also been made and fixed.

Corporations and the Electric Lighting Act.—On Tuesday a deputation of representatives from the corporations of many towns in the United Kingdom had an interview with the President of the Board of Trade, with the object of getting clauses inserted in all Electric Bills which would render it permissive, instead of obligatory, as at present, for corporations to use the electric light.—Mr. Littler, Q.C., said the corporations, although in many cases owners of gasworks, were not blind to the benefits of electric lighting, and were perfectly ready and willing to take steps to favour its introduction. They did, however, feel very strongly that they should maintain the principle of local self-government, and that they should be allowed to be guided by the wishes of their constituents. They did not desire to have companies compulsorily within their boroughs. Not that they did not want the electric light, but they wanted a discretion in the matter.—Mr. Chamberlain, in reply, said, looking at the Act of Parliament he thought it was the evident feeling of Parliament that no obstacle should be put in the way of the full development of electricity, and he did not think this would be done if powers were given to the local authorities to keep out possible competitors without doing anything themselves. The alarm felt by the corporations seemed to be exaggerated, having regard to the conditions under which companies were to be allowed to intrude. He thought the spirit of the Act would not be carried out unless the corporation undertook an obligatory order with regard to at least a portion of the district. If that were done, he saw no objection to a permissive undertaking with respect to the rest of the borough, but this permission must be subject to certain conditions. There was no possibility of a monopoly under the Act. He would, however, further consider the subject, with the views they had put before him.

May 26, 1883.]

THE STATIST.

Maxim-Weston Electric Company.—At the adjourned extraordinary meeting, at the outset of the proceedings, the chairman said he did not accept the figures in the circular recently issued by the managing director. He then read a letter received from Mr. de Kabath, general agent for the United States Electric Company, expressing readiness to join the Board of the company, and referring to the business of the United States Electric Company, and the immense progress made in New York in the past two years. The resignation of the Board was not accepted. The resolution passed at the last meeting increasing the nominal capital of the company to £500,000, by the issue of 327,500 shares of £1 each, was then submitted for confirmation. A discussion followed as to the liability of the shareholders in the event of the new shares being allotted fully paid at 5s., and the solicitor stated that the difficulty could be overcome legally by each of the shareholders signing an agreement to the effect that he had subscribed for the fully paid-up shares at 5s. each. The chairman put the resolution and declared it carried, stating that the directors would not increase the capital beyond £250,000 without further consulting the shareholders. The new shares would be issued at 5s. and allotted *pro rata* among the shareholders, and any balance not taken up would be offered afterwards to the public.

Metropolitan (London) Nov. 25, 82.

The "Ferranti" System of Electric Lighting.—An exhibition was given on Monday evening under the auspices of the Hammond Company, which, beyond all question, would seem to indicate a very considerable advance in the matter of electric lighting. Indeed, we doubt if in the course of the past five or six years any single invention has been brought under the notice of the public accomplishing at one bound anything approaching the real progress which it is asserted—and as it appears to us with good reason—has been achieved by the advent of the new dynamo machine, invented by Mr. Ferranti and Sir William Thomson. Our readers will perhaps remember that some two or three months back considerable interest was aroused in electric lighting circles by a statement of Mr. Hammond, made at a meeting of one of the numerous "Brush" companies, as to the capabilities of a new dynamo, with which the name of Mr. Ferranti was associated, and which it was said had then been practically perfected. The statement Mr. Hammond—if one may judge from the opinions publicly expressed in regard to it—was received in many quarters with some amount of incredulity; while among those interested in the financial success of the "Brush" subsidiary companies, the possibility of their "concessions" becoming in a great measure valueless was not unnaturally viewed with no little alarm. The "demonstration" given on Monday evening, however, in the arches beneath the Cannon-street Railway Station, in the presence of a large number of electricians, and others interested in the subject, certainly goes to show that, at any rate so far as incandescent lighting is concerned, Mr. Hammond was fairly justified in the statement he originally made. The "Ferranti" patents cover a continuous current dynamo machine, an alternating current dynamo machine, and an arc lamp. The machine employed for the purposes of the exhibition was that producing an alternating current. It appears that the attention of the makers is at the present moment being exclusively given to the production of this type of machine, in view of its suitability for running incandescent lights, and in consequence also of the want existing at the present moment of a low tension machine, capable of running satisfactorily a large number of incandescent lamps. The machine was running no less than 320 Swan lamps of 20-candle power each, and certainly in steadiness the illumination left absolutely nothing to be desired. This number of lights was obtained by an expenditure of about 27-horse power, including the power absorbed by a small exciter. This result, it will be observed, shows that about 12 lamps of 20-candle power were realised from each indicated horse power. If deductions are made for driving of counter shafting and engine itself, these results would be even higher. On examining the machine, one is struck with the very small weight of metal contained in the revolving armature. In most systems the armature is of very bulky dimensions, the result being that any endeavour to multiply the size of the machine would lead to the making of an armature quite unwieldy in its proportions. The great merit claimed for the Ferranti machine is that it is of such a construction that it can be enlarged to almost any extent with a corresponding increase in electrical results. We were assured on Monday evening that the machine then in use, can, with a trifling alteration, give 500 lights, and that a machine to give 2,000 lights, which is in course of construction, and which will be ready to be supplied at an early date, is only very slightly larger. The extent of the progress indicated by this invention may be further illustrated by a comparison of its general features and capabilities when in use with those of another form of dynamo machine comparatively well known. The largest "Brush" dynamo constructed weighs we believe about three tons, and will maintain 40 arc lights or 160 incandescent lights of 20-candle power each, absorbing 40-horse power. The Ferranti machine weighs 11 cwt., and will light 500 incandescent lamps, also of 20-candle power, by an expenditure of about 42-horse power. The latter machine, it is true, requires to be driven at a much higher speed than the Brush; but when it is stated that the revolving armature of the Ferranti weighs less than 20lbs. and that of the Brush 9 or 11 cwt., the advantage, it will be at once seen, is all on the side of the former. As already stated, the largest "Brush" dynamo yet constructed is equal to the maintenance of 160 incandescent lamps, but the large sizes of the new machine which the Ferranti Company have in hand, are capable of yielding 1,000, 5,000, 10,000 and 25,000 lights respectively. House-to-house lighting by electricity has hitherto not been attempted in England, owing in a very great measure to the prohibitory cost of dynamo machines of large size. It is stated that the large-sized Ferranti machines will be made so economically that this great difficulty will be entirely overcome, and that a great impetus will therefore be given to lighting over large areas. Any number of lights may be switched out without altering the speed of the machine, the consumption of horse-power at the pulleys being reduced in exactly the same proportion as the number of lights turned out. There are other points in connection with the Ferranti dynamo to which reference might be made as illustrating its improvement on other appliances of a like kind, but it seems to us we have already given more than sufficient to show that in the invention of this apparatus progress of an unmistakable order has been made. We are, of course, aware that in practical working the machine may not bear out in every particular the present claims of its inventors, but after the exhibition of Monday evening, and having had some opportunities of inquiring into the matter, we have no hesitation in recording it as our opinion that the Ferranti dynamo, if not accomplishing everything that might be desired, has, beyond question, immeasurably advanced the cause of the electric light as a convenient and economical illuminant for household purposes.

The Incandescent Electric Lighting Company, Limited, is the title of a new undertaking that was registered on the 15th ult., with a capital of £250,000 in £5 shares, to carry on the business of an electric light and power company. Mr. R. E. B Crompton is one of the first subscribers.

The Jablochkoff Electric Light and Power Company, Limited, has appointed the secretary (Mr. Francis R. Reeves) to be Secretary and General Manager to the Company.

The Gulcher Electric Light and Power Company, Limited, have orders for supplying electrical plant for lighting the Benares-bridge, now being constructed on the Ganges by the Oude and Rohilkund Railway Company.

Sept. 3, 1883.

American Gas Light Journal.

Mr. Edison to be a Business Man for a Year.—Mr. Thomas A. Edison is reported as having recently said the following to a representative of the New York *Daily Sun*: "I am going to be simply a business man for a year. I am now a regular contractor for electric light plants, and I am going to take a long vacation in the matter of inventions. I won't go near a laboratory. I have sold out my electric locomotive to a railroad company, who, I believe, are going to take up the thing and push it. At the expiration of the year I will renew my experiments at Menlo Park. The experiments will all be confined to electricity—no more phonographs or things of that kind. The more I think of that phonograph the more I am convinced that it would have been a terrible thing to set a machine at work recording all that a person said."

And the more we think of the manner in which the gas companies have been annihilated, since the introduction of the Edison incandescent lamps, the more ludicrous certain statements, made some *years* ago, now appear.

Electric Light for Arizona Mines.—It is stated that a number of mining companies in Arizona Territory are about to adopt the electric light, for the purpose of facilitating mining operations underground as well as on the surface. At the Silver King mine it is proposed to use four 3,000 candle power Brush lights above ground and two below, together with 25 small incandescent lamps. The dynamo located near the main shaft, will supply the current, descending 800 feet to the lower levels of the mine, to the arc lights and storage boxes, from which latter the Swan lamps are to be connected by small copper wires. Fixed lamps are to be suspended from the roofs of galleries, and the portable lights are to be attached to flexible conductors for convenience of shifting. These lights are to burn continuously, night and day. In the reduction works of this company both large and small lights are also to be used, a separate dynamo and two storage batteries supplying the current. The arc light circuit in the Silver King mine will be about half a mile in length.

Metropolitan, Sat. 28, 82

Electric Lighting at Birmingham.—The Gas Committee of the Birmingham Town Council have prepared an elaborate report on the relative advantages of gas and electricity, with special reference to the applications for lighting powers, of which notice has been given by various companies and persons. The committee, after full and careful consideration of the subject, recommend—1. That no application be now made by the council for authority to supply electricity in the borough or in any part of it. 2. That the council be authorised to oppose any application under the Electric Lighting Act or by special Act of Parliament. 3. That the committee be authorised to enter on negotiations with the companies applying for powers to supply electricity within the borough for the purpose of arriving at some terms or some sufficient provision for the protection of the council of the full control of the streets, for the adoption of suitable plans for the works, for the safety of the public, and for the inspection of the installations within a limited time, and for the limitation of the duration of the concession. 4. That, subject to satisfactory conditions being arranged with the companies in this way, the committee be authorised to support on behalf of the council such applications to the Board of Trade by one or more of the companies for powers to supply one or more limited areas within the borough. 5. That, subject to the foregoing recommendations, the committee be authorised to oppose all or any of the applications of which notice has been given to the council.

The Chelsea Vestry and the Electric Light.—A special meeting of the Chelsea Vestry, convened under the powers of Sec. 3 of the Electric Lighting Act, was held at the Chelsea Vestry Hall on Wednesday, Mr. Tuxbridge in the chair. Mr. Odgers explained that "it is incumbent on the vestry at this time to take any action with respect to an application for a Provisional Order for electricity in this parish." The Vestry had, since the issue of the notice calling the meeting a month since, appointed a committee to make a thorough investigation of the subject; but their work was not nearly complete, and it would be premature to proceed in the matter without further information before them.—Mr. Hodge seconded, and in the course of an exhaustive review of the Vestry's position, pointed out the principal obstacles in the way of the Vestry adopting the electric light, referring especially to the difficulties in obtaining a site for the works, and to the cost. £100,000 would, at a low estimate, be the expenditure involved in placing the mains, so the very largest capital sum would be obtained for the undertaking. If such an intention were made the Vestry would find either that it would be placed at a great disadvantage, or that it would have to employ as near as might be to make it profitable. The Vestry must be prepared to sell a dividend of £7,000 on a capital of £140,000. He found that the annual cost of maintaining the Siemens lights in the Strand, Embankment, and Gardens, Chelsea, being into account the payments of the parish at £6,000, and the number of inhabited houses at 20,000. The inhabitants of the Vestry's offices and staff, and the Vestry would be called upon to pay £7,000 a year as the annual necessity for the expenses. The Vestry ought not, therefore, to pledge themselves to such an expenditure, but offer to a trustworthy company every possible facility, since the Vestry would be able to supply the light well in hand by the end of the year. It must not be expected that the Board of Trade would allow a local authority to sell their private property to its private use, or refuse it to any company that came on the terms. The meeting was put and carried unanimously, the Chairman remarking that it was at present the only subject under consideration. The question could be reopened, and a second special meeting convened, as the necessity arose. The committee had been able to procure the report of the Islington Vestry upon the subject, which they were now making.

The Islington Vestry and Electric Lighting.—At the last meeting of the Islington Vestry the consideration of the report of the Lighting Committee upon the application of Messrs. Siemens for a Provisional Order (the substance of which was overwise, it will be remembered, to the effect that the Vestry appeared disposed to give a final opinion as to the desirability of adopting the electric light, and to recommend the Board to grant the application in itself, it was considered that, effective as such a light in the streets, in its infancy, and unverified, as a means of lighting of the system, which time would probably remedy. The committee recommended that the report be referred back to them with authority to take the necessary steps. It was moved that the report be adopted, which was seconded by Mr. Stevens.—Mr. Moss said there was nothing whatever, with one exception, to recommend to have calculations made of the probable cost of the service, and a bulk of paper. He (Mr. Moss) could not see the purpose of making a way to get the electricity, an experiment to see where it was not a fair one. The lighting of private houses was the next consideration to the committee, but the committee seemed to think it was possible that in the investigations part of the report. They had been lighting of public authorities; and he (Mr. Moss) was most desirable that the local authorities should undertake the work and authority, which was the Vestry, then a public company.—Mr. Hall supplying the electric light Vestry, he thought, be adopted only so far as the Vestry take steps to oppose the granting of a license or provisional order to any other person or public company to supply electricity in the parish.—Mr. Thompson seconded the amendment.—Mr. Lambert considered it a great mistake to have referred the subject to the Lighting Committee, it should have been a special committee. The committee had gone nowhere but the Board of Trade to make inquiries, and had elected a very short time to the matter, the work being only about the last of Mr. Parry and Mr. Dyson.—Mr. Newman believed that the question had not received the consideration it had from the hands of the committee.—Mr. Price said the Lighting Committee had been blamed for not doing more than they had done, but they had not been told what they would have gone further in the matter.—Mr. Bloomfield. Electric lighting was in its infancy at present, and no doubt improvements and experiments, and he was opposed to the adoption of the electric light until it was a commercial success. After some further remarks had been made, the amendment on Dr. Chilcott was put and carried.—Mr. Foley then moved as an amendment, that the question be referred to a special committee for consideration, which was also seconded.—The further consideration of the matter was then adjourned till the next meeting.

The Financier, alluding to the "Brush" Electric Light Companies, states that several shareholders are threatening to move an injunction against the "parent Brush" for compensation and damages in selling exclusive rights for some patents to which, it is alleged, they have a valuable title.

The Corporation of Sheffield, having resolved to apply to Parliament under the Electric Lighting Act for extensive powers for the illumination of the borough by electricity, not only in the streets and public buildings, but also in the private houses, Mr. Crompton, C.E., of London, who has been specially consulting engineer to the Corporation, has been instructed to prepare and report upon a scheme to be adopted by the Corporation.

It having been stated that it is the intention of certain parties to lay down a system of distribution of electric force for lighting purposes, upon a plan consisting the use of secondary batteries as a means of storage and dynamo machines and transformers, Mr. St. George Lane Fox gives notice by public advertisement "that such a combination is covered by the Letters Patent granted to me on the 9th of October, 1878, and that any infringing or acting under patented combination without licence from me will be proceeded against."

Miscellaneous.—The Admiralty have decided to light the *Inconstant*, *Monarch* throughout with Swan's incandescent electric lamps. The Swans engineer is to be employed are of the Siemens's type, driven by a Brotherhood engine.

Metropolitan, Feb. 1884.

Metropolitan Brush Electric Light Company.—An extraordinary meeting of this company was held at the Cannon-street Hotel on Tuesday, under the presidency of Mr. Bower, to receive the report of the committee of investigation appointed to inquire into the affairs of the company. Mr. Alexander Peebles read and moved the adoption of the report of the committee, in which it was stated that no lighting stations had yet been established, no street recommended winding-up. This having been seconded, Mr. Shipp undertook to show how they could be made money out of.—Mr. Hammond made an effort to take money out of the company, giving £20,000 in debentures and £30,000 in fully-paid shares in the Anglo-Continental Company, or £20,000 cash.—Eventually the resolutions were passed adopting the report and resolving on winding-up.

Miscellaneous.—The Wellington Club hall-room, Liverpool, is now lighted by the electric light. More than two dozen lamps have been fixed in the cut-glass chandeliers with which the rooms are fitted, rendering a very beautiful effect.

Metropolitan (Chelsea) July 1882

The Pilsen Joel and Oriental Electric Light Company.—The first ordinary general meeting of the Pilsen, Joel, and Oriental Electric Light Company was held on Tuesday at the City Terminus Hotel, Cannon-street, Sir Lees in the chair. According to the directors' report, the meeting was convened in accordance with the terms of the agreement, which required that a general meeting of the shareholders should be held within four months of the registration of the company. This was the first opportunity they had of meeting, and the second was to form themselves into an extraordinary meeting after the general meeting was finished, for the purpose of considering certain changes in the articles of association which the formation of the Stock Exchange considered desirable in the interests of the shareholders. Although the present meeting was not one at which it was usual to enter into any detailed statements of the proceedings of the company, which the directors hoped to do at the next ordinary meeting, yet it was a pleasure, for the directors to meet the shareholders at any time and to give them any information in their power as to the operations of the company. The company was registered on the 19th of May, and was advertised on the next day, and such was the demand for shares that the new electric light company that in the afternoon of the 20th of May, the directors were obliged to advertise that no more applications for shares could be received after the 23th for town, and the 28th for the country. We might state that for 28,000 shares applied for they had to dispose of to the public they had applications for 168,000, and for a capital of £140,000 they had applications amounting to £1,400,000—more than seven times the number of shares they had to dispose of. The allotment was completed on the 23rd of May, and was to about 800 shareholders. The shares which were issued were of the value of £5, and the directors had contemplated calling up the first £2, of which £1 per share, which would give a working capital of £2 per share, which had been called up, and with the exception of a trifling sum, all paid up. The shares were allotted pro rata to the applications, and the allotment is considerable premium. But before the company was actually formed and in operation, the directors had to take a very different view of its prospects than when it had first been started. When the company was first created, the directors had hoped to be able to sell a number of concessions in order to form a number of smaller companies, as had been done in the case of Belgium. But from the moment of the existence of the company, it was pretty evident that the latter position was not to be the case, and that the continental working of the consolidated, and from the establishment of a successful and commercial manufactory of its valuable patents. After referring at length to detail matters, he said, in conclusion, that the object of the directors had been throughout to insure a substantial and profitable consolidation of their several patents, to study strict economy in their arrangements to avoid all expensive agencies, to refrain from costly and unnecessary solicitations, and so to conduct the operations of the company that the public, as they were confident of realising, an ample and just satisfactory return for the shareholders for the money which they had invested. Several shareholders expressed themselves in a satisfactory manner with the statement made by the chairman, and the meeting was then resolved itself into that of the purpose of adopting various formal alterations in the articles of association of the company. These were all agreed to, and the proceedings terminated with a very hearty vote to the chairman.

Nov. 24 1882

American Gas Light Journal.

ELECTRIC LIGHTS.

Owing to the pressure upon our columns, caused by the publication of the proceedings of the American Gas Light Association, the continuation of the article, by H. Mossday, on the "Value of Electric Units," is unavoidably delayed.

Electric Lighting in Chesterfield, England.

A late Number of *Engineering* contains this paragraph relative to the attempted electric lighting scheme at Chesterfield, England:—

"The experiment of lighting by electricity at Chesterfield has not so far proved successful. It will be remembered that about a year ago, owing to differences with the gas company, the Corporation determined to abandon the street lighting, and to illuminate all the streets with arc lamps. The contract was entrusted to the Hammond Company, and it was decided to use both arc and incandescent lamps. After a long delay the work has recently been handed over by the contractors as incomplete, but according to the Town Council it is little less than a dismal failure. "In a letter addressed to the Mayor by the Brush Company are most variable in their lighting power, whilst some are good, others only give a feeble light, instead of a light equal to that of fifteen candles as expected. The arc lights are doing good service in some of the large streets, but on a whole I think it has been fully demonstrated in a year's trial if Chesterfield, that the field for arc lighting is very limited indeed.' The inhabitants of the town do not appear inclined in any single instance to abandon gas, and the disappointment at the result of this enterprise is very great.

"Judging from the success that has attended the electric lighting of streets elsewhere we suspect that the fault lies chiefly with the mode of installation; the defective Lane-Fox lamps can doubtless be replaced by perfect ones, and probably a better distribution of the arc lamps could be effected. Although Gen's letter is a timely one, that no many municipal bodies are turning their attention ardently to the question of abandoning gas."

Electric Lights a Nuisance.—The blazing electric lights in the City Hall Park are nuisances. They dazzle the eyes, and thereby increase the peril of crossing the crowded streets that border the park. Where they do give no light they give too much, and at times they leave the park in darkness. The old gas lamps served the purpose much better, and made the park safer and more pleasant.—*N. Y. Sun.*

March 1882.

At the *Fête* in Paris yesterday the electric light played a prominent part. It was used to illuminate the fountains of the Tuileries Gardens, the upper portion of Notre Dame, the Louvre, the dome of the Pantheon, Porte Saint Denis, and several other public places. Among the electrical displays in the Palais de Glace the most interesting experiments was that of M. Serrin from the top of his house, facing the Place de la Bastille, where the gas companies organised an unrivalled illumination. M. Serrin has invented a system which has been already tried with great success, and may be moved in any direction with an amazing velocity. His powerful ray of light describes curves in azimuth and in distance. Some new forms of regulators were exhibited for the first time on this occasion. The *Fête*, being inclosed, was celebrated all over France in the 40,000 communes or townships of the Republic, and the electric light was used in the provinces as well as in Paris. The most notable display was probably at Rouen, where a group of sixteen Siemens lights, of a power of about 100,000 candles, was placed on the top of the spire of the Cathedral.

Nov. 16, 1882

American Gas Light Journal.

More about Mr. Edison and His System.

"ELECTRIC LIGHTING."

TO THE EDITOR OF THE TIMES.

SIR,—Having now before us most of the "objections" lodged in respect of the application for Provisional Orders made by our clients, the Metropolitan (Brush) Electric Light and Power Company (Limited), we are enabled to arrive at the conclusion that there are but few cases where the Board of Trade will not be able to adjust the differences between the local authorities and the undertakers.

The announced determination of the Board of Trade to give effect to the provisions of the Electric Lighting Act has prevented purely obstructive objections, and the undertakers have confidence that in the public interest the Board of Trade will settle the outstanding points, in what is necessarily more or less of a bargain, between the local authorities and the undertakers. So far as the objections are tenable, they are of a commercially trifling nature, and constitute the most conclusive testimony to the efficiency and ability with which our learned counsel, Mr. Fletcher Moulton, Q.C., constructed the plan of area for application, and carefully selected the salient legal and actuarial features. Mr. Monckton's temperate letter of the 30th instant may be taken as a fair sample of the views of the bulk of the metropolitan vestries—views which we are not likely to underrate to considerable modification; after more mature study of the subject, and when the safeguards to be introduced into the Orders are more fully specialized.

We could not suppose that the draft Order, even with the more backward of the proposals, would be regarded as perfect, but we are now convinced that if both parties attend the Board of Trade Inquiries with a wish fairly to meet each other, and to secure legislative powers which, while protecting the interests of the public, shall offer an adequate return to capitalists, a sound and satisfactory Order will be the result.

As to the clauses relating to public safety, efficient supply, and price, the Board of Trade will probably not be before them such skilled evidence as will enable them to correct any inequalities which may exist in a manner satisfactory to the vestries.

As to the breaking up of streets, if deemed desirable by the local authorities and the Board of Trade, the company would not object to the work being carried out at the fullest extent by the vestry. And as to the "overhead" wires, the company has given instructions to the heads of the Board of Trade.

Then, as to the compulsory portion of the work, it seems only reasonable that if a pioneer company incurs the risk of establishing a new enterprise and bears the expenditure of capital demonstrates the public utility of a new source of light, other things being equal, it should have the preference in carrying out the further work if required on the request thereto within the district. Nothing more than this is proposed by the Order. The question of the time into section, the first and most important of which the undertakers secure the obligation of lighting during the period of two years. In addition to the 200-horse power engines running at a high rate of speed, there were also attached to each a four-inch bobbin, which in effect increased the power equal to about 1000-horse. The next thing that happened was the melting in a second of six or eight pounds of copper which was thrown off in a sort of vapor, filling the room and everything else with the necessity of extinguishing all when any one was out of order was manifested by the failure of the lights, and moreover there was a possibility of the insulators connecting the wires with the ground having also been thoroughly demonstrated, and I have now no fear whatever of the perfect working success of the scheme. I have also perfected a meter for measuring the amount of electricity used in a given time, which is absolutely perfect and certain, because not mechanical, and therefore not liable to get out of order. Furthermore, the production and sale of electricity for lighting purposes will in no way come in competition with gas, as many more than gas does with kerosene, because it has an actual commercial value above gas, which will take it out of the line of competition and elevate it to a plane of its own. We measure electricity, for instance, on the basis of a ten-candle power of illumination, and we charge at the rate of one and one-sixteenth of a cent an hour for a ten-candle light. It makes no difference whether a consumer burns ten candles' worth an hour or one hundred, he is charged accordingly. Electricity is worth, as a commercial product, one-third more than gas, and therefore people will use it and pay one-third more for it than they will for gas. Of course, the system is not yet by any means perfect, but I am constantly working at it, and in three months' time I will have it down pretty fine, as the saying is. I do not consider the lighting of the streets as of any importance whatever, and have never had my attention directed to it. My system is perfect, and now I am prepared to go ahead. In the first place people said that the wires could not be laid underground. I have fully demonstrated that they can. The lighting of the streets does not represent one-fifth of the future possibilities of the business that I have been stirring for, but it is the miles and miles of houses with the 46, 86, and 88 per month from the thousands of customers that I am after. The result of the experiment in this district now being developed will tell this story. If it is such as to satisfy the capitalists that it is a success, which I have no doubt it will be, other districts will be solicited as fast as the plants can be laid and the stations established. I fully expect in time to light the whole city of New York by means of electricity."

It will be remembered that our issue of October 16th contained some statements made by Mr. Edison to the reporters of two of the daily journals of New York city. It will also be recollected that Mr. Edison, and his system seemed, stated quite positively that nothing was going wrong in the working of his scheme for incandescent lighting—in fact, that "everything was lovely." That this was not "all rose" would seem to be proven by the following interview which he had with a reporter of the New York *Daily World*, on Nov. 3d, and which is here reproduced.

SNOW ON HIS LOOM.

The Edison Electric Light Company, which has secured the right to light all the buildings of the city with electricity, subject to the option of the owners or occupants of the buildings, has been for months laying wires throughout the district bounded by Spruce, Nassau and Wall streets and the East River. The city has been divided into thirty districts, and the one just mentioned is the first to be developed and is intended to demonstrate the practical workings of Mr. Edison's district system. The station is in Pearl street near Fulton, and there are already six immense dynamo machines, each one by a 200-horse power engine, completed and ready for operation. Each dynamo is capable of furnishing sufficient electricity to run 1,400 lights, and so, when the whole district is completed, there will be over 14,000 lights to furnish, it will be necessary to have six more similar machines to operate the entire district. The six dynamos already completed and set up were ready for use four or five weeks ago, but when they came to be tested efforts were found to exist in the machinery which were at once recognized as serious and which it has taken Mr. Edison all that time to overcome. Each engine and dynamo are on one bedplate, and form one machine. The idea was to turn all the electricity generated by the six machines into one set of mains. When the experiment was tried, however, the result was not what had been expected. The diffi-ty, as explained to a *World* reporter by Mr. Edison, may be summed up as follows:

"I found on trying the experiment," said Mr. Edison, "that the trouble was that when the electric current from two dynamos was united it was impossible to make them work smoothly, for the reason that if one engine ran faster than the other the fast engine would take all the load off the slow one, and the slow engine would be run merely as an electro-motor. The result of the first experiment was such as to astonish the engineers and every one who witnessed it, and came near proving serious. When the current from the second dynamo was turned on, first one engine and then the other would go like lightning, and first one and then the other was converted into a motor. One of the engineers, witnessing the effect, shut off steam, and still his engine was running just as rapidly as before. He came running towards me as white as a sheet, exclaiming: 'My God, Mr. Edison, what is the matter? I have shut off the steam, and yet my engine is running at lightning speed, and I can't stop it!' In addition to the 200-horse power engines running at a

It therefore seems to be in the interests of the public that strong district companies should be established, to which the local authorities may look for the supply of light, and to which, rather than to the Board of Trade, or, in the latter, a multiplicity of undertakers should be encouraged. Nothing, however, can be further from the wish of the Board of Trade than to create a monopoly, so that should the original undertakers exercise their powers inefficiently, or overcharge, or otherwise dissatisfy the public, the vestries or other authorities would be readily resorted to. It would appear that the metropolis, if the Board of Trade can only be induced to take a liberal and statesmanlike view of the situation, is within reach of the adoption of a scheme for the lighting of London which, while not fettering the Board of Trade unduly, would offer inducements to capitalists to embark in electric lighting undertakings with confidence in the ultimate success of the undertaking, and duly to safeguard the interests of the public.

We are, sir, your obedient servants,

WALTER WEBB & CO.

28, Queen Victoria-street, E.C., Jan. 31.

May 12, 1883.

THE STATIST.

HOUSTON ELECTRIC LIGHT AND POWER SUPPLY COMPANY.—According to the report, the available balance is $19,385. This allows the following appropriations:—A dividend of 5 per cent. upon the ordinary shares, £5,000 to the redemption off the pavilett and concession account, £3,000 to reserve fund, and £1,000 carried forward. The amount of distribution would have been larger, but the directors had not considered it right to do so, as the concessions for Yorkshires, Staffordshire, Warwickshire, and the concessions for Yorkshires, Staffordshire, Warwickshire, and the concessions for Lancashire, would require a large expenditure in connection with the meeting held on Wednesday, the chairman said that they were prepared a dividend of per cent. on £2,000 for the year ended and conversions account, in place £3,000 to the reserve fund, and to carry forward £1,085. With regard to the Lease for control, they were advised that they had a strong defence in the event of litigation with the licensees; but it was suggested to them that it would not be wise in the interests of the shareholders to enter into protracted litigation, and it was pretty generally considered that the ultimate result of which might be highly prejudicial to the proper business of the company. After long consideration, they therefore resolved to take the advice of their counsel—to repay the money they had received, and to hand back the lease to the receiver; except those for which they had sustained from the reticence of that company on this important point. A suit was pending between the company and the Brush Company. They had great difficulties to contend with, owing to the tremendous monopoly of the gas companies. The Electric Lighting Act, which at first seemed to be adverse to their interests, was really a great help to them, for it had given Parliamentary recognition to a great fact, and though only tentative it had legalized a position which was to enjoy immunity. It had been said that no public electric lighting contract had yet shown a profit. He was not prepared to admit the accuracy of the statement, but he should like to know what gas company could show a profit from the first week lighting if it had not the privilege of the private lighting? With their new Parnell meeting they could, he anticipated, serve a district that no gas company had shown a profit. Mr. Robert Hammond, in the course of a lengthy speech, stated that the Board of Trade had been in communication with their electric light which had shaken confidence; and in the past few days he had received from himself direct confirmation of the inquiries. They were prepared to put up plant to supply 40,000 lights, and to erect a station to accommodate that number. They could not, however, be extended that it might be done at 1s. 7d. per light. He

DR. C. W. SIEMENS UPON THE DISTRIBUTION OF ELECTRICITY.

In another column will be found an address by Dr. C. W. Siemens, delivered before the Society of Arts, in London, of which body he is Chairman.

This paper may be considered as of more than usual importance for various reasons. It comes from a source of undisputed authority, for few men in our day occupy the commanding position held by Dr. Siemens as regards scientific acquirement, practical knowledge, and, more rare than either, a combination of both in a business way which has resulted in the accumulation of great wealth; in short, he is most eminently a man of science who has made science pay.

When the subject of removing his contract for the lighting of a portion of the city of London was under discussion last Spring, he frankly told the authorities that, while others perhaps might be able to afford to advertise their patents at the expense involved in furnishing electric lighting at prices paid previously to that time, he could not; and that the price would have to be increased. In other words, being largely engaged in commercial transactions, he could not see why he should light a part of London, except upon a commercial basis. In the case which he has assumed as a model in his address the Doctor professes to deal with the case in the same spirit; but among the other assumptions in which the Doctor excels most scientific men may be found his skillful use of the English language. It is not his mother tongue, but we must say that few who are born with an English tongue are so skillful in the use of it. The ease with which the plainest and simplest statement is made to cover not only a supposed scientific truth, but a plain practical fact which will result therefrom, has always some exemplifications in an address from Dr. Siemens—and an address of his is look for each in this address. After clearly stating the amount of light that should be required in a certain district equal to one-quarter of one square mile, and proceeding to deduct therefrom such portions as would not be included, or would have a tendency to increase his average too much, he makes an estimate for the expense of the establishment of necessary works, including machinery, engines, distribution, etc., for doing 25 per cent. of the lighting in a district one-quarter of one square mile in extent, at about $883,000—and this includes no house connections or interior fittings.

When speaking of working expenses, the Doctor, with all the ease and quietness of speech imaginable, assumes that his lights are run "six hours a day," and that "with coal at twenty shillings a ton, and a consumption of two pounds of coal per effective horse power per hour," the coal will amount to a certain figure, which is perfectly satisfactory to the Doctor; but any one adopting the standard of coal laid down must closely adhere to the conditions mentioned.

Does the immense establishment of the Siemens Brothers, at Greenwich, obtain all their power of every kind with an expenditure of two pounds of coal per horse power per hour? If so it is very economically managed as to motive power.

And the next matter is gas works. Here, with clearness and simplicity, the Doctor says: "The cost of establishing gas works would not exceed £80,000" ($400,000) as against £177,000 ($885,000) for electricity. Whether the gas works are to supply twenty-five per cent. of the light required, or the whole, is not mentioned. But the main interest is in the conclusion that the Doctor draws from his own comparisons, which are in substance—

That the future of the gas industry bids fair to be a bright one, in spite of electricity. Doctor Siemens, although so familiar as my one else with the capabilities and the possibilities of electricity, has always maintained the doctrine that gas had only good to look for from the introduction of electricity, and he is of the same opinion still; and when he says that incandescent electric lights are a luxury, to be enjoyed, perhaps, by the wealthy, but that gas is the poor man's friend, it certainly does not appear that electric light is to supercede all other forms of artificial lighting on the ground of *price*; not look much like a broad margin of profit for those who sell it "as cheap as gas."

[From the "Journal of the Society of Arts."]

The Cost of Electric Lighting.

At the First Ordinary Meeting of the Society of Arts, held on Wednesday, November 15th, 1882, Charles William Siemens, D.C.L., LL.D., F.R.S., Chairman of the Council, delivered the following address:

Having received the honor of being elected Chairman of the Society of Arts for the ensuing year, the duty devolves upon me of opening the coming session with some introductory remarks::

Only a few months have elapsed since I was called upon to deliver a presidential address to the British Association at Southampton, and it may be reasonably supposed that I then exhausted my stock of accumulated thought and observation regarding the present development of science, both abstract and applied; that, in fact, I came before you, to use a popular phrase, pretty well pumped dry. And yet, so large is the field of modern science and industry, that, notwithstanding the good opportunity given me at Southampton, I could then do only scanty justice to comparatively few of the branches of modern progress, and had to curtail, or entirely omit, reference to others, upon which I should otherwise have wished to dwell.

There is this essential difference between the British Association and the Society of Arts, that the former can only take an annual survey of the progress of science, and must then confide to individuals, or to committees, specific inquiries, to be reported upon to the different sections at subsequent meetings; whereas the Society of Arts, with its 3,400 permanent members, its 95 associated societies, spread throughout the length and breadth of the country, its permanent building, its well-conducted *Journal*, its almost daily meetings and lectures, extending over six months of the year, possesses exceptionally favorable opportunities of following up questions of industrial progress to the point of their practical accomplishment.

In glancing back upon its history during the 128 years of its existence, we discover that the Society of Arts was the first institution to introduce science into the industrial arts; it was through the Society of Arts that the late Albert, past-president, the late Prince Consort, that the first Universal Exhibition was proposed, and brought to a successful issue in 1851; and it was due to the same Society, supported on all important occasions by its present president, the Prince of Wales, that so many important changes in our educational and industrial institutions have been inaugurated, too numerous to be referred to specifically on the present occasion.

Amongst the practical questions that now chiefly occupy public attention are those of electric lighting, and of the transmission of force by electricity. These together form a subject which has occupied my attention for many years, my brothers for a great number of years, and upon which I may consequently be supposed to dwell on the present occasion, considering that at Southampton I could deal only with some purely scientific considerations involved in this important subject.

I need hardly remind you that electric lighting, viewed as a physical experiment, has been known to us since the early part of the present century, and that many attempts have from time to time been made to promote its application. Two principal obstacles have stood in the way of its practical introduction—viz., the great cost of producing an electric current so long as chemical means had to be resorted to, and the mechanical difficulty of constructing electric lamps capable of sustaining, with steadiness, prolonged effects.

The dynamo machine, which enables us to convert mechanical into electrical force, purely and simply, has very effectually disposed of the former difficulty, inasmuch as a properly conceived and well constructed machine of this character converts more than 90 per cent. of the mechanical force imparted to it into electricity, 90 per cent. again of which may be converted into mechanical force at a moderate distance. The margin of loss, therefore, does not exceed 19 per cent., including purely mechanical losses; and this is quite capable of being further reduced to some extent by improved modes of construction. But it results from these figures that no great step in advance can be looked for in this direction. The dynamo machine presents the great advantage of simplicity over steam or other power-transmitting engines; it has but one working part, namely, a shaft, which, revolving in a pair of bearings, carries a coil or coils of wire admitting of perfect balancing. Frictional resistance is thus reduced to an absolute minimum, and no allowance has to be made for loss by combustion, or badly fitting pistons, stuffing boxes, or valves, or for the jerking action due to oscillating weights. The materials composing the machine, namely, soft iron and copper wire, undergo no deterioration or change by continuous working, and the depreciation of value is therefore a minimum, except where currents of exceedingly high potential are used, which appear to render the copper wire brittle.

The essential points to be attended to in the completion of the dynamo machine are the generation of induced currents in the iron, and the placing of the wire in such a position as to make the whole of it effective for the production of outward current. These principles, which have been clearly established by the labors of comparatively few workers in applied science, admit of being carried out in an almost infinite variety of construction forms, for each of which may be claimed some real or imaginary merits regarding questions of convenience or cost of production.

For many years after the principles involved in the construction of dynamo machines had been made known, little general interest was manifested in their favor, and few were the forms of construction offered for public use. The essential feature involved in the dynamo machine, the Siemens armature (1856), the Pacinotti ring (1861), and the self-exciting principle (1867), were published by their authors for the pure scientific interest attached to them, without being made subject matter of letters patent, which circumstance appears to have had the contrary effect of what might have been expected, in that it has retarded the introduction of this class of electric machine, because no person or firm had a sufficient commercial interest to undertake the large expenditure which must necessarily be incurred in reducing a first conception into a practical shape. Great credit is due to Messrs. Gramme for undertaking the initiative in the practical introduction of dynamo machines embodying those principles; but when, five years ago, I ventured to predict for the dynamo-electric current a great practical future, on a scene of time mitting power to a distance, those views were still looked upon as more or less chimerical. A few striking examples of what could be practically effected by the dynamo-electric current, such as the illumination of the Place de l'Opera, Paris, the occasional exhibition of powerful arc lights, and their adoption for military and lighthouse purposes, but especially the general accomplishment of the much desired lamp by incandescence in vacuum, gave rise to a somewhat sudden reversion of public feeling; and you may remember that in the month of last February, affecting the value of gas shares, which ensued in 1878, when the accomplishment of the subdivision of the electric light by incandescence was first announced, somewhat prematurely, through the Atlantic cable.

From this time forward electric lighting has been attracting more and more public attention, until the brilliant displays at the exhibition of Paris, and at Crystal Palace last year, served to excite public interest to an extraordinary degree. Now companies for the purpose of introducing electric light and power have been announced almost daily, whose claims to public attention and support in many instances were based in some cases only very slight modifications of well-known forms of dynamo machines, of arc regulators, or of incandescent carbon lights, the merits of which rested rather upon misconceptions than upon any scientific or practical proof. These misconceptions were supposed to be of such superlative merit that gas and other illuminants must soon be matters simply of history, and hence unwarranted speculative excitement. It must be borne in mind, however, that any great technical advance is necessarily the work of the scientific labor, and that when accomplished it is generally found that, so far from injuring industries, it calls additional ones into existence, to supply new demands, and thus gives rise to an increase in the sum total of our resources. It is therefore reasonable to expect that, side by side with the introduction of the new illuminant, gas lighting will go on improving and extending, although the advantages of electric light for many applications, such as the lighting of public halls and warehouses, of our dressing rooms and theatres, of our passenger steamers, our docks and harbors, are so evident that its advent may be looked upon as a matter of certainty.

Our legislature has been very slow in recognizing the importance of the new illuminant. In 1879 a select committee of the House of Commons instituted a careful inquiry into its nature and probable cost, with a view to legislation; the committee, at which they arrived were, I consider, the best that could have been laid down. They advised that applications should be encouraged tentatively by the granting of permissive bills, and this policy has given rise to the Electric Lighting Bill, 1882, promoted by Mr. Chamberlain, the President of the Board of Trade, regarding which much controversy has arisen. It could, indeed, hardly be expected that any act of legislation upon this subject could give universal satisfaction, because, while there are many believers in gas who would gladly oppose any measure likely to favor the progress of the rival illuminant, and others who wish to see it monopolized, either by local authorities or by large financial corporations, there are others again who would throw the doors open so wide as to enable almost all comers to interfere with the public thoroughfares, for the establishment of conducting wires without let or hindrance.

The law as now established takes, as I consider, a medium course between these diverging opinions, and, if properly interpreted, will protect, I believe, all legitimate interests, without impeding the healthy growth of establishments for the distribution of electric energy for lighting and for the transmission of power. Any firm or lighting company may, by application to the local authorities, obtain leave to place electric conductors below public streets and roadways in such positions as may be mutually agreed upon, thoroughfares, subject to such conditions as may be mutually agreed upon; the term of such license being limited to seven years; or an application may be made to the Board of Trade for a provisional order to the same effect, which, when sanctioned by Parliament, secures a right of occupation for 21 years. The license offers the advantage of cheapness, and may be regarded

American Gas Light Journal.

ANOTHER VICTORY AGAINST ELECTRIC COMPANY.—In the case of the Gramme Electric Company against the ARMOUR & HOCKHAUSEN Electrical Company, in a suit which was brought by the former to restrain the latter from employing the Gramme-pirano electric machine, decision adverse to the complainant was lately rendered by Judge Blatchford. The defendants contended that as the Gramme patents in Austria had expired in 1880, the American patents also lapsed at the same date, and in this view Judge Blatchford coincided.

LIGHTNING EXPERS AN ENGLISH COAL MINE.—The Newcastle *Chronicle* states that a most unusual and extraordinary occurrence took place at Dinnington colliery, Newcastle, England, during a severe thunderstorm.

The electric fluid seemed to strike the wet winding rope of the west shaft in the direction pointed upon the pulley. One current passed down into the winding engine-house, where it was seen to flash up and down the foot pump below the level of the floor, and quite illuminated the place at the time; another current passed down the rope to the bottom of the shaft, a depth of 35 fms., striking the cage, which fortunately was standing upon the bottom at the time, and exploded. The cassetter describes it as like a bell of fire falling upon the iron flat sheets at the bottom. He had his hand upon the cage, and received a smart electric shock, and was nearly blinded by the flash for the moment, but fortunately received no personal injury. The shaft is fitted up with round wire rope guides for two cages; those guides are suspended from the top of the pulley frames or head gearing, and secured at the bottom with heavily-weighted levers. Those iron rope guides would probably act as lightning conductors, and thus lessen the shock of any excess of electric fluid by carrying it off into the pump. Had the cages been running in the shaft at the time, and the shaft fitted up with the usual wooden guides, serious damage might have been caused, which would have been most difficult to account for or explain. After careful examination of the frames, pulleys, ropes, shaft, etc., no injury could be detected.

American Gas Light Journal.

Street Lighting in Fond du Lac, Wisconsin.

A number of the residents of Fond du Lac, Wis., have concluded that the electric light is neither what has been claimed nor expected of it, and consequently are much displeased with the workings and effect. The disappointment is the more severe considering many of these were advocates of the town's system of lighting. On Division, Barney, Linden, Second and other thoroughfares residents are now negotiating for a continuance of gas lamps at or near their residences so that the pedestrian may have light. Division street, east of Portland, will soon be lighted by gas, paid for by private individuals, while on the corner of Second and Barney streets the light of a particular favored that a number of industrial and wealthy citizens, and all heavy taxpayers, will petition the council to repudiate the electric light as per contract, after the expiration of 60 days, as not satisfactory, nor up to thousand and promised.

SEPTEMBER 23, 1882.
THE TIMES.
THE ELECTRIC LIGHTING ACT.

TO THE EDITOR OF THE TIMES.

SIR,—Are our local authorities alive to the fact that during the next four months a monopoly may be established for lighting their district by electricity?

By section 3 of the Act of Session and year of reign, before the 1Pth inst., 'apply to the Board of Trade, who may grant a license to supply electricity for public and private purposes. This is with the consent of the local authorities; but this clause is spoilt by limiting the time to seven years, which, unless altered in the Provisional Order, will probably make this clause, which is a good and practical one, unworkable.

By section 4 the Board of Trade, without the consent of the local authorities, can grant a provisional order "as such period, whether limited or unlimited," after the local authorities have had notice, subject to this order being submitted to Parliament, and subject to any opposition against the scheme before a Parliamentary Committee. A pleasant prospect for the lawyers!

"May the local authorities should have notice is made apparent by the rule issued by the Board of Trade in August—viz., if the local authorities choose to apply for a license or a provisional order, they will have plenty over other persons applying.

"Provided, that there shall be the grass grow under their feet." In the past, many a fortune comes from a large number of companies have been started so as to be ready notifying their intention to apply for a license of Trade under both sections, and possibly the one license has been adopted in every other district. Each company desire to obtain the start.

2. That the local authorities are well taken care of under clause 3. Whether the Board of Trade can be made to do so is doubtful. They will probably grant provisional orders with discretion. They may establish a monopoly for the district system all over the country, or they may allow half-dozen systems be tried in one street. They may leave it to the solvency of the companies, or they may let it to others without. I think it possible that the local authority may apply for a license, to protect themselves; but then will the Board force the ratepayers to light all their streets? Will they give the ratepayers time to see what the best streets, and will they hold us to do the work all at once, or in blocks of a mile, as I see recently proposed in New York by Sir Julian?

Parliament has given no compulsory power to purchase lands. This will, I think, render the Act unworkable.

Your obedient servant,

46, Cannon-street, E.C., London, Sept. 21. CHARLES HOSKOLD.

in the case of iron in pure air, but not where it comes into repeated contact with water or carbonic acid. An interesting phenomenon has likewise been observed on railways. It has been found that iron sleepers and spikes rust very much if the line is not used for some time. It is assumed that iron bodies are more liable to rust in a state of rest than if they are exposed to vibration from time to time, in which case, perhaps, an electrical effect comes into play which lessens the affinity of iron to oxygen.

In demolishing old buildings, there are often found iron cramps, blocks, etc., which, so far as they are surrounded by mortar, are completely free from rust, just as if they had come from the forge. A similar phenomenon has been met with by M. Vicat, a French engineer, when he had the anchor fastenings of several suspension bridges exposed which had been put down thirty years before. Where the iron in the masonry was surrounded by rich mortar, there was not a sign of the formation of rust, whilst the continuations of the anchors in hollow spaces were rusted to such a degree as to have lost two-thirds of their former dimensions. It has been frequently observed that iron does not oxidize in water if small quantities of caustic alkalies, or alkaline earths, are solved in it, by which case acids of whatever nature would be excluded. It appears that the above experiences have served as the basis for the rust protective paints invented by Herr A. Riegelmann, of Hamm (Hanover). He adds to his paints caustic alkaline earths, (baryta, strontia, etc.) By coating iron with them, it is said to be in the same state as the anchors of suspension bridges in lime mortar. Although simple coatings of such paints, owing to their slight thickness, cannot contain much alkaline matter, as is the case in walling in iron, alkaline effects will show themselves as long as they contain a certain percentage of it. But in any case these paints are free from noxious acids, which cannot be said of all other paints for iron. Should the paint be found in practice to possess the protective properties claimed for it, a step in advance would have been taken in the preservation of iron, and its greater application would be ensured.

The Buffalo (N. Y.) Electric Street Lighting Scheme Vetoed by Mayor Manning.

Mayor Manning, of Buffalo, N. Y., presented to the Buffalo Common Council, at its meeting in August, a veto of the action of the Aldermen authorizing the Comptroller to contract with the Brush Electric Light Company to light certain streets of the city with electricity. It is particularly gratifying in these days of corrupt, degenerate and extravagant systems of municipal government, to consider that some exceptions to the rule may be still found; and more than pleasing, it is comforting to find one exception to the rescues, clear and cogent, given by Mayor Manning in sustaining the position taken by him in this matter.

The electric lighting companies interested at one time to have taken a firm hold upon the affections of the solons at the head of municipal affairs in certain cities in the interior of the State; and some of these places find themselves burdened with contracts for lighting streets which they would very much like to cancel. Buffalo's Mayor has given the subject cool and calm consideration, having arrived at his determination on grounds which admit of no other interpretation than that they were solely for the best interests of the municipality of which he is the official head. The document is as follows:

"I return without my approval the following resolution adopted by your Honorable Body, on the 23d of July, viz.:

"That the Comptroller be and is hereby authorized and directed to contract with the Brush Electric Light Company for lighting certain streets streets with electric light from August 1, 1883, to August 1, 1884, at their bid of 55 cents per lamp per night; lights to be placed subject to the order of the Commissioner; also that the gas light companies shall discontinue all lamps in street crossings of a distance of 200 feet where electric lights are placed on the corners; the city reserving the right to discontinue any or all lights at any time during the term of contract, and in case of failure of any electric light to burn the full time, pro rata reduction shall be made for the time light fails to burn.

"On the 11th of May last you adopted a resolution authorizing the Comptroller to contract with the electric light company to light certain streets therein named. This resolution was returned without my approval, and I think no subsequent action was taken upon it. In the authority contained in the foregoing resolution of July 23, the same streets are included, and in addition thereto the Comptroller is authorized to contract with said company for the lighting in whole or in parts of thirteen other streets.

"In my communication of May 28 last, I stated somewhat at large some reasons why I could not yield my assent to the said resolution of May 14. The reasons apply with equal force to the resolution above set forth. I will not trouble you with a re-statement of them now, but respectfully beg leave to refer you to them as useful review and re-consideration. In regard to the last resolution I beg leave to make some additional suggestions. The street named in it is to be lighted instead of being 41 miles in length as stated in my said communication are according to a computation of the engineer 65,700 feet, or over 12 miles exclusive of parts of streets now lighted by electric light and the sum proposed for each electric light per night instead of 65 cents as at first proposed is now to be 55 cents. But I am satisfied that does not substantially change the position heretofore taken by me as to the comparative cost of gas and electric lights. In my said communication I stated that the difference in favor of gas was more than 55 per cent.; and on further examination and from such information I have been able to obtain, I am confirmed in that conclusion.

"As I learn from the parties concerned, it is not disputed that the interval between electric lamps should be not less than 600 feet, and that the usual and proper interval between gas street lamps should be 125 feet. There may be some exceptions to this rule, but the average distances are, as I am assured, as here stated. Different theories of computation have been adopted, but here is a basis of simple, ascertainable facts, viz: The number of electric lights to be furnished in a given district and the number of gas lamps in the same district. These being ascertained, there is no longer any question as to the comparative cost. It thus appears:

"Whole distance of streets to be lighted 65,700 feet. Divide this by 600 feet, the intervals between the electric lights and gives the number of lights at 104.

"Cost of each electric light per year, $200.75.

"One hundred and sixty-four electric lights at $200.75 gives the total cost per year $32,923."

COST OF GAS.

"Divide the whole distance as above stated by 125 feet, the interval between the gas lamps and it gives the whole number of lamps 525.

"The total cost of maintaining the 525 gas lamps at $56.45 each per year as proposed by the the gas companies, $13,012."

Comparative Cost Per Year.

Electric light	$32,923
Gas lamps	13,012
Difference per year	$19,911

"I have given this matter the most careful consideration, and I am confident that the above is as accurate a statement as it is practicable to obtain. It is based, as will be seen, upon the number of electric lights and gas lamps actually to be used and cannot be changed by suggestions founded upon mere speculation and conjecture, and it is but the comparative expenses of these two modes of lighting to public streets. Should you have any doubts about this statement, it might be well for you to make such inquiry as to satisfy you of its correctness. In your resolution of May 14, which was disapproved by me, you provided for lighting a certain district at an expense of over $2,000 more than it could have been lighted for with gas, and now as your communication recites reasons given for disapproving the resolution you have adopted another resolution describing another district which you provide for lighting with electric lights *at a cost of nearly $20,000 more than it could be lighted for with gas!* and though the district is confined mainly to a particular part of the city, this large sum would under the provisions of the city charter, virtually have to be raised by general tax on the whole city; so that this is a question which affects all the property owners in the city, and it will be for you to determine how far your project of lighting these certain streets with electricity will meet the approval, not of any particular ward or locality, but of every ward and every part of the city. I am not advised, gentlemen, of the reasons controlling your action in adopting your resolution, nor can I even conjecture what they may have been. With a certain few exceptions all the lighted parts of the city are with gas, and this has generally been found quite sufficient for the needs of the public. You have not authorized the lighting with electricity (in addition to streets already so lighted) of more than twelve miles of streets, along more than six miles of which, as I am informed, no gas pipes have been laid. With most exceptions these are outlying streets mostly in very thinly populated districts, and some of them being hardly more than *country roads*. Yet you propose to light all these at a *rate of expense more than double that of lighting the most densely populated portions of the city!* If there is any reason for this it would doubtless satisfy the taxpayers of this city that they should be informed of it. Nor do I think that the people along some of these streets would be greatly pleased to have this project thrust upon them. As to such streets as Broadway and Genesee-street the inhabitants on them. As to such streets as Broadway and Genesee-street the inhabitants along them would not fail to petition for this *costly* light if they desired it. It would be the same with the people on the other streets. Yet so far as I can learn not a single such petition has been presented as to any of the streets, and I am not aware that any evidence has been furnished of the existence of such desire. This is significant of the little support which will be received from the great mass of taxpayers for this project authorized by your resolution as to placing gas in streets not now lighted, the situation is the same. As to placing gas in streets not now lighted, the situation is the same as at the time of my said communication of May 28. All the gas companies have given ample assurance in writing that they will extend their gas mains as your honorable body shall direct, specially including all the streets designated

London Times, Feb. 1883.

TO THE EDITOR OF THE TIMES.

SIR,—It cannot be denied that your able article of Monday last and the subsequent letters thereon have cleared the ground. On the one hand, local authorities will see the unreasonableness of expecting to have all their own way, and on the other, electric lighting companies cannot expect to succeed in their attempt to saddle the public with provisions so objectionable as those contained in their draft orders.

Although I fully reciprocate the wish expressed by Messrs. Walter Webb and Co., and am willing to discuss the question fairly and liberally and to surrender many considerations in the utmost extent consistent with our interest, it is gratifying to find that the views of the Chiefs of Trade are supported so fully by other local authorities. Such a scheme as that proposed by the Brush Company was never contemplated when Mr. Farrer gave his evidence before the Select Committee of the House of Commons, nor do I think one word in the evidence or in the Act itself which supports the mode of dealing with the area of supply.

In Chelsea the Brush Company propose to lay down 720 literal yards of lines for "incandescent" lighting and about two miles of lines for "arc" lighting. The former consists of a length of 250 yards from a central station in three different directions (that being the greatest distance for working incandescent lighting successfully), and the latter for street lighting, upon which system electricity may be transmitted many miles, from one central station. These lines are to cost £14,000, but the company does not propose to carry them out under two years, and as regards the latter, at the request of the local authorities only; I submit that it could not have been intended to give facilities for "experimenting" with an important district under so trivial a liability and for giving preemption for 30 or 40 miles of streets in consideration of the completion to supply less than half a mile for "private" purposes, the latter being the great purpose of the Act.

If Mr. Chamberlain is a practical man he will insist on a test case or cases being decided by the Board—say, Chelsea, where we have no competing company, and St. Pancras, where two commercial companies and may overlap one another. If the companies are satisfied with the Board's decision there may be an end of the matter. If the Board decides in favour of the companies' scheme as to area of supply we shall find the case before Parliament. The Board having given their decision, they could bring into the House of Lords a Bill to sanction the two schemes, on which both sides could be heard. We should have the best and practical talent in Local Boards and the case for dealing with lighting of this description, time and money would thus go before the Speaker's Counsel, the most highest authority in the land, and the Committee upon the two Bills having been selected and assisted would come to a satisfactory decision. Let the Board have no more than two months, by which time the terms of the other orders for the Metropolis, which have for the first time received the sanction of Parliament, will have become the law of the land, and the Board will be in the position of the whole country and of one entity for each of the two schemes to be carried out by the Metropolitan Board, the amount to be ascertained by Mr. Adam, the House of Lords' Taxing Master.

If my suggestion is adopted, thousands of pounds will be saved to the companies and the ratepayers, and the interests of the Board of Trade will not be compromised, and the effects of all the orders will be incorporated in the Bill. Parliament shall avoid the trouble both to consider at once, and broken down by cross-examination of public servants being put on the back of the Board of Trade Provisional Order Act, and of the other orders, and the Bill to sanction the details be passed by a Committee of their rather late counsel duties.

Your obedient servant,

CHARLES MORROP.

60, Carnon-street, S.G., Feb. 2.

THE TIMES, FRIDAY, OCTOBER 6, 1882

ELECTRIC LIGHTING.

TO THE EDITOR OF THE TIMES.

SIR,—In considering the question from the public view, there is complaint of the greatest importance which is—the system or plan to be adopted in laying down the mains in the streets. I have not a copy of the Electric Lighting Act before me, but believe I am right in saying that there is no special provision on this section of the subject.

If new companies are allowed to break up the streets, then there will be confusion and inconvenience, but, as pointed out in your leading article in The Times of the 30th ult., this will doubtless be guarded against by the Board of Trade.

But even if one company supply a given district it is hardly likely that mains of sufficient capacity to supply all the electricity that may be consumed in that district will be laid down at once. Any such inconvenient lamps may be required from time to time in increasing numbers, probably to be worked at various degrees of electrical pressure or electro-motive force; all the public have a concurrent pulling up of the streets as the system becomes more and more extended; now what I am leading up to is this, that it is of the greatest importance that proper subways should be constructed to start with, in which it will be easy from time to time to lay additional mains without constantly disturbing the streets and traffic; the wasting is cost in the long run will be great. The local authority ought, I think, to construct these subways, and make the charge for the purpose. There is no one point in the whole question more important than this.

As regards the cost of the electric light, and the cost of installation, it is quite waste of time for us here to talk about its probable amount and make estimates with such data as we possess, as we can only deceive ourselves, but are allowing American enterprise to lead the way; we may as well wait until the result of the lighting of the mile block, now being laid down for electric lighting by Mr. Edison, in New York, is ascertained from the actual thing. Referring to the estimated cost of the various dynamo electric machines, the data quoted in recent letters in The Times are more or less fallacious, because the cost cannot be ascertained with any degree of accuracy until large machines of various systems have been constructed.

In two years' time, if not renewed, the patent for the light of dynamo-electric machines, the Gramme—system, and then there will be a general fall in prices.

I am, Sir, your obedient servant,

7, Northumberland-street, W.C., Oct. 2. RADCLIFFE WARD.

TO THE EDITOR OF THE TIMES.

SIR,—Referring to the correspondence which has appeared in The Times on the subject of the Provisional Orders and the licences for lighting by means of electricity in different districts in Great Britain, I find that already steps are being taken by enterprising speculators to utilise the provisions of the Act for their own personal profit. Many of these Orders and licences have been applied for by persons wholly unconnected with existing electric lighting interests, and without the necessary capabilities to carry their schemes into a successful issue. Of course, the object these gentlemen have in view is, after they have obtained a Provisional Order, to sell it to some one of the existing companies, and thus make a profit by means of a species of black mail, which must, of course, ultimately come out of the pockets of the consumers.

I think you will agree with me that the Board of Trade ought to be most careful in not issuing any Licences or Provisional Orders unless they are satisfied that the persons applying for the same have sufficient capital to carry out the same, and that, if possible, some condition should be made that these Licences or Orders should not be transferable by sale.

I am, Sir, your obedient servant,

ONE INTERESTED.

THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 42 PINE STREET

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(OFFICIAL NOTICE.)

Central New York Gas Engineers Association.

OFFICE OF CENTRAL N.Y. GAS ENGINEERS' ASSOCIATION, Sept. 10th, 1882.

On account of the Meeting of the American Gas Light Association occurring upon the day set apart for the semi-annual meeting of the Central New York Gas Engineers Association, the members of the latter Association are earnestly requested to be present at the American Association meeting at Pittsburgh, where final arrangements for a session will be arranged.

CHAS. A. WHITE, *Secretary.* JOHN MCDONALD, *President.*

(OFFICIAL NOTICE.)

American Gas Light Association.

OFFICE OF AMERICAN GAS LIGHT ASSOCIATION, No. 42 PINE STREET, N. Y.

The Tenth Annual Meeting of this Association will be held in the city of Pittsburgh, Pa., on the 18th, 19th and 20th days of October. The first session commencing at 10 o'clock on the morning of the 18th.

Headquarters will be at the Monongahela House, where the sessions of the Association will be held. Special rates of board, three dollars per day, have been arranged for members and their ladies. Under charge of the Committee of Arrangements, Friday, October 20th, will be devoted to visiting objects of interest in the city, a trip to the mines of the Westmoreland Gas Coal Company, and to the usual hospitalities of the local gas companies.

Ladies who may accompany members will be cared for during the sessions of the Association by a committee, who will accompany them to various places of public interest in the city.

Members who intend to present papers are again respectfully urged to promptly notify the Secretary of the fact, as also of the subject selected, so that the Executive Committee may complete its programme, and all be enabled to secure proper presentation and discussion of their papers.

Any officer of a gas company, person skilled in gas manufacture or illuminants connected therewith, is qualified for membership in the Association, and can obtain blank forms of application by applying to this office.

WM. HAMMIT WHITE, *Secretary.*

THE STUDY OF ELECTRICITY.

A little more than four years ago those vicious heathens it is to supply it. luminating agents to the public were somewhat startled by the wonderful announcements sent forth by the promoters of schemes for electric lighting. Almost simultaneously, and from different systems based forth, and since then the records of the patent offices of the different nations of the globe bear wonderful testimony of the fertility of man's inventive genius in attempting to grapple with the practical working out of problems whose solutions were, to a very large extent, empirical.

The very science of electricity was in its infancy, and, as yet, the information empirically, and perhaps, in some instances, theoretically obtained, had not been brought together and formulated under fixed heads and subdivisions. Men of science, as well as practical men, have since devoted time and money to the questions involved; and in less than five years we have witnessed international exhibitions, and congresses of all nations, devoted to the formulating and crystallizing into language that shall be understood and uniform meaning, the principles thus far established of this almost new department of science. The results accomplished are alike creditable in the energy, patience and skill of the various investigators who, coming from both sides of the Atlantic, and from various nations, have met with so much success in attaining their ends.

The result of this is that enough is now known to place the subject of the application of electro-motive force either for the production of light, or for use as a motive power, beyond the pale of conjecture, assertion or preposterous. It is true, perhaps, that the relative economies of the different applications, as compared with those of other means, may not yet have been fully worked out in detail; but we are happy to state that, so far as lighting is

NOVEMBER 21, 1882.

THE TIMES.

DR. C. W. SIEMENS ON ELECTRIC LIGHTING.

TO THE EDITOR OF THE TIMES.

SIR,—Referring to your report of Dr. Siemens's address and to comments thereon in your leading article of Nov. 16, I trust you will permit me to direct attention to some points that may tend to modify the effect of the statements therein contained.

First, as to the comparison instituted between gas and electricity, it should, I think, be borne in mind that Dr. Siemens is an inventor and advocate of various systems for the more effectual utilization of gas and that he, therefore, occupies the position rather of an advocate than of a judge. For he is from me to impute any unworthy motives as influencing the judgment of so highly distinguished a philosopher; but, seeing that this philosopher is no less distinguished as a man, shrewd man of business, I think I may, without giving offence, recommend the exercise of caution in implicitly accepting the opinions of such men.

Secondly, I may point out that by Dr. Siemens's own showing eight-hour power is equivalent to only about the smallest power of electric light, whereas the general calculation of cost proceeds upon the assumption that the seven hours' power is the full 16-candle power. It is true that for seven and a-half hours it is lighted and in the other to incandescent light, but it is yet to learn that quality has been attained and that the practical development of electric lighting results will be forthcoming to any considerable extent of what has already been proved to be possible.

Thirdly, it must be remembered that the firm of Siemens Brothers, and Co. (limited) has itself very recently conferred a practical monopoly of electric lighting upon the Swan and the formation of electric companies has discouraged a number of competitors into the field. Moreover, it is hardly to be expected to view cost comparisons with any degree of favour and if they volunteer advice to the public as to the economy of investing capital in their own undertaking, they are not likely to paint the picture in sweetest hues.

Fourthly, Dr. Siemens proceeds upon the assumption that electric lighting must necessarily involve the introduction of steam engines, and the question of a costly system of combustion between those stations and the points of consumption. He seems to assume the possibility of preventing electricity at the outset from consumption; yet if this indeed be practicable it must entirely destroy the value of the case. Actual experience is daily demonstrating its practicability, and the shareholders in electric companies may well regard the calculations of their directors with a considerable degree of complacency.

Fifthly, the story presented to the public is too worthy of invention to keep indefinitely. But not that we are prone to add invention, and to win untrammelled credence for the idle tales which Barnum, Hannum, Jacobs and many others could name, and which seems they have sought the aid of printed ink to carry out. But as to the most important particulars of the case, the public are hardly in condition to form any opinion upon the possession of any number of degrees of knowledge by any means the case that all of the certainly-favoured companies are burdened with large directors of this company, for many years advised him with the commercial results of their operations, ascertaining nothing but that the best electrical systems in vogue were those in force.

I am, Sir, your obedient servant,
HUGH H. HIRSCH, General Manager.
The "Imperial" Electric Light, Power, and Heating Company (limited), 9, Salisbury-street, Strand, W., Nov. 17.

Oct. 16, 1882.

American Gas Light Journal.

The Edison System.

The letter from a Washington correspondent which appeared in our columns of October 5th (p. 261) seems to have excited considerable interest as to the present status of the Edison system in New York city. It has also furnished the distinguished inventor an opportunity of explaining to the readers of the New York *Daily Tribune*, and other daily papers, what the proprietors of this paper are obliged to publish. If this statement is as accurate as some others which are credited to Mr. Edison, it can simply pass for what it is worth. Almost newspaper notoriety being a cause for fear, we can safely say that Mr. Edison never has shown the slightest alarm at its terrors. And silent the matter of gas stock holders being so much "down in the dumps," perhaps some bold holders of stock in the original Edison concern, who bought at $2,000 per share, will tell how it is that this same stock can now be purchased for $200 a share. If, at any time, Mr. Edison should see fit we will be much pleased to have him contribute to our columns a full, clear, and complete statement concerning what he has done in this field of artificial lighting, with the cost thereof, including a fair return upon the money invested; thus we shall be able to give to our readers an authoritative statement that should be satisfactory to Mr. Edison, at least.

The newspaper extracts which follow explain themselves.

[From the New York "Daily Tribune."]

"It was stated yesterday that Thomas A. Edison, the inventor, had met with a great disappointment in the failure of his electric light apparatus to supply as many lights as he had expected it to do. The statement originated in a letter written to the AMERICAN GAS LIGHT JOURNAL. A *Tribune* reporter called at the central office of the Edison Electric Light Company, and found Mr. Edison busy at his desk. 'Has the generator at the central station down-town failed to supply the number of lights which it was expected to?' asked the reporter.

"'Oh, you've seen that gaslight paragraph, too, have you?' replied Mr. Edison, laughing. 'Well, now, we began operations by furnishing 1,600 lights, and that is exactly the number we are furnishing now.'

"'Did you expect to furnish more than that?'

"'Not until we had completed certain additions to our engine; and when they are completed, we shall furnish more.'

"What about the street mains?

"'Why, we've never had any trouble at all. Any statement that we have had such trouble is absolutely false and without basis. Those stories have been printed in a journal that has to publish what will please the holders of gas stocks; but they will not be pleased at having any daily paper take pains of their statements, because that gives us publicity of a kind which they do not like. The fact is that our success is such as to alarm holders of gas stocks. We have had no trouble of any kind with our apparatus.'

"At the central power-station of the company, in Pearl street, it was said a greater number of lights would be furnished. The superintendent of the most successful parts of the company's work. The mains were put down in lengths of twenty feet, and each length was subjected at the factory to a test of resistance. The loss of current in conductors extending fourteen miles power. At this rate, if the whole of Manhattan Island were lighted through mains such as are now used, the loss by leakage would not amount to current the reporter was denied emphatically that they had met with any kind of shock or disappointment in their operations."

[From the New York "Sun."]

"Touching the Edison incandescent light, we have received the subjoined communication:

"'To the Editor of the Sun.—Sir: The statement copied from the AMERICAN GAS LIGHT JOURNAL, which appeared in your Saturday edition, in which the statement is made that my system of underground conductors was a failure, and that I had been greatly disappointed, is absolutely untrue, but the opposite being the truth, as any one may easily ascertain, the system being in daily use.

"'THOMAS A. EDISON.

"'October 7.'"

"In order that the value of this denial may be properly estimated, we reprint what we copied from the GAS LIGHT JOURNAL:—

"'His information was derived from an electrician just returned from New York, who, as I understand, was summoned to your city for consultation on the subject. My informant states that Mr. Edison has just met with the greatest disappointment of his life—the complete failure of his attempt to light 2,000 lamps with his incandescent lamps by his underground system of wires; but fifty houses could be lighted, the electricity being carried away owing to imperfect insulation. As the institution was supposed to be perfect the conclusion is that underground conductors cannot be made to work.'

"It seems to us that Mr. Edison should be more explicit, and not throw the burden on the public of ascertaining the facts. Does or does not his underground system suffice to light 2,000 houses? Does it at present light more than fifty houses? And was or was not an electrician summoned to New York for consultation on the subject? That the system is in daily use, and that Mr. Edison was not greatly disappointed are entirely consistent with the conclusion that his underground conductors cannot be made to do the work laid out for them."

American Gas Light Journal, June 2, 82.

Electric Light at Railway Stations.

The following is taken from the *Manchester Guardian*:—At Manchester for some months past the electric light has been in use at the Victoria and London Road Stations. At Victoria it was first introduced by the Lancashire and Yorkshire Railway Company, who have tried two systems of lighting by electricity. The London and Northwestern Company soon followed at Victoria, but did not introduce electricity in the lighting of their station in London Road. The Sheffield and Lincolnshire Company, however, took up the question and introduced electric lamps in their portion of the station. The Lancashire and Yorkshire Railway Company have given the light the longest trial, and their experience is that it has proved a complete failure. The light is brilliant, but it is marred by serious unsteadiness, and, besides, it has proved unreliable. On several occasions when crowded trains have arrived at the platforms the lights have suddenly failed, and the station has been plunged in darkness. Feeling that this was a great drawback to the efficiency of the electric light, the company have decided to discontinue its use, and on Saturday it was seen for the last time. On Sunday the station was lighted with gas in the ordinary manner, and for the present this will be continued. It is believed that the company intend to introduce improvements in the system of lighting, but that they intend to rely, at all events in the first instance, on their own engineers for suggestions. At the London and Northwestern end of the station on Saturday evening considerable inconvenience was caused by the failure of the electric light. A crowded train had just drawn up at the platform, but before the passengers were able to leave the carriages the light failed. The passengers were greatly alarmed and could not find their way about, and it was not until the gas lamps had been lighted that fear was allayed and quiet restored. Comment upon the above is unnecessary.—*Gas and Water Review.*

The Troy *Evening Standard* gives the following statement of the action of the Board of Aldermen of that city in relation to the proposition to light the streets by electricity—

At the meeting of the common council held Thursday, September 21st, Alderman Fox, of the Sixth ward, moved the adoption of a resolution offering James O'Neill, Edward F. Murray, P. P. Connolly, Thomas Galvin, Thomas Farrell, John H. Gleason, and Michael Cavanaugh, the exclusive right to introduce and operate the electric light in this city and light the streets with the same. If even ordinary decency had prevailed among the Democratic members, or if any regard was had for the public weal, the resolution would have been referred to a committee, but when Alderman Fox moved the matter be investigated by the streets and alleys committee, his motion was lost—12 nays, 7 ayes.

The affirmative votes were cast by the ring democrats and voted away the biggest privileges ever granted by the city. More than this, an absolute monopoly was created, and a few aldermen by their own votes constituted themselves a party with unlimited power for the ultimate end of defrauding the city. The seven men named by Fox's resolution are mere dummies in the matter, and merely represent seven aldermen who have gone into a blind pool speculation, and by obtaining the electric light franchise sell it to the highest bidder.

The conspiracy it is said was first hatched in the fertile brain of Alderman Hopkins. The thing was all settled some time before the city fathers met, but at the last moment one of the aldermen backed out. Aldermen Fox and Hopkins then introduced the subject of electric light to Alderman Martin Murphy. "If we put through this resolution," said Hopkins, "we will get something nice, and if you vote for it you can become one of the shareholders."

"This is rather short notice," said Murphy.

"Well," broke in Fox, "your name need not appear in the matter at all. I'll put Johnnie Gleason's name in the resolution and he will represent you."

"All right," replied Murphy, "I guess Gleason will do the right thing by me."

Great minds run in great channels and the great minds of the electric light cohorts of the common council run in a groove supposed to be lined with $50,000. It is not the purpose of the virtuous solons who contrived to pass the resolution for an electric franchise to establish for themselves a monopolitous franchise to the highest bidder. The Albany electric light company, which illuminates with the Brush system, and the United States company of New York are both anxious to buy the franchise for a good round sum, purchasing of course, that the aldermen guarantee a contract. The Albany company has purchased the exclusive right to operate the Brush system in Troy from the Brush company of New York city, and it is said has offered to pay $30,000 for the franchise recently granted to the seven virtuous citizens. The United States company will pay $50,000.

His honor, Mayor Grace of New York, recently wrote a letter to his honor, Mayor Murphy of Troy, asking him to use his best efforts to induce the city to use the United States light for illuminating the highways and byways. The reason for Mayor Grace's solicitude is that he is one of the largest stockholders in the United States company. By his efforts in New York he succeeded in having the city contract with his company for the illumination of certain streets from Canal street to Union square. Of course Mayor Grace's letter to Mayor Murphy and the presage of the present electric light resolution may be only coincidences, singular and striking, but the connection would seem to be as strong as that between sin and Satan.

In New York city the various companies own the lamps and lamp posts, and are paid seventy cents per night for each light. In Albany the city owns the lamps and lamp posts, having purchased them from the company for $125 each. The company is paid fifty cents for each light nightly. There are at present 325 lamps in the city, which are operated at a cost of $162 50 per night, or $59,312 50 per year. They has 696 gas lamps, which are illuminated for $14,400 per year. Leaving aside the cost of erecting electric light lamps and lamp posts, and computing only the actual running cost of the light in Troy, and estimating only for 250 lamps, the cost would be $125 a night, or $45,625 a year. More than triple the present outlay for illuminating the city.

"As soon as the electric light commissioners make their bargain with the United States or Albany company it is expected that they will rush through a resolution in the common council directing the contracting board to advertising the only person having a valid right to lay electric light wires will be there. They will then submit it to one of the companies and thus defraud the city and enrich themselves.

Taxpayers will eagerly look for the mayor's action on this barefaced attempt to rob the city treasury for the benefit of a few men who are noising more than cancers in the body of the people. The mayor need not veto the bill on any sentimental grounds, for if he consults his astute city attorney he will learn that it is against the statutes of the state to grant an exclusive privilege in any city to any company, not only because it is a monopoly, but because it acts as a bar to future progress.

Persons well informed assert the mayor is in a quandary. He has been given to understand plainly that if he defeats the pet scheme of the aldermanic coterie he need not expect their support for any of his favorites in the coming election. It is underrated his honor wants the matter to rest until the campaign is finished, but the aldermen have grossly eyes on the golden ring, and there is likely to be trouble in the democratic camp.

No matter what final action may be taken by the mayor, the taxpayers should at once stamp their disapproval of this attempt to wring from them by force money to fill the pockets of political vultures. If this scheme should prove successful its originator it would be but the forerunner for others more stupendous, and all citizens who are interested in the prosperity of the city, and in decent government, should not only oppose the scheme, but relegate to well-deserved retirement the representatives who made its success possible by their votes.

Feb. 2, 1883.

American Gas Light Journal.

Mr. Lane-Fox and His Predictions.

With reference to the lecture delivered by Mr. Lane-Fox, on "The Future of Electric Lighting," before the Royal United Service Institute, we find *Engineering* making use of the following—

"Now we, like Mr. Fox, believe that there is a great future before electricity, but we find a difficulty in keeping pace with him when he gives the rein to his imagination. In the first place, taking his own data, we work out the cost for him, with coal at 20s. per ton, to be rather more than a halfpenny instead of a farthing. But even with this higher figure the result is sufficiently good to please the most ardent depreciator of gas. An ordinary gas jet costs one-fifth of a penny per hour, so that if Mr. Fox's prophecy ever come true we shall obtain four times the light from electricity for the same price we now pay for gas. It is a pity that some clue is not given as to the possible direction in which the improvements by which this great reduction is to be made. To-day there would be a difficulty in getting a supply of incandescence lights at the price of gas, even if the consumer undertook the renewals of the lamps. Where then is this reduction of four times (Mr. Lane Fox himself gives it as 12 times) to come from? There is no likelihood of engines burning much less coal or of coal becoming cheaper. Dynamos already convert 85 to 90 per cent. of the energy delivered to them into current, so there is little hope in that direction. The only other factor is the lamp, but the lecturer appears to exclude that, for it is upon the energy retailed that he bases his calculation, and not upon the light. No doubt there is much room for improvement in incandescence lamps, and the discovery of a conductor that would endure a higher temperature could make a wonderful alteration in the cost of maintenance, but at present we see no prospect of such a discovery. We wish that Mr. Lane-Fox had been more explicit with his sanguine, and but furnished reasons that would have enabled us to share his rosy anticipations."

St. Louis Daily Globe-Democrat, April 29, 1883.

The Edison Light in St. Louis.

Mr. Wm. T. Brewster, special agent for the organization of local branches of the Edison Electric Light Company, of New York, has been in the city during the past week and has perfected arrangements to illuminate the central part of the city. It is reported that a company has been formed and that agents are canvassing the district and making estimates, in order to arrive at the proper size of conductor which is to be laid under the streets. This sudden movement was undertaken in order to prevent prospective customers from entering into five-year contracts with the agents of the water-gas company. A GLOBE-DEMOCRAT reporter called yesterday evening on Mr. Brewster at the Southern Hotel, and on directly inquiring the cause of his visit to St. Louis received the following reply:

"We have been making a canvass with the view of putting in a central system of lighting, the same as we have in New York, with the ultimate intention of introducing it in all sections of the city."

"Is this a new enterprise?"

"This is not a new enterprise. A party of about a dozen gentlemen, comprising the heaviest capitalists of St. Louis, appointed a committee which visited Menlo Park in 1879 and made a thorough investigation, as it was then developed."

Having become satisfied this was the coming light that was to supersede gas for interior lighting, they formed a company to introduce the light in St. Louis. Similar companies were formed in all the leading cities of the Union, but Mr. Edison did not favor introducing the system generally until he had installed a large central plant in New York, the Edison Company preferring, at its own expense, to demonstrate that a central system of lighting could be made an electrical and commercial success. This has now been done, and we are to-day lighting a district one mile square in New York, and, notwithstanding the extra expense attendant on the plant, it will show a good dividend on investment for the first year. Since we have been satisfied that this is the case, we have notified our friends in different parts of the country, and steps are now being taken to introduce a central system of lighting in over twenty towns and cities in the United States."

"When will the plant be ready?"

"We can erect it very rapidly, and in six months will have the system in practical operation in St. Louis."

NOVEMBER 18, 1882

THE CHICAGO TRIBUNE:

WISCONSIN.

THE ELECTRIC LIGHT.

Special Dispatch to The Chicago Tribune.

APPLETON, Wis., Nov. 17.—Edison's electric light is being introduced into all the leading cities of the Lower Fox River Valley. Oshkosh and Fond du Lac introduced it during the summer, and now Appleton is taking decisive steps in that direction. Already machinery with a generative power of 250 Edison electric lights is in operation. A new building has been erected solely for the purpose, and ere another month passes all the large manufactories will be illuminated by it. It is also being introduced into dwelling-houses.

Aug. 16, 1882.

American Gas Light Journal

Gas versus Electric Lighting.

In view of the assertions going the rounds of the Press, as to the great "economy" of using incandescent electric lights for purposes of household illumination, the following letter, to the London *Metropolitan*, from H. Saxon Snell, F.R.I.B.A., will be of interest. Mr. Snell has studied the question very closely, and his statements are not those of bare assertion, but are the deductions drawn from actual comparisons of cost. The letter is as follows:

To the Editor of the *Metropolitan*:

Many hundreds of thousands of pounds have lately been invested in electric light companies upon the faith of statements made in prospectuses that the mode of lighting is as cheap, if not cheaper, than that by gas. As to public buildings, we are told that "the difference between the cost of gas and electricity, light for light, is largely in favor of electric light, as proved by the Brush arc system at South Kensington (a saving of £325 16s. 4d. having been effected during the nine months as compared with gas)." Then Sir William Thompson is stated to have "had his house fitted with incandescent lamps from cellar to attic to the entire banishment of gas, and the cost of internal *wires* for electric lamps is less than the cost of fittings in connection with gas pipes." Lastly, we have the statement of Mr. William Crookes, F.R.S., and director of the Gulcher Electric Light Company, that he has fitted up two rooms in his private house with electric lamps, and has effected a saving of £4 17s. 6d. per annum as compared with gas lights.

No wonder, then, that one of my clients, a public Board, deemed it its duty to ascertain the cost of lighting by electricity one of the large institutions under its control. It instructed me to obtain estimates, and accordingly I applied to three of the most important electric light companies for specifications and tenders for lighting the building in question, merely stipulating that the work should be executed under the same general conditions as those employed in the contract for the supply of gas pipes and fittings.

In the result, three tenders were received for the execution of the works, amounting respectively to £5,500, £4,345, and £3,143.

It then became my duty to make an estimate of what would be the annual cost of lighting the building, supposing one or the other of these tenders to be accepted, and I did so as follows from one furnished me by one of the companies in question, though I thought it my duty to inform my client that I considered many of these items to be considerably underrated.

	No. 1. £.	s.	d.	No. 2. £.	s.	d.	No. 3. £.	s.	d.
Interest on first outlay at 5 per cent.	275	0	0	217	5	0	157	3	0
Depreciation of plant and general repairs at 10 per cent.	550	0	0	434	10	0	314	6	0
Coals—say 8 tons per day, at 20s. per ton delivered	730	0	0	730	0	0	730	0	0
Oil, waste, etc.	52	0	0	52	0	0	52	0	0
Wages, 2 engineers at £2 per week	208	0	0	208	0	0	208	0	0
" 2 assistants at 30 shillings	156	0	0	156	0	0	156	0	0
Renewal of lamps after first year, not including accidental breakage, but assuming the average life of a lamp to be 1000 hours, and that the average time of lighting would be 5½ hours daily	475	0	0	475	0	0	475	0	0
Total	2,446	0	0	2,272	15	0	2,092	9	0

As I was anxious that my report should as far as possible be incapable of question, I sent a copy of each of these estimates to the respective companies, with a request that they would point out any errors they might conceive to exist, and in reply they sent me their revisals, which resulted in the following estimates for the annual expense—viz., £2,394, £1,905, and £2,000, as against my own of £2,446, £2,272, and £2,092 respectively. These reductions were made in various ways, some conceiving 4 per cent. for interest on outlay, and an average of 5 per cent. only for depreciation and repairs, to be a sufficient allowance.

It now became necessary to calculate the corresponding cost of gas lighting. The total outlay for fitting up the building in question with gas pipes, burners, meters, and all other appliances, had been £906. The annual cost of gas consumed, exclusive of that consumed in a cooking apparatus, was £738, but more than one manufacturer has offered to supply regulators (there are none at present), and to guarantee a reduction in the consumption of 20 per cent., failing which no claim would be made for payment. Moreover, I have lately had the meters, from the records of which the above amount is computed, tested by a Government official, and he reports, as to three or four of them, that they register three and four per cent. more than the actual consumption. But neglecting these important considerations, and assuming the consumption to continue now as in the past, we find the annual cost of the gas lighting to be as follows:

Interest as before on first outlay (£906) at 5 per cent.	£45	6	0
Depreciation of plant and general repairs as before at 10 per cent.	90	12	0
Annual cost of gas actually used in the past	738	0	0
Total	£873	18	0

Now observe how the matter would stand supposing that the lowest tender (No. 3, £3,143) for the electric lighting appliances were accepted, and that in the execution of the works no extra expenses were found to be necessary, assume also that the corresponding estimate, £2,000, *made by the company itself* for the annual cost of lighting to be the right one, and we have—

	Gas Lighting.	Electric Lighting.
Cost of all appliances	£906	£3,143
Annual cost of lighting	£874	£2,000

These estimates ignore the fact that even though the electric light were adopted, it would still be necessary to retain and use the present gas fittings because the majority of the rooms and corridors of the institution in question from the nature of their use require to be lighted with a subdued light during the whole of the night. It would clearly not be fair to calculate that the electric light machinery would be working all the time to supply this comparatively small demand, neither does it take into consideration the very important fact that the gas burners give greatly-increased warmth to the rooms in which they are placed, and that, therefore, in the absence of these appliances, a much larger consumption of coals for heating purposes would necessarily result.

This inquiry was entered into by me without the slightest prejudice in favor of either system, and in entire ignorance of their relative monetary values; but the information I have gathered during the course of my investigation results in a strong conviction that if the statements before referred to as to the economy of gas lighting in private houses were submitted to similar impartial tests they would be shown to be fallacious. Further, I have no hesitation in saying that if only a tithe of the scientific labor now devoted to the improvement of electric lighting apparatus were expended upon discovering methods for improving the construction of gas lamps in closed rooms, the superiority of gas as a lighting agent in such situations would be shown to be paramount. I do not hazard an opinion as to the relative advantages of the two systems when employed to light railway stations or other such like open spaces.

Mr. Crookes says that with the use of gas "the ceilings get blackened, the curtains are soiled with soot and smoke, the decorative paint work is destroyed, the gildings tarnished, the bindings of the books rotted, and the air of the room is not cool and fresh, but vitiated by the hot fumes from burnt or semi-burnt gas." But surely he must be aware that these ills do not attain where proper apparatus, such as "Rickett's ventilating gas globe lights," "Siemen's regenerative gas burners," or the ordinary "sunlights" are employed for lighting up rooms. These appliances, when in use, carry off into the outer air not only the products of combustion, but they also act as powerful ventilators by drawing away foul air from the upper parts of the rooms in which they are placed, air which would stagnate there were these lamps to be replaced by electric lights; and it is, therefore, to the improvement of this class of apparatus so as to moderate their present prices that I would, as a corollary to my investigation, commend the attention of our scientists and mechanicians.

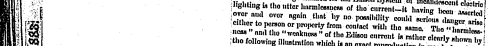
NOVEMBER 22, 1882

THE DAILY NEWS,

ELECTRIC LIGHTING IN THE CITY.—Yesterday, at a special meeting of the City Commissioners of Sewers held at Guildhall, Mr. Felton presiding, the Streets Committee, by Mr. Pannell, their chairman, brought a report in regard to the notices from various electric lighting companies of their intention to apply to the Board of Trade under the Act of 1882 to enable them to light the City by electricity. The Committee instructed Colonel Heywood, the engineer, to obtain the opinion of some eminent electrician as to whether it would be practicable to lay in the same tube the conductors of various companies for lighting by different systems of electricity without the conductors so laid injuriously interfering with each other, and also whether the conductors laid in a district by any one company could, if their usage by that company be discontinued, be made available for any other company using a different system. They now submitted a long report from Mr. W. H. Preece, of the General Post Office, on these points. His opinion was that, except in a subway of considerable size, it was impracticable to maintain the conductors of different companies in the same tube. As to the other point, he observed that the arrangement of conductors to fulfil the requirements of an electric light system was a very complicated matter indeed, and he knew of no branch of engineering where more forethought was necessary to calculate all the contingencies likely to be met with than a system designed to illuminate a large city like London. Every system required its own distribution, dependent upon the area to be illuminated, the number of lights, the route of the conductors, and the position of the generating station. The whole question of the distribution of electricity for lighting purposes was in a very tentative state. Sufficient experience had not yet been gained to determine exactly what was required in all circumstances, or even what those circumstances would be, and he thought that those corporations who had taken on themselves to supply electricity had undertaken a responsibility that they had not sufficiently contemplated, and which, with the present state of our knowledge, was extremely difficult to discharge. Hence, he said, that while there might be cases where the conductors of one company might be available for another, there could not be a case where they were properly available unless the two companies employed the same system and utilised the same central station for the generation of their electricity and the distribution of their force.—Mr. J. V. Moore moved, and Mr. Boor seconded, "That the Remembrancer be instructed to take all necessary steps to enable the Commission to become the undertakers for the supply of electricity to the City under the provisions of the Electric Lighting Act, 1882; to obtain a provisional order under the regulations laid down by the Board of Trade, and to oppose the applications of all other parties." To that Mr. Innes moved, and Mr. Baptie seconded, as an amendment, "That while the Commission was in favour of electric lighting in the abstract, it was advisable to allow all further experiments to be conducted at the risk of the lighting companies, and not at the expense of the ratepayers." After a discussion lasting some hours, the amendment was carried by 31 votes to 26, and subsequently, on its becoming the substantive motion, by 22 votes to 21. It was then further resolved, at the instance of Mr. Alderman Staples, that the Remembrancer be instructed to appear, on the application of the electric lighting companies, and secure clauses protecting public and private rights. Mr. Stoneham gave notice of motion for the appointment of a Select Committee to inquire into the steps to be taken to enable the Commission to be the undertakers for the supply of electricity, looking at the vast interests at stake.

Aug. 2, 1883.
American Gas Light Journal.

Service Pipe Fused by an Edison Illuminating Wire.—Among other "dead sure" things claimed for the Edison System of incandescent electric lighting is the utter harmlessness of its current—it having been asserted over and over again that by no possibility could serious danger arise either to person or property from contact with the same. The "harmlessness" and the "weakness" of the Edison current is rather clearly shown by the following illustration which is an exact reproduction in wood of a photograph of a service pipe which formerly led into the buildings Nos. 121 and 123 Front street, New York city. Mr. J. W. Phyfe, who has his offices on



the first floor of the premises mentioned, uses the Edison light for purposes of illumination, the rest of the building being supplied with gas from the mains of the New York Gas Light Company. The gas service pipe was two inches in diameter, and entered the building alongside of the Edison supply wires. As nearly as can be ascertained (for the investigation subsequently made proved nothing conclusively) one of the electric light wires became reduced it to the condition as seen in the engraving. The escaping gas became ignited, causing an explosion, and setting fire to the premises; the flames were easily and speedily extinguished, so that no great amount of pecuniary damage ensued. This is mainly of interest from the fact that it entirely upsets the "perfect safety" theory so often advanced by Mr. Edison and his confreres.

Pond du Lac's Towers Heard from Once More.—On May 12, we announced that one of the electric light towers at Fond du Lac, Wis., was leveled to the ground during the prevalence of a storm of wind on the night of April 14. We also predicted, at the time, that some of the other structures of a similar nature would probably come down in the same manner. Well, this prediction is now verified. On the morning of July 16, the principal electric light tower, situated in the center of the town, suddenly tumbled. One portion of it, a piece weighing about 500 pounds, crashed through the roof of a saloon, demolishing a stove at which a woman was cooking; strange to say, she escaped injury. The loss is put at $2,000. It might be added here that no storm of any kind prevailed at the time. Wonder how long before New York will have a similar experience.

The authorities have at last reached the sapient conclusion, from the evidence presented, that it is no longer safe to trust the towers which still remain in position. The Mayor of Fond du Lac telegraphed the Electric Tower Company (the contractors who erected them) ordering the structures to be taken down. The tower company made no response, and so the city authorities, to guard against further accidents, are belaboring them (the towers) with guy rods. They never had to put "guys" around the lamp-posts. Moral, go back to gas; or better still, never "go back" on gas.

American Gas Light Journal.
An Electric "Leak."
Sept. 2, 1882.

On the morning of Thursday, August 24th, one of the Edison conducting mains, situated in Nassau street, near Ann, New York city, became injured in some manner, probably through the carelessness of the laborers employed by the steam heating company engaged in piping the downtown district. The consequence was that an escape of the electric current occurred, powerful enough to be felt by horses passing over the street in close proximity to the spot where the fracture existed. The strange antics of the animals when first experiencing the shock, created considerable amusement for the bystanders.

A reporter of the New York *World* had the following interview with Mr. Edison in relation to the "leak"—

"In the first place," said Mr. Edison, "the report that it would be impossible for the fluid to communicate with the horses unless their shoes came directly into contact with some metal is all a mistake. The thing can be, and, in this case, has been done. The disturbances was directly due to a very simple circumstance. A service pipe had been laid from the main to a printing office in an upper story of a house in Nassau street, passing through a liquor-beer saloon in the basement of the building. We had only got so far as the basement with our operations and the end of the pipe was left there, protected by a small metal cap. This cap, which had apparently not been properly screwed on, became loose and slipped on to the conductors, between which and the pipe enclosing them communication was thus established. The electricity, finding its way along the pipe, radiated in all directions in the earth, and a horse passing along the street near the base of the radiation, and forming part of what is technically called earth, would receive a shock sufficient to cause it considerable surprise, if not alarm. It was by some overweight, such as the most careful workmen are liable to, that electricity was in the service pipe at all, when we tested it yesterday we at once found a fault which it contained, for by our system we can locate faults with the greatest facility, and orders were given that it should not be connected with the machine. The branch, however, was supplied with electricity. But the force of the current that affected the animals was very trivial, equal to only some seven or eight cells of a common battery. Such a weak current could only affect the lower animals. All the steeplechasing that happened was simply due to the nervousness of the animals at the novelty of the sensation. At Menlo Park I have [illegible] tric railroad, and a horse crossing it will occasionally get a slight shock [illegible] become secured. Yet a man can take hold of the rails with impunity. [illegible] electro-motive force is equal to 100 cells of a Daniell's battery, which would cause a pressure of 100 volts—a very low pressure, indeed."

"Had you much difficulty in setting matters right?"

"We just took the service into out and disconnected it. You see it here."

Mr. Edison pointed to a short piece of iron pipe about three inches in diameter, containing two copper rods insulated from each other by means of an asphaltic compound. At one end was a flat iron box containing a quantity of the compound, and which Mr. Edison explained was used for making the connection between the service pipe and the main. The size of the conductors vary according to circumstances, the main conductors being equal to a copper rod half an inch in diameter, and the service conductors to rods of a smaller size."

"We were rather surprised at the very successful insulation we obtained by repeated experiment," said Mr. Edison. "We calculated that a certain length of pipe having a certain leakage, a hundred times the length would have a hundred times the leakage. We found, on the contrary, that by the use of one compound the insulation was in the ratio of no more than three to one. We tested three and one-half miles last night and the insulation amounted to 2,800,000 ohms, which is unprecedented for the size of our work and the necessarily rough and practical character of our machinery. Of course, compared with things like the Atlantic cable, the insulation is nothing extraordinary, but the instruments used for those purposes are of the most delicate and refined type."

"Do you expect soon to have your works in active operation?"

"Well, we are ready to go to work now, if the company pleased; but at present we are cutting in, and so on. I suppose in ten days we [illegible] 1,000 lights cut in. 'Cutting in' means establishing communication between the house and the main pipe. In the Nassau street district [illegible] 3,100 service pipes, and about fourteen miles of pipe altogether. [illegible] strict comprises 512 consumers. There are 14,011 lamps to be connected with these wires."

St. Louis Health Globe Remedy. April 29, 1883.

...AMERICAN

...GHT JOURNAL

...OFFICE No. 42 PINE STREET...

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[OFFICIAL NOTICE.]

American Gas Light Association.

OFFICE AMERICAN GAS LIGHT ASSOCIATION,
No. 142 Cedar Street, N. Y.

The Tenth Annual Meeting of the Association will be held in the city of Pittsburgh, Pa., on the 18th, 19th and 20th days of October, commencing at ten o'clock, A.M.

Headquarters of the Association will be at the Monongahela House—terms, three dollars per day.]

Members who intend to present papers at this meeting are requested to notify the Secretary of the titles of their articles, so that a programme may be arranged at as early a date as

Sept. 16, 1882.

Blank applications sent to ...ntire desirous of ...

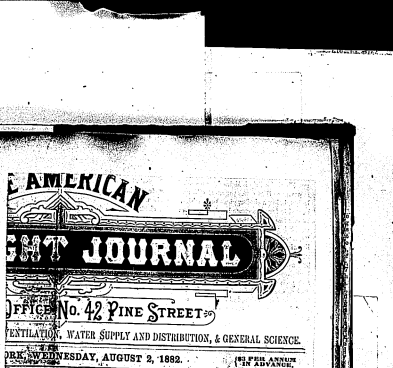
American Gas Light Journal, ...rer, Secretary.

PROGRESS OF GAS AND ELECTRICITY.

As time goes on and the earlier excitements incident to the first introduction of so-called novelty and new discovery gradually subside, as the echo of the flourish of trumpets preceding the launching of the great schemes of stockers times dies away behind the rolling hours of three or four short years, a lull in the excitement, a quiet hour for actual investigation of facts is granted, and even the public, who are ever ready to grasp at novelty, and remove that impatient of the delay of careful investigation, becomes satisfied in time that there is a wide margin between the promises of enthusiastic "promoters," and the results obtainable under the ordinary working conditions of every-day practice.

...t four years ago we published a report, made by the Editor of this Journal, after a most careful investigation of the subject of electric lightings made under exceptionally favorable circumstances in Paris, where "the light of the future" was then brought forth under most favorable auspices. The opinions expressed in the report are true to-day than when they were written, if we may be pardoned the expression, for they are most fully borne out by the experience of the years that have elapsed since 1878. At that time the Avenue de l'Opera, the Place du Theatre Francais, and the Place de l'Opera, were refulgent with the beautifully clustered coming effect of the Jablochoff electric candle. Its use continued for some three years thereafter, but the traveler or the citizen looks in vain to-day for the electric light in any of those places, but instead, if one cares to notice, is to be found the improved street lighting by gas.

We are fully aware that the conditions under which the streets of Paris are lighted are exceptional; but this does not in any way affect the reasons for the discontinuance of the electric street lighting. That resulted simply from the inability of the company to continue the service, without financial loss, at the prices which were at first submitted as ample for proper compensation. In fact the manager of the company is said to have stated that they could not afford to continue the advertisement at so great an expense. A similar result was reached in London in at least one case—that part of the city in the vicinity of the Mansion House, which was most superbly lighted (regardless of cost) by the Siemens system. After one year's trial it was found that the price obtained, which was several times that previously paid for gaslighting, was not sufficient to warrant those supplying the electric light in continuing the service without a large increase in compensation.



...AMERICAN

...GHT JOURNAL

...OFFICE No. 42 PINE STREET...

...VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

...ORK, WEDNESDAY, AUGUST 2, 1882. [$3 PER ANNUM IN ADVANCE.

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Those intending to be present at said meeting are earnestly requested to notify the Secretary, on or before August 12th, of such intention, and whether they wish rooms engaged.

PROGRAMME.

Wednesday, August 16.

8 A.M.—Leave Boston by Boston and Providence Railroad.
8:15 A.M.—Leave Boston by Old Colony Railroad.
10:30 A.M.—Arrive at New Bedford; short walk to Bancroft House.
11 A.M.—Business meeting.
1 P.M.—Dinner.
2 P.M.—Business meeting.
4 P.M.—Visit gas works, etc.
7 P.M.—Tea.

Thursday, August 17.

7:30 A.M.—Breakfast.
8:30 A.M.—Take steamer for Oak Bluffs, Martha's Vineyard.
10:30 A.M.—Arrive at Oak Bluffs.
12 M.—Dinner at Sea View House, Oak Bluffs.
1 P.M.—Take steamer for Gay Head and extended sail back to New Bedford, arriving at about 4 o'clock.
4:30 P.M.—Train leaves for Boston by Old Colony Railroad.

August 1, 1882.

GEO. B. NEAL, *Secretary.*

A. B. SLATER,
H. A. ALLYN,
R. B. ——,
Com.

Aug. 2, 1882.

American Gas Light Journal.

ELECTRIC LIGHTING ON OCEAN STEAMSHIPS.

There is probably an application of the electric light more advantageous, or more conducive to the security of those interested, than its adaptation to the uses of those immense steamers that are engaged in plying between this country and Europe. When we consider the large and increasing number of our people who cross and re-cross the ocean every summer, the large number of ships employed, and the immense size of some of them, safety becomes a consideration of the first importance; and it cannot be denied that the incandescent light has been so adapted to the requirements of the case as to give great relief from the danger which must ever attend the use of open lamps at sea.

There is no steamship as yet which relies entirely upon the electric system of lighting; but there are several that have introduced it to a greater or less extent, with a degree of success, so far as the lighting is concerned, that renders it worthy of notice and commendation.

The steamer Servia, of the Cunard line, is said to be the largest commercial steamer afloat, excepting the Great Eastern, being 530 feet in length, 52 feet beam, 40 feet 9 inches deep, and having a measurement of 8,500 tons. She is propelled by engines of 10,000 horse power, while her screw is 23 feet 6 inches in diameter. Thirty-nine boilers and furnaces, all told, supply the power for all purposes, and steam power is employed for every possible purpose, in order to reduce to the minimum the manual labor required. A large

Feb. 16, 1882.

American Gas Light Journal.

REMARKABLE REPORT ON THE COST OF INCANDESCENT ELECTRIC LIGHTING.

Herewith is given the gist of a report to the American Electric Light Company, by Mr. E. P. Roberts, on the cost of incandescent electric lighting—

"I calculate that we can, merely allowing equal illumination, and not taking into account the immense advantages of incandescent lighting, compete with gas at 96 cents per M.

"The following is the data from which I have obtained the above result—

"Take a 500-H.P. engine—cylinder 26×45; pressure by gauge, 75 lbs.; revolutions, 100; pressure absolute, 90 lbs.; 25 per cent. cylinder condensation; assuming 7.65 lbs. of water evaporated per pound of coal; coal $4.25 per ton of 2,000 lbs.; clearance 2½ per cent.

Cost of engine, $9,000. Cost of boiler, $8,500

Interest on cost of engine, per hour	.062
" " boiler "	.059
Repairs to engine, "	.018
" boiler. "	.023
Depreciation of engine, life 25 years	.012
" boiler, " 12 years	.082
Oil and waste	.062
Wages of engineer	.400
" fireman and coal passer	.350
Cost of coal	4.184
Total	$5.282

This engine develops economically 502-H.P., when expanding 3.4 times. Cost of 1-H.P. per hour, $.015.

"The following is an estimate of the cost of a plant of thirty 100-light machines, to be run by the above mentioned 500-H.P. engine and boiler. Each H.P, to run six 16 candle power lamps, or 96 candle power, giving a total of 48,000 candle power.

"First cost of electrical plant—

Cost 30 machines @ $600	$18,000
" 3000 lamps @1.25	3,750
" 20 miles of main @ $3,500	70,000
" laying " @ $1,800	36,000
Shafting, pulleys, tools, fittings, testing aprratus, etc	3,000
Capital	$130,750
Interest on $130,750 @ 6 per cent	7,845.00
Salary one electrician	1,500.00
" two assistant electricians	1,200.00
" one helper	500.00
12,000 renewals @ 15 cents	1,800.00
Rent	2,500.00
Repairs @ 10 per cent. on $130,750	13,075.00
Depreciation @ 10 per cent	13,075.00
	$41,495.00

To run 30 machines 10 hours per day, cost per hour	11.37
" 1 " " " "	.379
" 1 light " " "	.00379
" 6 " " " "	.0227
Giving the electrical cost of 6 lights, each 16 C.P.	.0227
Cost horse power for same	.0105
Total	.0332

"The same illumination with 18 candle power gas, would cost .0331 at 96 cents per thousand."

REMARKS.

The above is given as showing from what false premises conclusions are reached when the public is asked for means to carry on what must prove, from the author's own data and admissions, an unprofitable enterprise.

From such a writer blunders and misstatements may be looked for; but when, to advantage his argument, he overstates by 30 per ct. the cost of the light of 96 candles from 18 candle gas at 96 cents per thousand cubic feet, he trespasses on the credulity of the general public and causes engineers to mistrust every other statement in his report. It was not convenient to the argument to state that an electrical lighting for three and three-tenth cents gave the light of 96 candles, whereas, with 18 candle gas, 26.6 cubic feet would be required to give a light of 96 candles which, at 96 cents per M, would cost 2.55 cents, and not 3.31 cents.

The admissions in the report confirm the information already obtained that the interest alone, at ten per cent. on the capital required in such an electrical plant as estimated for, would entirely cover the present charge for gas to the consumer in many of our cities. To this charge, in incandescent electrical lighting, must be added the cost of coal, not less than twice as much, per candle of light for so-called 16-candle power incandescent lamps, as for gas, and all the other items entering into the cost of manufacture and distribution. The total cost to the user of electric lights instead of three and three-tenth cents for the light of 96 candles must be much more if the stockholders in an electric light company are to receive any interest returns for their investment from supplying the public with light.

The writer displays an inexcusable or willful ignorance of the conditions that obtain in the use of illuminating agents by estimating that an electrical plant, with a maximum capacity of 48,000 candles light per hour, is going to deliver to its customers this amount of light for ten hours in each and every day in the year. This never happens; but this is the false but convenient basis by which comparison is made with a gas plant. When the conditions under which light is actually used are considered it becomes evident that nearly all of the writer's items of cost have to be more than trebled.

Not only so, but the cost of plant and working are underestimated, the low figures made cannot be substantiated by the data of any practical working. The delivery of candle power per horse power is overestimated as, in practice, it is doubtful if the delivery to the consumer of the equivalent, in all respects, of 50 candles in gas per horse power has been reached where the incandescent lamps are of 16 candle power, nominal. Moreover, in the above estimate, many of the serious items of cost, necessary to the distribution of every illuminating agent, have been entirely neglected.

American Gas Light Journal.
Feb. 83.

Some Figures as to the Probable Cost of the Electric Lighting Experiment at Hartford, Conn.—To cover the territory named in the resolution, not less than 24 arc lights would be requisite, the cost of which for 336 nights all night would amount to $8,064. These would displace 147 gas lights, costing for the same number of nights and hours, as near as can now be estimated, $34 each for the time, amounting to $4,998. It will be seen that the increased cost is $3,066, or more than sixty per centum. If portions of the city are lighted by electricity there will be a demand for the same from all other sections, and if the 1,280 gas lamps are all displaced the additional cost to the city yearly would be $26,700. Substituting the electric for the naphtha lights would extend this excess to the neighborhood of $30,000. In short, the lighting of the whole city by electricity (on existing systems) would call for an annual expenditure of $75,000, or more.

ROYAL AQUARIUM ELECTRICAL EXHIBITION.

The arrangements for the holding of an electrical exhibition at the Royal Aquarium at Westminster having been somewhat delayed, the formal opening, which was to have taken place on Saturday evening, has been postponed for a few days. By the end of the present week, however, it is hoped that everything will be in readiness. In the meantime some of the more attractive features of the as yet incomplete exhibition are on view to those who patronise the musical and other entertainments, with which it is not proposed that the new undertaking should interfere in any way. The entries, although necessarily not so numerous as those at the Crystal Palace, are yet sufficiently large and representative, all the inventors and manufacturers whose names are at all known to the public in connection with the development of electricity being represented. No startling novelty is shown, yet an inspection of the many minor improvements in electrical apparatus, many of them of considerable ingenuity, which have been made but yesterday, as it were, helps one to realise the extraordinary and increasing activity which prevails in this fascinating branch of engineering science. Messrs. C. and F. H. Varley exhibit an entirely new arc light, which it is claimed, owing to the efficiency of the apparatus for adjusting the carbons, gives an exceptionally steady light. Of this visitors to the Aquarium will have an opportunity of judging when it is in operation side by side with the twenty-six large Siemens lamps which for some days past already have served to illuminate the interior of the building. Messrs. Varley also show besides some interesting slides and subdividers, specimens of flexible carbon made from fibre which, it is alleged, is capable of producing a light of far greater intensity in an arc lamp than the ordinary hard carbon, while it is no less durable. A bolder flight of ingenuity is that by which Mr. C. W. Harding proposes to utilise the action of the waves of the sea for generating and storing up electricity. If this is really practicable it is obvious that the motive power at the disposal of the inventor is practically illimitable. The electricity is supposed to be generated by air compressed by a vessel rising and falling. Mr. Harding bases his calculations upon the supposition that a vessel 40 feet in diameter would be capable of lifting 20 tons at each rise of the waves; that the average rise of each wave allowing for fair weather and foul is 3 feet; and that the vessel encounters 8 waves a minute. In addition to the Siemens lights already mentioned, there are nearly one hundred lamps on the Pilsen, Lampe-Soleil, Gülcher, and other well-known systems, which are fitted up upon massive supports ready to flood the already well-lighted interior of the building with their brilliant light. The beautiful little incandescent lamps of Mr. Edison and Mr. Swan are in operation in separate courts, while the annexe devoted to the Beckwith swimming exhibition is provided with some 400 lights on the Ferranti-Thompson system. As usual, Mr. Edison's lamps are the most tasteful and varied of all as regards the fittings. One room in which they are exhibited is laid out with ferns and grottos and palm trees by Messrs. Dick Radclyffe and Co. The effect is delightfully fresh and pleasing, with the green leaves and rockwork lighted up by the bright, glowing threads of carbon throwing out their coloured lights. It would be impossible of course to give even a bare mention to the thousand and one applications of electricity to the service of mankind. The exhibits are divided into some thirteen branches or sections. One is devoted entirely to the important subject of the production of electricity, another to its transmission and distribution, a third to its application to lighting, a fourth to its storage, and so forth. Dynamometers for measuring the quantity of electricity which has passed along a wire; microphones, telephones, mining lamps and Edison's lighting apparatus are among the more generally interesting specimens of the uses of electricity. One firm exhibits burglar alarms, which will ring a bell on the opening of any door or window to which it is fitted up. The bell continues to ring should the door or window be closed again immediately, or even should the wire be broken.

JULY 11, 1882
THE DAILY NEWS.

ELECTRIC LIGHTING IN THE CITY.

...on his report to the Electric Committee of the Commissioners of Sewers, Lieutenant-Colonel Haywood gives a favourable account of the experimental lighting of the Holborn viaduct by the electric light. The incandescent lamps are of course infinitely superior to the arc lamps, and the only reason for which one should be disposed to prefer the latter is the fact that the single gas lamp, which they displace, "is so dim, that it is not the object to which ordinary illumination is a great consideration, and this cannot be attained by the lamps system was about the ten-and-one-half feet apart. Lieutenant-Colonel Haywood says that the electric lamps in the Holborn which he visited (and there are other lamps are in course of erection to destroy the eye and the footway) there is no flickering, and no material variation in fluctuating power, as far as can be noticed by the ordinary observer, and the Viaduct is the most perfectly and well lighted. The Edison lamp, however, is by far the superior of the two, and the Holborn Viaduct supplies a mass of facts and figures bearing on the valuable experience already gained of lighting the City by the Brush, the Lontin, and the Swan systems. From the general statement it is contended that the cost of lighting by the Brush system was about two-and-a-half times as much as ordinary gas lighting, while the Lontin cost about three times as much. Under the three systems there is a loss of light (in proportion to quantity) of about one-fifth after the period of about 500 hours' use. Electric illumination should not be thought of, but on special occasions, and have practically no longer for themselves, the continued use of which would necessitate expenditure to an unjustifiable extent. The matter of this report has already been made public in the columns of the Times some considerable. It appears from figures attending in the report of the Electric Committee of the Commissioners of Sewers regarding the electric lighting, the cost of the light in the City, which will be considerably reduced by the proposed use of the Holborn Viaduct. Colonel Haywood in the purpose of lighting besides the commercial new districts in the east, north, and west of the City have divided into four districts, the boundaries of which appears from the tabular statistic that the competition between companies will be sufficient to secure the best service results, including the fixing of machinery, lamps, &c., varied considerably—the Brush Company's tender for one year being £1,600, or £1,800, or £2,000 against £611, the present cost of gas. In some instances, however, the Commissioners would with their leave to light private premises within the district. Colonel Haywood has also made inquiries as to the charge for lighting (exclusive of machinery, &c.), the same as for the gas saved, which the Commissioners recommend the Commissioners to proceed further in the matter. At present, the report of the Electric Lighting Committee, the Commissioners that, by the Bill now before Parliament, and the Corporation of London, by the Board of Trade, to be proposed to give power in the City to the Commissioners of Sewers, and to confer upon them the necessary powers to enable them completely the undertakings of that nature which they were given the powers of Parliament has decided that the Commissioners of Sewers should be the authority which should have the power to grant licenses for lighting streets, and that the Commissioners of Sewers should be the authority which would be responsible for the control of the electric lighting of the City by the Board, and the Commissioners are already empowered to which the undertaking operation. The Committee recommend that the Commissioners of Sewers now be informed the recommendations of the important questions involved in this document.

Feb. 2, 1883.

American Gas Light Journal.

INCANDESCENT LIGHTS IN NEW YORK.

We are informed by the officers of the New York Gas Light Company, who partly supply the down-town district with gas where the Edison system has been introduced, that in the month of December last (1882) one hundred and two of the gas company's consumers were using the incandescence electric lights. During the month of December, 1881, the previous year, these same 110 consumers burned 1,025,000 cubic feet of gas, while during December, 1882, they consumed 618,000 cubic feet, thus making a difference of 427,000 cubic feet.

This difference may not all have come from the use of the electric light, as during the winter months the consumption of the down-town districts varies very largely with the state of the weather. A very dark, foggy or stormy day will sometimes increase the send-out 30 per cent. over what it would be on a clear, bright day.

One fact is evident, from the figures given, and this is that electricity does not do all the lighting for even those places where it has been introduced. A goodly quantity of gas seems to be needed; and, if rumors are true, a goodly quantity of money will be required to pay the electric lighting bills. Sample bills were sent round to the electric consumers, for the month of December, not for payment, but to show about what the cost of the new light would be; in most cases this cost amounted to about three times the price of all the gas used formerly, besides the cost of gas used at present.

Of course, the prices charged for electric light are subject to modification, from time to time, and they will have to be made satisfactory to consumers or they will not use the light.

There is some trouble about estimating by the candle power of the incandescence lights, as it sometimes happens that the bulbs become discolored on the inside, from some cause or other, and they do not then transmit the full volume of light which they are calculated to supply. This is not a new fear of renewals of lamps necessary to give the proper amount of light. The working thus far would rather tend to show that Dr. C. W. Siemens was right when he said that, "Electricity is a light of luxury, but gas is the poor man's friend."

American Gas Light Journal, Feb. 2/83.

Electric Light in China.

Nature says the introduction of western improvements into China by Europeans is evidently a work beset with many difficulties. Some years ago the only railway in the country was purchased by the government from the promoters and promptly torn up; but now the officials themselves are laying down railroads from the mines in North China to the nearest canal. The telegraph also had to encounter a vigorous opposition, from the authorities and people for many years; at present, however, the capital is connected by wire with the coast. The electric light is the latest improvement which has excited the suspicion and dislike of the Mandarins. The foreign settlement at Shanghai has for some time been lighted on the Brush system, apparently much to the comfort and jubilation of the denizens of the "model settlement," as the foreign part of the city is generally called. This grew, however, to have to be reckoned without the Chinese officials. They prob ably thought that where gas was introduced there could be no objection to electricity. The Chinese Governor of the district appears to be of a different opinion. He has addressed a letter to the senior Foreign Consul, translations from European papers, that horrible accidents have arisen from the use of such dreadful risks.

"Hundreds of thousands of lives might be destroyed, millions of lives might be lost; even the walls of the city might be blown down if anything went wrong with the machines. He has strictly forbidden his own countrymen to use it, and has peremptorily ordered those who have already adopted it to discontinue it forthwith.

NATURE

VIENNA INTERNATIONAL ELECTRICAL EXHIBITION

THE Vienna Electrical Exhibition was opened to-day to the public. The patrons of the Exhibition are the Crown Prince Rudolph, the Portuguese Crown Prince, the Princes of the Imperial family, the higher functionaries of the State, and the Corps Diplomatique were present at the opening ceremony. The attendance of the public was small; only 2000 persons have visited the Exhibition to-day, the weather being rainy. The Crown Prince, in a speech, which was afterwards delivered by Baron Erlanger, the president of the Exhibition Commission, said that it did not seem to be only by chance that the third and greatest Electrical Exhibition is held in Vienna—in the town in which, in 1833, lucifer matches were invented by Preschel, from which, in 1837, the tentative candle found its way through the whole world, and where the lighting of streets by gas had been suggested by the Moravian, Zinzar, before it was carried out in England.

The Exhibition, though still incomplete, promises a good display illustrative of the great progress made in practical electricity during recent years, and showing how the application of electricity for the various purposes of industry and of daily life is becoming more and more common. So far as we can see now, although the work of installation of the machinery and apparatus is not yet completed, the Exhibition will stand comparison with previous exhibitions as to the number and variety of exhibits and the arrangements of the whole. From the official catalogue published to-day we learn that there are 372 exhibitors, 23 of whom are from Austria, 133 from France, 68 from Germany, 22 from Russia, 16 from Italy, 10 from Denmark, 13 from America, and 27 from England. Thus the Exhibition is rather a Continental one, and it is generally much regretted that so few exhibits have been sent from England, which has played a leading part in the development of applied electricity.

A special feature of the Vienna Exhibition is the building itself—the Rotunda, built by Scott Russell, the eminent engineer, in 1873, covering with its annexes and courts a space of 15,000 square metres. The vast dome is 79 m. in height, and three galleries, the highest—the interior gallery—being 66 m. above the ground, make it well adapted for illumination by electric lamps. Everything has been done to make the Exhibition as interesting and attractive as possible. Between the Rotunda and the Praterstern an electric tramway will run. The Rotunda is brought into telephonic connection with the Opera. A gallery of the Exhibition building contains a model theatre lighted by incandescent lamps, where ballets will be performed and scientific lectures given by eminent specialists, while another gallery contains beautifully arranged and furnished interiors and the picture gallery. In the machine rooms the great boilers make a gigantic impression; they will supply the various motors with 1,500 horse-power to drive the electric machinery for lighting and transmission of motive power. In the nave are arranged the exhibits of different makes of compactes and also various scientific apparatus, of which further details will be given in subsequent communications.

Vienna, August 16

NATURE

THE VIENNA INTERNATIONAL ELECTRIC EXHIBITION

FOR two weeks, the arrangement of the machinery being nearly complete, the Exhibition has been open in the evening from 7 till 11. The effect of the illumination of the immense interior of the Rotunda and its annexes by the various incandescent lamps, and of the surrounding places which are lighted by Brge reflectors, is brilliant. The electric railway of Siemens and Halske between the Rotunda and the Praterstern is already in operation. The theatrical performances at the "Asphalteln" Theatre, which is lighted by 1500 Swan lamps fed by a large Ziemtrowsky alternating current machine, have also begun this week.

The series of lectures to be held at the theatre during the Exhibition was inaugurated on August 27 by Sir C. W. Siemens, with a lecture "On the Temperature, Light, and Total Radiating Power of the Sun." After a short introductory sketch of the nature of the terrestrial sources of light, the lecturer gave an account of the ratio of the three forms of radiant energy, viz. heat, light, and actinism, as produced by the sun and terrestrial light sources. Then referring to the difference between the statements of various astronomers and physicists relating to the temperature, he expressed his opinion that the temperature of the sun could not exceed 2000° C., and explained the experimental methods he used for measuring the solar temperature. The second lecture was delivered on Sep-

[1] A name or other surname of Jacob's one whose ends exactly coincide with the edges of the rectangle, and which is the greatest circle that can be bounded by lines within the margins of the rectangle in which it is inscribed.

tember 1, by Dr. Aron of Berlin, "On the Telephone and Microphone." In this lecture the principles were explained on which the construction of the different telephones and microphones is based. These were also mentioned the variations of timbre as produced by these instruments; according to the experiments of Helmholtz the higher tones are transmitted better by the telephone, and therefore the timbre becomes clearer, while by the simple microphone, as Dr. Aron has found, the deeper tones are better transmitted, causing a duller timbre, but this latter is avoidable by using microphones with metal rods. The lecturer explained also the principle of a new instrument, invented by himself, called the sensaphone. In this instrument the variations of the current in a coil of insulated wire are transmitted by means of a second coil joined to a telephone or microphone. Dr. Aron made experiments with his sensaphone at Berlin, and was able to hear signals, the distance between the two coils being 70 feet. A similar experiment was carried out by Dr. Aron in the course of his lecture, and we could hear the noise made by a Neef's interrupter for from the lecture room, using a Siemens' telephone; the distance between the two coils being 5 feet.

Electric lighting is very well represented at the Exhibition, and a variety of new incandescent and arc lamps is to be seen there. As to the number of lamps exhibited, the first place is taken by the Swan lamps. Nearly 2000 Swan lamps are distributed at the theatre, the splendidly fitted private interiors, and other parts of the building, fed by dynamo machines or by Pisare-Sellon-Volckmar accumulators. The durability of these lamps seems to be confirmed by a collection of lamps exhibited by Ganz and Co., used 1720 to 2330 hours. The carbon filaments do not show any damage, only the glass bulb being darkened by a carbon deposit. The exhibition of Edison lamps is not as extensive as it was at previous exhibitions. The Maxim lamps are used for lighting the Oriental pavilion and some of the interiors. The Lane-Fox lamps are also lighting some furnished apartments, and show the applicability of incandescent lamps for street-lighting under the "Ausstellungsstrasse." The lamp of C. H. R. Müller has a screw-like carbol carbon filament to make the emission of rays uniform in all directions. The U-shaped carbon lamp of the Greiner and Friedrich incandescent lamp is prepared from lamp-black and graphite, coal-tar being used as cement. The coal-tar, at first treated with sulphuric acid, is heated till it becomes an asphalte-like mass, to which lamp-black and graphite are then added, so that a spout paste is formed. By pressing this

American Gas Light Journal.

Lessening the Fire Risks of Electric Lighting.

The Society of Telegraph Engineers and of Electricians, London, England, through a committee composed of representatives of both bodies, have submitted the following revised rules to govern the installation of electric light wires. It is claimed by the inventor to have many advantages over the other incandescent lamps. It will be noted that the rules previously published by us in 1882 are materially changed.

I.—THE DYNAMO MACHINE.

1. The dynamo machine should be fixed in a dry place.

2. It should not be exposed to dust or flyings.

3. It should be kept perfectly clean and its bearings well oiled.

4. The insulation of its coils and conductors should be periodically perfect.

5. All conductors in the dynamo room should be properly supported, well insulated, conveniently arranged for inspection, and marked or numbered.

II.—THE WIRES.

6. Every switch or commutator used for turning the current on or off should be constructed so that when it is moved and left it cannot permit of a permanent arc or heating.

7. Every part of the circuit should be so determined that the gauge of wire to be used is properly proportioned to the currents it will have to carry, and all junctions with a smaller conductor should be fitted with a suitable safety fuse or protector, so that no portion of the conductor should ever be allowed to attain a temperature exceeding 250° F.

8. Under ordinary circumstances complete metallic circuits should be used; the employment of gas and water pipes as conductors for the purpose of completing the circuit should not in any case be allowed.

9. Bare wires passing over the tops of houses should never be less than 7 feet clear of any part of the roof, and all wires crossing thoroughfares should be sufficiently high enough to allow fire escapes to pass under them.

10. It is most necessary that joints should be effectually and mechanically perfect and united by solder.

11. The position of wires when underground should be clearly indicated, and they should be laid down so as to be easily inspected and repaired.

12. All wires used for indoor purposes should be efficiently insulated, either by being covered throughout with some insulating medium, or, if bare, by resting on insulated supports.

13. Where these wires pass through roofs, floors, walls, or partitions, or where they cross or are liable to touch metallic masses, like iron girders or pipes, they should be thoroughly protected by suitable additional coverings; and where they are liable to abrasion from any cause, or to the depredations

14. Where indoor wires are put out of sight, as beneath flooring, they should be thoroughly protected from mechanical injury, and their position should be indicated.

N.B.—The value of frequently testing the apparatus and circuits cannot be too strongly urged. The escape of electricity cannot be detected by the sense of smell, as can gas, but it can be detected by apparatus far more perfect and delicate. Leakage not only means waste, but in the presence of moisture it means destruction of the conductor and the insulating covering by electric action.

III.—LAMPS.

15. Arc lamps should always be guarded by proper lanterns to prevent danger from falling incandescent pieces of carbon, and from succeeding sparks. The globes should be protected with wire netting.

16. The lanterns, and all parts which are to be handled, should be insulated from the circuit.

IV.—DANGER TO PERSON.

17. Where bare wire out of doors rests on insulating supports, it should be coated with insulating material, such as india-rubber tape or tube, for at least two feet on each side of the support.

18. To secure persons from danger inside buildings, it is essential so to arrange and protect the conductors and fittings that no one can be exposed to the shocks of alternating currents of a mean electro-motive force exceeding 100 volts, or to continuous currents of 200 volts.

19. If the difference of potential within any house exceeds 200 volts, the house should be provided with a "switch," so arranged that the supply of electricity can be at once cut off.

American Gas Light Journal, May 7, 1882.

Award of Contracts for Public Lighting in N. Y. City.

The Gas Commission, which consists of Mayor Grace, Comptroller Campbell, and Commissioner Thompson, of the Department of Public Works, yesterday awarded the contracts for lighting the city for the year ending April 30, 1883. The contract made last year with the Brush Electric Light Company, for lighting Broadway from Fourteenth to Thirty-fourth street, Fourteenth street from Fourth to Fifth avenue, Thirty-fourth street from Broadway to Fifth avenue, and Union and Madison squares, was continued for the ensuing year. Last year the Brush Company were paid 331 cents per lamp per night, but this year a demand was made for 70 cents per lamp per night. While continuing the old contract, the Gas Commission refused to extend the Brush Company's territory, because of the greatly increased expense.

The United States Electric Light Company for the first time received the contract to light Battery Park, City Hall Park, Broadway from Canal to Fourteenth street, Washington Park, and Fifth avenue from Washington Park to Fourteenth street. The price agreed upon is 70 cents per lamp per night.

Contracts were awarded to the various gas companies as follows:

New York Gas Company, the district south of Grand street, at $17.50 a lamp per year; Manhattan Gas Company, the district bounded by Grand and Thirty-fourth street, at $17.50 per lamp per year; Mutual Gas Company, certain streets in the district between Thirty-fourth and Seventy-ninth streets, and the parks south of Thirty-fourth street, with the exception of Madison and Union squares, at $17.50 per lamp; Metropolitan Gas Company, the remaining streets in the district between Thirty-fourth and Seventy-fourth streets, at $17.50 per lamp; Harlem Gas Company, the district north of Seventy-ninth street, south of Spuyten Duyvil Creek and the Harlem River, at $19.50 per lamp; Central Gas Company, the Twenty-third Ward, at $20 per lamp; Northern Gas Company, that portion of the Twenty-fourth Ward known as West Farms, at $20 per year; Yonkers Gas Company, the remaining portion of the Twenty-fourth Ward, at $20 per

New York Herald, April 18.

American Gas Light Journal.

ELECTRIC LIGHTING IN DENVER, COL.—It is stated that, in proportion to population and territory, Denver can boast of a greater number of arc lights than any other city in the United States; and, by the way, Denver must in time be a well-lighted place, judging from the number of parties who are anxious to get established there in the business of supplying artificial light. What with the old gas company and the Brush electric company, the new gas company and the Colorado Edison Electric Light Company, we must conclude with the inhabitants of the place. The last-named corporation was organized about six weeks ago, and starts in with a capital of $100,000. The officers are as follows: Wm. Orton (son of Wm. Orton, late President of the Western Union Telegraph Company), President; Wm. Moore, Vice-President; W. D. Todd, Secretary; Wm. M. Orr, Treasurer; and S. T. Armstrong, General Superintendent.

STREET LIGHTING AT EVANSVILLE, IND.—Evansville, Ind., is at present lighted, as to its streets, by 818 street lamps, and these lamps are scattered over a large area, owing to the somewhat irregular manner in which Evansville has spread. The electric light folks are trying hard to get a foothold, and, as usual, make great promises. They claim that one of the arc lights will give as good if not a better service than six of the gas lights now in use, etc., etc. The Evansville *Daily News* does not seem to be very enthusiastic on the project, as witness the following:

"In order to illuminate the city by electricity, as originally proposed, it will require a fraction over 136 lights, at $312.50 each per year, or $42,500, to substitute that light for gas, which costs now $16,852.96 per year, or an increase of $26,140.04 yearly to light the same area. That it is the intention of the company to ask for another change in its contract with the city, so that it may be released from the lower clause, as we said before the election that lower system will not do.

"This sum is little in excess of the minimum figures given by the *News* before the election, which were $30,000. But the present calculation is but a conjecture, based on the way the lights are now placed at street intersections; and if we will assume that the company will propose to put up but two-thirds of the number named, or 90 lights, the cost will be $28,437.50, which seems to us as low as anything like the present area can be lighted with the electric light, or nearly double what it costs with gas. As it is evident that some such change is contemplated, we suggest to the tax league, if it is still in existence, that the payment of the money to the company, or any other money, unless it be a sum that is less than is now paid the gas company for lighting the same area, be enjoined as contrary to the law, which forbids the incurring of any more indebtedness, the city being already in debt beyond its constitutional limit.

"We freely admit that the reference to the tax league is sarcastic, now that so many of its members are stockholders or advocates of the substitution of the electric light for gas; but we trust that someone else, who is sincere in his objection to the increase of expenses, will take the hint and enjoin the payment of the first bill of the electric light company that shall be ordered paid by the council, unless it lights the same area now lighted by gas at a less expense."

BALTIMORE'S ELECTRIC LIGHTS.—There are 225 "arc" lights in the streets of Baltimore, Md. The price paid per lamp per night is 70 cents; the lamps burn all night. Since the reduction in price of gas to $1.00 per thousand, many storekeepers, who had hitherto been using the "arc" light, have discontinued its employment. With gas at this figure, it will even trouble kerosene oil to "keep the pace."

STREET LIGHTING AT HOUSTON, TEXAS.—The committee of the city council of Houston, Texas, to whom was referred the application of Dr. Pinckard, President of the Electric Light Company, to establish and maintain 50 electric lights in the streets of the above-mentioned city, reported in favor of allowing the electric light people to place in position 32 lamps instead of 50. The contract price is $25 cents per light per night. The committee say in their report, "It is true that the financial condition of the city at the present time is not very flattering, owing to some derangement in the collector's department, but it is believed that this matter will be adjusted within a few days when everything will resume its proper shape." Right on the back of this statement this same committee recommends that a contract be entered into whereby the city is pledged to pay a most exorbitant price for electric lighting. One or two more recommendations of a similar nature, it would strike us, would require that affairs in the bureau of audit might suffer "derangement," and necessitate a "readjustment" of the kind now so popular in the South owing to the efforts of Mahone and his able imitators.

Mr. T. P. White, Secretary and Treasurer of the Houston Gas Light Company, made a proposition on behalf of himself and associates; the proposition was referred to a committee consisting of Aldermen Kennedy, Thomas and Meyer, and is as follows:

To the Honorable Mayor and Aldermen of the City of Houston—Gentlemen: The Houston Gas Light Company hereby agrees to contract with the city of Houston to light with gas the street lamps on the line of its mains, and keep the same regularly lighted during the hours specified in the last contract made between the city and the gas light company, on the following terms and conditions:

80 lamps at $2.90 each per month	$232.00
100 lamps at $2.80 each per month	280.00
125 lamps at $2.70 each per month	337.50
150 lamps at $2.65 each per month	397.50
200 lamps at $2.60 each per month	520.00

The gas light company agreeing to keep said lamps in good order during the existence of the contract. Said contract to remain in force for a period of not less than one year and for not more than five years.

First action has not been taken in the matter, and we hope that when such action is taken there will not be need of any kind of readjustment whatever.

INCANDESCENCE LIGHTS AT NEW ORLEANS, LA.—The Edison system of incandescence lamps has lately been installed at the St. Charles Hotel, New Orleans, La. In mentioning the fact that such an installation had been accomplished, a writer speaking through the columns of *New Orleans Picayune* of date of April 2, mentions, among other things, that, "It is a remarkable and significant fact that Edison gets nearly three times as much light from a pound of coal as the gas companies, and herein lies the promise of its future usefulness." The italics are ours.

Mr. Carroll writes that he visited the hotel, and was much astonished at the difference between a real 16 candle light, and the incandescent light represented as equal to 16 candles. The light looked as red as an ordinary gas light; and, so far as Mr. C. could judge from the evidence of eye-sight, gave a light of 12 candles—*nothing more*. Some of the lights he did not think were equal to 12 candles. The average illuminating power of gas supplied by the New Orleans Gas Light Company during the year 1882 was equal to 16.6 candles. There are 250 lights in use in the St. Charles Hotel, and it is claimed that the total cost, including coal, wages, depreciation, interest, &c., is but $1.07 per hour. Very nice figuring certainly; but why is the Edison system not in more extended use throughout the country, if this is true?

NATURE

On Friday night a series of interesting experiments with the Jablochkoff electric light took place at the West India Docks, under the direction of M. Denayrouse. The apparatus used for the occasion consisted merely of an electro-magnetic machine worked by a small steam-engine, some insulated wires, and the electric candles, which are the invention of M. Jablochkoff, and composed, as we have already described, of two carbons placed side by side with a slip of insulating substance between them, which burns away with the carbon exactly in the same way as the wax of a wax candle is consumed with the wick. The first experiment in order to show the suitableness of the invention for dock purposes consisted in the lighting of four of the "candles" in a large yard. The light thus obtained, which was shaded by ground glass, brilliantly illuminated the inclosure, it being possible to read small print at a considerable distance from the lights, while at the same time the eyes were not affected by the glare, as is the case with the ordinary electric light. The second experiment was confined to the illumination of the top story of one of the large warehouses, and this, like its predecessor, was equally successful. A large vessel at the quay side was also lighted up, as also was a portion of the quay. The whole of the experiments were very successful, and it was stated that each "candle" gave a light equal to 100 gas lights. The light is said to be much less expensive than gas.

March 10, 1881

NATURE

An important experiment in electric lighting is about to be made in the City. If thanks the electric light has been used, as on the Thames Embankment and Waterloo Bridge, in conjunction with gas; but in the City the thoroughfares selected are to be lighted by electricity alone until it be continued all night. The first district begins with Blackfriars Bridge, and extends along Bridge Street, Ludgate Hill, the north side of St. Paul's Churchyard, and down Cheapside as far as King Street. The scheme is eight yards, and is to be lighted by the Brush system. At King Street the Siemens system will begin, and will extend along the rest of Cheapside, the Poultry, Mansion House Street, King William Street, and Gracechurch Place, and across London Bridge. The same system will be extended down King Street, Queen Street, and Moon House Street. The whole length of street covered by the Siemens light will be 1,321 yards. Another district to the south of these will be lighted by the Jablochkoff lamps, the Embankment. It will include Southwark Bridge, Queen Victoria Street, Queen Street Place, and part of Queen Street, a distance of 1,045 yards. The experiment is to be continued for a year, at an outlay of about £900.

July 20, 1882

NATURE

FIRE RISKS FROM ELECTRIC LIGHTING

A VERY strong and influential committee was recently formed by the Society of Electricians to draw up a series of rules and regulations not only for the guidance and instruction of those who have electric lighting apparatus installed on their premises, but for the reduction to a minimum of those risks of fire which are inherent to every system of artificial illumination. They point out that the chief dangers of every new application of electricity arise mainly from ignorance and inexperience on the part of those who superintend it up the requisite point. The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded against by "testing" or probing with electric currents. They point out that defective insulation, undue waste of energy and the production of heat. These defects can only be detected by measuring, by means of special apparatus, the currents that are either ordinarily there or supposed constantly to exist. Hence, without frequent inspection, since the accidental failure on to, or the thoughtless placing of other conducting bodies upon such conductors might lead to "short circuiting" or the sudden generation of heat due to a powerful current of electricity in conductors too small to carry it.

The Committee point out this it cannot be too strongly urged that amongst the chief enemies to be guarded against are the presence of moisture and the use of "earth" as part of the circuit. Moisture leads to loss of current and to the destruction of the conductor by electrolytic corrosion, and the introduction of the conductor by electrolytic corrosion, and the introduction of "earth" as a part of the circuit leads to magnify every other source of difficulty and danger.

The chief element of safety is the employment of skilled and experienced electricians to supervise the work.

This would deal with the installation of the dynamo-machine, the fixture of the wires, the character of the lamps to be used, and the danger that accrues to the person.

To secure persons from danger inside buildings, it is essential so to arrange the conductors and lamps, that no one can be exposed to the shocks of alternating currents exceeding 60 volts; and that there should never be a difference of potential of more than 200 volts between any two points in the system.

If the difference of potential within any house exceeds 200 volts, whether the source of electricity be external or internal, the house should be provided outside with a "switch," so arranged that the supply of electricity can be at once cut off.

The rules are very valuable, and should be obtained by all who are contemplating the use of the electric light.

American Gas Light Journal, May 2, 83.

ELECTRIC LIGHT IN THE STREETS OF BUFFALO, N. Y.—The Brush Electric Light Company wants to get a slice of the street lighting in Buffalo, N. Y. On Thursday, April 12th, a committee of the Common Council considered the proposal of the Brush Electric Light Company to light portions of Seneca, Exchange, Elk, Smith and Sobieki Streets, and the Abbott road by electricity at 75 cents per night for each lamp. The company proposes to place the lamps not more than 400 feet apart, if a lamp was out from fifteen minutes to an hour, one half the price for the night is to be deducted; if out for an hour, the whole price to be deducted. This collection business is certainly refreshing.

Mr. James Adams said that if the lamps were placed 300 feet apart the company would only charge 63 cents per lamp per night.

Mr. George Fullerton, the Superintendent of the Mutual Gas Company, then addressed the committee and his figures clearly demonstrated that the lighting of the streets named by gas was much cheaper than by electric light. He figured as follows:

Seneca street, between Smith street and Buffalo river, 7,280 feet. Exchange street, between Smith and Seneca streets, 680 feet. Elk street, between Smith and Seneca streets, 6,720 feet. Abbott road, between Exchange street and Buffalo river, 2,600 feet. Smith street, between Exchange street and Abbott road, 3,000 feet. Sobieki street, between Exchange Elk streets, 1,870 feet. Total distance, 22,200 feet.

Electric lights, 400 feet apart (the maximum) 60. Each lamp per year of 365 nights, at 75 cents per lamp per night, $273.75. Per year for 60 lamps, $16,320.

Gas lamps, 140 feet apart (the maximum) 160. Gas consumed per lamp per year of 3,614 hours, at four feet per hour, 15,285 feet, making at $1.75 per 1,000 feet the cost per lamp per year $26.76; adding $3.04 per lamp per Cost of of 169 lamps per year, $4,084.40.

Cost of lamp-posts and lamps and setting them, $2,480.

Total cost of 190 gas lights per year, $7,672.40."

Gas cheaper than electric lights the first year, $8,251.60. Gas cheaper than electric light after the first year, $10,731.60.

His statement, however, failed to make any impression upon the committee, as they immediately resolved to report to the council in favor of contracting with the electric light company for lighting the territory in question at 75 cents per lamp per night.

American Gas Light Journal
July 16 1883.

LIGHTING THE SOUTHERN EXPOSITION BUILDINGS AT LOUISVILLE, KY.—A contract for lighting the buildings in which the Southern Exposition is to be held was entered into with the representative of the Edison Company for fifteen hundred electric lights, of a nominal candle power of 4,000 Edison incandescent of copper wire used and over 40,000 pounds, and, if stretched out, would reach 40 miles. It will take the labor of 100 men working steadily for one month, to install the plant. Fifteen dynamo machines will be required to furnish the current, and the cost of these alone will be in the neighborhood of $60,000. The power will be furnished by four Armington & Sims engines, and one large Reynolds-Corliss engine, the latter being provided by the Exposition Company. It is estimated that the latter being present lighting equipment will be fully $100,000. The grounds surrounding the buildings, as also the courts, will be illuminated by 75 arc lights; the usual 2,000-candle statement lamps will be illuminated by 75 are lights; the usual Exposition people had better put in the gas pipes too, for it is more than likely that "the bulb might slip."

THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 42 PINE STREET.

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

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A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. S. WARREN BRISSELL, C.E., Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MATTER.

THE AMERICAN ELECTRIC LIGHT COMPANY OF BOSTON.

A company, said to be organized under the laws of the State of Massachusetts, with the above name, has, according to the Boston papers, come to grief, and seems to be left in a wrecked condition with $16,000 debts and no assets, except "a fine stock."

The affairs of this company seemed to be decidedly mixed between parties from New York and parties from Boston, and it is needless to attempt to unravel its mysteries for the benefit of our readers. Highly respectables names cannot, of themselves, save any concern.

The three requisites to insure to electric lighting schemes it might be suggested that the business of lighting by electricity or by any other illuminant, when carried on in a legitimate way, and is entitled to respect; but when the popular cry of "lighting by electricity" is employed to promote schemes for floating stock, selling rights, and otherwise doing a kite-flying business, it becomes another matter, and it is a pity that the beauty of the pure electric arc, or incandescent loop, should be marred by having its name used for improper purposes. But how can it be expected that electric lighting should escape any more than gas lighting—for less not the good old-fashioned business of gas lighting had to endure the tribulation of having many a scheme, promoted under its name, which had no other backbone than interests for processes which, somehow or other, could never be made to work with satisfaction and profit after their removal from the nursery where they were born.

With many of these paienis there were "millions in it" before they were tried. So it is with other branches of business. If a company is organized to sell electric light on a business basis, and can get plenty of business at prices that will pay a profit, there is no reason why any one should not invest in it, if he has the money, and feels disposed to use it in that way. But there is no royal road to wealth in the lighting business, whether by oil, or by gas, or by electricity. Companies that are properly conducted, and sell a good article at remunerative prices, usually pay; but money cannot legitimately be made out of nothing. Stocks may be worked and manipulated for a while, but some one gets hurt in the end.

To those who propose to invest in electric light we would say, *invest in a business* and not in a scheme.

The whole business is very well covered with patents, and a strong and powerful combination has been made for the purpose of defending the essential patents from all infringement. It would seem from this that those who are disposed to do a legitimate business, in a legitimate way, here become fully convinced of the danger inherent in a multiplicity of interests working for the same ends, and that the wisdom of consolidation must appear if there is any truth in the old motto, "in union there is strength." Of course there is a great advantage in mutual protection; *how much* among value this advantage is worth remains to be seen.

The New York *World*, of April 28th, publishes the following—

"An important movement in electric lighting was consummated yesterday at the election of the representatives of the different companies to the new "pool-board." For some time the so-called Gaseous Company has been composed of the United States, the American, of New Jersey, Cons; the Brush, the Fuller, the Jablochkoff and the Weston. On Tuesday last, arrangements were completed under which the Edison joined the combination. The following gentlemen were yesterday elected as representatives: G. W. Hibbard from the United States; G. W. Stockley from the Brush; Leon-

May 2, 1882.

American Gas Light Journal.

Electric Light at Newport, R. I.

A taxpayers' vote upon the following proposition was taken on April 10th, and resulted in its adoption by a majority of 295 in a total vote of 930.

"Shall the City Council be authorized to light Equality Park, Washington Square, Touro Park, and Bellevue Avenue with the electric light at a cost not to exceed six thousand dollars per annum?"

No definite statement is here made of the number of lights or the price per lamp.

Electric Light at Lafayette, Ind.

The Cincinnati *Commercial*, of April 17th, says that the Brush company have put their lights in operation in the above-named city. They have but one most and five lamps. The city contracted for two years. The light went into operation on the evening of the 14th, and caused quite an excitement among the people of the city. There is a wide diversity of opinion as to whether or not the light will prove a success sufficient to do away with gas.

The Electric Light.—Its Uses and Abuses.

The parties who have undertaken the task of furnishing the electric light in this city suffer a great many inconveniences. In the first place, it is asserted that the engine used at the company's headquarters is not of sufficient power to furnish the necessary light, as annoyance greatly complained of by customers. Very often it transpires that the light is entirely extinguished, and the only alternative left the customers is to use the gas—an expense entirely unlooked for. It often happens that light is not furnished for four or five nights during the month, but when the monthly bills arrive it is found that no reduction has been made for the nights on which no light had been furnished, a fact which causes a deal of trouble to both the consumers and the company. Winne & Co., being considerably bothered by the extinguishing of the light on occasions when it was most needed, notified the company to take out their lamps, as it was the intention of the firm to give up using the electric light. The company paid no attention to the notification, whereupon the wires in Winne & Co.'s store were cut by the firm, thus shutting off the supply. Other merchants who have been placed to a great deal of trouble by the antics of the electric light threaten to follow the example of Winne & Co., and it looks as if the electric light company will have a hard road to travel before the arrangements will work to the satisfaction of all its customers.—*Troy Observer*, April 17.

American Gas Light Journal,
July 7, 82.

Electric Light Accident at Rochester, N. Y.

On the evening of the 30th of June, shortly after the electric lights were ignited, it was discovered that the roof of the building, No. 124 State street, Rochester, N. Y., was on fire. An extinguisher was immediately brought to bear on the flames, and the blaze was speedily suppressed. It was evident that the fire was caused by imperfect insulation of one of the wires of the Brush Electric Lighting Company, and, strange to say, no attempt was made to prevent a recurrence of the trouble. The consequence was that about an hour and a-half afterwards precisely the same thing happened. A policeman was summoned, and in his attempts to extinguish the flames inadvertently touched the wire and received a severe shock, as did also a man named Clark, who was endeavoring to assist him.

A reporter of the *Democrat and Chronicle* went to the scene of trouble with one of the employees of the Brush Company, and investigation showed that one of the electric light wires had rubbed against the edge of the roof, causing the insulating material to wear away, and the bare wire coming in contact in some manner with a telephone wire fixed the woodwork of the projecting cornice. Measures were at once taken to make the conducting wire secure.

April 25, 1882.

American Gas Light Journal.

Electric Light at Akron, Ohio.

EXCHANGE HOTEL,
COLUMBUS, OHIO, March, 22, 1882.

To the Editor AMERICAN GAS LIGHT JOURNAL:

A few days ago I sent you a copy of the Akron (Ohio) Daily News, containing expressions of opinion by citizens of Akron adverse to the Brush tower lights in use in that place. Thinking a personal observation of the light might interest your readers I concluded to write to you. I went to Akron not so much for the purpose of finding what was the cost of operating the nine lamps (that has been pretty clearly demonstrated, I believe, to largely exceed the cost of the gas previously used) but to see how the lower system *lighted* the town. The sum of my observations is that the town cannot be said, as a whole, to be lighted at all. No gas is used for street lamps, and the oil lamps are burned only in parts of the town. The towers only give a light of practical value within a range of less than three short squares in the streets on which the lights are situated. The cross streets running into those on which the lights are situated are "as dark as Egypt," the electric light only illuminating the tops of the houses on one side of three streets. While the Brush lamps are brilliant at the burning point (painfully so to the eyes) the distance to which they will cast a good light seems surprisingly small, even when we remember that the ranges, in a direct line, of different lights are not directly proportional to their intensities, but only as the square roots of their respective candle powers.

To show how short the range of the tower lights is—at the intersection of Howard and Market streets is a wrought iron tower 208 feet high, on top of which are four lamps, said to be of 4000 candle power each; now, for a test of what this light can do. Desiring to know the exact three short squares from the tower on the same street (Howard) I could not see far enough in front of me to find whether there was a store crossing there or not (my eyes are good ones, 3} years old) and on the *fourth* square from the tower, and in a direct line with it, the oil lamps were burning—they *ought* to have been burning on the *third* square.

At the engine house there was one 4000 candle Brush lamp which threw a good light on the spot where I was standing with a friend on the sidewalk opposite the engine house. The shadow of the building extended over the sidewalk, across the way, and into the street a few feet. Now, although the street is rather narrow, on looking across it the shadow of the engine house was so black that we could not see the figure of a man, nor any other object, in the shadow.

From a short distance from the big tower light the shadows were extremely black. The light does not seem to diffuse at all. After the stop lights are out a footpad could lurk unobserved in any doorway, or behind any projection, and strike you down before you saw him. The shadows are so sharp that even within a short distance of the tower you cannot see the faces of persons coming towards you from the town.

A prominent manufacturer of Akron, whose name and character are widely and favorably known, in conversation with me pronounced the system for street lighting a "humbug"; and, although he uses one of their machines in his factory, operating it with the same engine that he uses to run his machinery, says he only put it in because he was too far away from the gas mains to get gas, which he would greatly prefer, as a modern price.

An old citizen of high standing laughingly remarked to the writer that the Brush people were "lighting" for smartness, and that it was always when the moon was about a week old, and its light sufficient to help out the electric light that they brought village councilmen and other inspectors to Akron.

As the expressions of all the citizens to whom I talked were adverse to the present system of lighting the town, I cannot think it will be very long until the sovereign voter will make himself heard, and Akron will abolish the present ghastly glare and return to her "old love," the soft, beautiful, diffusive, always reliable gas light.

Yours truly,

HARRY CALDWELL.

[September 30, 1882.]

THE STATIST.

HAMMOND ELECTRIC LIGHT AND POWER COMPANY.—Mr. Hammond writes in reference to an incorrect rumour, and states that the new construction which the company are busily at work in connection with the Brush system, but is first thereof.

CHELSEA ELECTRIC LIGHT AND POWER COMPANY.—At an extraordinary meeting a resolution was passed omitting clauses 10, 30, and 31, and making certain alterations in clauses 32 and 34 of the articles of association. The chairman explained the object of the alterations, which he said had been suggested by the Stock Exchange Committee on their application for a settlement. The first general meeting of the company was afterwards held. The company was formed with a nominal capital of £300,000, of which they had allotted £100,000 in fifty shares each, leaving £200,000 unissued. The directors' report stated that they had been engaged in the Chelsea Vestry Hall, he said, have completed the whole of the capital if they had obtained it. Besides their regular customers, they were receiving numerous inquiries from hardware merchants, decks, theatres, and private persons; in fact, no great were the demands that they had a difficulty in fulfilling all the requirements made on them. They had made applications to the vestries of London and all the various local authorities for permission to lay their wires in order that they might supply current who required the electric light, just as gas and water were supplied. The Board of Works had prolonged their contract with the company for lighting the Thames Embankment, and they had now given them permission to erect a much larger building on the Embankment, in order that they might have larger engine power there, and supply a greater amount of electric light. They had also taken a building on the Albert Embankment for the purpose of making their own meters. The meters were obtained from another company, who made them in France. They used to cost 7l. each, while they now cost 2l. They hoped by making them themselves to reduce the price, and have a profit equal, if not greater than they now had. They believed that when they made the meters themselves they would be able to allow a tremendous reduction in their present rate, as well as make them larger; and they hoped not only to supply them to their own customers, but also to the French company working on the same system as themselves. Since the formation of the company Dr. Jablochkoff had visited this country with a new patent maker, which they had purchased from him. It would be able to drive any small machine by electricity, and in itself it was a generator of electricity. In answer to questions, the chairman said that as soon as the company could manufacture the candles he had referred to. The time was not yet opportune for the formation of subsidiary companies, but when the proper time arrived they might grant powers for small towns and parishes. They were now making preparations for lighting the Gaiety Restaurant in the Strand. They believed their lighting of the Thames Embankment paid for itself, and they had given notice to the District Railway Company to cease lighting for nothing Charing Cross Station.

BRUSH ELECTRIC LIGHT AND COLONIAL ELECTRIC COMPANY.—The chairman, at the meeting held the company was formed on June 13th, and on the Monday following the applications for shares amounted to 24,452, which were all allotted. The object of the company was to acquire the patent rights of Mr. Edison for electric lighting, and to apply them in India, Australia, Ceylon, and the Australian colonies. They had received late negotiations for the formations of companies at the Cape and in New Zealand, and in the Australian colonies, and there was every reason to believe that the company would meet with success. The company having now been formally formed, the directors had no reason to make any report to the meeting, but he trusted that when the annual meeting was held they would be able to present a very satisfactory report.

SWAN UNITED ELECTRIC LIGHT COMPANY.—At the statutory meeting the chairman said it was too soon yet to say much of the prospects of the company, as electric lighting was yet in its infancy. He believed, however, there was a great future for the Swan light. This company possessed very valuable addition to their property in the right to make and use accumulators, without which it would not be possible to deal with electric lighting on a large scale. With reference to the threatened litigation between the Edison and Swan Companies, there could be no doubt of the character of the inventions concerned, and he thought it not unlikely that the companies would join forces rather than fight each other.

THE BIGHT WAY TO LOOK AT IT.—Evansville, Ind., wants to try the new "mast" system of placing the arc light. The Evansville *Journal* evidently does not think very favorably of the idea; and, in dealing with the subject, speaks as follows:

"The new contract, it is understood, proposes to substitute for the six towers, each 250 feet high, originally contracted for, 12 masts, each 160 feet high, similar to the one, according to the *Courier*, which fell with a crash in Cleveland and came near destroying both life and property. In other words, it is deliberately proposed now by the electric light company to exchange the towers, whose height and stability constituted their chief charm, according to the *Courier* and other champions of the system, for 12 masts, whose liability to tumble over and endanger life and limb they have fully conceded. Before councilmen consent to this change they will do well to hold two or three tests in mind. First and foremost, the city is in no financial condition to indulge in two systems of street lighting. The city already has a contract with the gas company which will hold good until the city is so well lighted for less money. The electric light company ought to be required to indemnify the city against all liability or loss by *reason of lackadaisy* of the gas contract before entering into any new contract. If the electric light people are so confident of the success of their system, they cannot reasonably object to giving such a bond.—This is business and common sense, not politics or jobbing."

ELECTRIC LIGHT IN WASHINGTON MARKET, N. Y. CITY.—The United States Electric Light Company have removed their incandescence lamps from the stands and booths in Washington Market. The reason given is that they were unable to supply the lamps. The company proposed to charge consumers at the rate of $2 per lamp per month, the lights to be charged for whether burned all the time or not at all. Several marketmen, among whom may be mentioned C. W. O'Brien & Co., Reynolds & Co., Sattler & Bauer, Thurnall & Co., Kay & Co., Kennedy & Co., in stating that at no time was the illuminating service rendered by the lamps comparable with that obtained with gas. It might be here stated that the incandescence lamps were in use in the market about two months.

ELECTRIC LIGHT IN BOSTON, MASS.—At the meeting of the Boston Board of Aldermen last week the following order was adopted:

Ordered, that the committee on lamps be and they are hereby authorized to contract with any responsible electric lighting company or companies, for furnishing the city electric lights, the cost of the same to be charged to the appropriation for lamps.

This order is making considerable stir, from the fact that two of the committee on lamps are interested in electric lighting companies in this city—the Brush and the American. A general interpretation of this order has been that it is to authorize the committee to light the entire city by electricity. Alderman C'Brien explains that the order is simply introduced to allow the committee to expend the balance of the appropriation made for electric lighting, amounting to $4,500.

ONE TWENTY-THREE FIELD.—A Boston (Mass.) paper states that one of the best testimonials as to the safety of the electric light for mill and factory Company. Of the concerns insured by them 82 are lighted wholly or in part by electricity, comprising 2,018 arc and 10,481 incandescent lights.

From all these lights only 22 fires have occurred from the following causes: Sparks, 8; water leaking or reeling flours, 5; water condensing on beams, 3; falling carbons, 5; other forms of cross currents, 2.

of interests in this direction could be effected that would probably result in a greater net gain to each than they now secure.

Notwithstanding all that has been done during the last few years to cheapen the cost and improve the quality of the gas, there is yet much that may be done, for our resources are far from being exhausted. We must be able to sell gas at a price so low that our consumers can afford to use it any and everywhere that light and heat are required; and just as fast as we make progress in reaching this point, just so fast will we lessen the ratio of capital to the sum cost, and with the possibilities before us of cheapening the cost of gas, if we do what is within our reach the day is not far distant when our sales will be doubled.

We have a great deal about oil gas, heating gas, water gas, etc.; but I have yet to be convinced that there is any water gas company in existence to-day that, laying aside the interest of the "patent process," or some special interest of the kind that someone has in it, but what could do better with coal gas, taking all things into consideration, than they now do. Water gas, as generally made, is practically prohibited by statute in some States, and should be in all. Whenever the poisonous nature of the gas is mentioned, it is silently ignored as being unworthy of a moment's notice. In fact, from the standpoint of water gas patents, one might infer that recent researches in chemistry had led to the discovery that carbonic oxide is not a poison; that all chemical text books were mistaken; that the aforesaid carbonic oxide is not only not a poison, but is actually a benefit to the gas. Gentlemen, we cannot afford to trifle with the health and lives of our customers by supplying a gas of such poisonous nature, when we can furnish an article that has not in its volume a quarter or a third of this poisonous element. The number of deaths that have occurred from the use of it since its introduction being more than has been known in the history of the business previously, is sufficient comment on that point.

Whenever any business is made successful you always find men who are quite willing to sacrifice personal motive and interest in other directions and exercise their philanthropic endeavors in serving the public in the same capacity, and the gas business is no exception to the rule. Probably most of you are aware that operations of this kind have been going on in various parts of the country for some time, promoted by several separate combinations or interests and their field of operations is not entirely outside of New England. The animus of some of these people may be imagined when I repeat to you a remark made to me personally by one who had a large interest in the class of patents, and who was gifted more with inwards than judgment. Said he, "All the gas companies in the country have got to come to me. I have got the money and the power to throttle the throat of every gas company in the country." Most of these gentlemen have a pleasing address, plenty of show of money and often have a way of explaining the matter so clearly to many members of municipal councils as to convince them that the public welfare can best be subserved by granting them the privilege of occupying the streets, and establishing a company to make gas by their patent process.

Members of this association should take it upon themselves to inform their directors of the operations these gentlemen are engaged in, and also to furnish the municipal authorities of their various cities and towns with such information as will tend to thwart the endeavors of these people to enrich their own pockets at the expense of the public, who are interested to at least an equal extent with gas companies. City and town authorities have only to study the history of all so called opposition gas companies to ascertain the results and effects in this and other countries, and to satisfy themselves that the only gain from such speculating schemes is to the pockets of the operators at the expense of every consumer of gas, as well as the city or town that is so short sighted as to allow them to dig up its streets.

In more than one instance have the efforts of directors of gas companies been seriously hindered by having to spend money to defend themselves against the schemes of speculators who have sometimes carried away large sums of money which might have been saved to the people in the price of gas, and at the same time the gas company has been left with an unnecessary expense of its capital. It is not improbable that these things will go on until it will necessitate action on the part of the State conferring to gas companies protection in their chartered rights and requires of them an annual report of their doings, and also restrict them within certain limits in their profits, as is the case in European countries to-day.

I am not sure that the time has not already arrived when gas companies should take the initiative in this matter, being guided by the experience of other countries, and proceed to secure such legislation in the several States as will effectually stop the operations of these speculators who, taking advantage of the ignorance of municipal authorities in regard to these things, often secure their aid to further their schemes. If our directors would properly inform themselves, take in the situation, and each New England gas company appoint a committee from its Board of Directors, say the president, a director or the engineer, with authority to act as he may deem to be for the best interest of the company he represents, meet and confer together, some united action could be taken, wise measures could be adopted, having for their object security and protection to both gas companies and consumers.

As I said before, having the experience of other countries to guide us, wise and judicious laws could be framed, which if enacted would give gas companies reasonable profits and a position secure from the interference of operators in so-called patent processes, and at the same time give consumers a feeling of satisfaction, which they do not now enjoy, of knowing that the profits of the business are not exorbitant as many consumers seem to think. This matter is worthy of your earnest consideration.

There are matters of interest which will, no doubt, be brought up in your discussions which I need not mention in this connection, as I have already taken up too much of your time, but I cannot let th's opportunity pass without again calling your attention to the aims and objects of our association, which to my mind are too much neglected. Must it be said that we as New England men are degenerating, that we are are departing from the standard and reputation of our ancestors? From the days of the Pilgrim Fathers down to the present moment, New England men have been identified with the prosperity and progress of almost every important movement and interest that marks our history. On into any State in the Union, you will find the work of the brain and hand of the omnipresent Yankee. Go into almost any country in the world you will find the product of his inventive genius and skill. Could you blot out at once all the machinery and improvements that has been developed from the brains of New England men you would perhaps see the mechanical history of the world. Shall it be said of us, of this New England Association of Gas Engineers, that we are untrue to the traditions of our fathers?

Must a single member of this association feel obliged to connect himself to some other association of workers in the same business before he can feel that the time and money spent in attending the meetings, have not been entirely wasted? We have the ability and the material in this association, which if properly used, would invest each meeting with such interest that each member would feel and know that he had lost something if he were unable to be present. Let each member bring to these meetings the same spirit and energy with which he prosecutes his own business at home, none would have cause to complain.

Many seem to think that a paper to be read before our association should be an account or a description of some wonderful invention or remarkable career of success that has been made; but such ideas are entirely erroneous. Let us have papers embodying the results of operations, experiments or trials which have resulted in failure. It will bring out the experiences of others in the same line, and oftentimes save some from spending money in doing the same thing. The efforts of your officers will be well nigh fruitless without your co-operation; with it the success of the New England Association of Gas Engineers is assured.

On motion of Mr. Stinson, a vote of thanks was tendered to President Slater for his very able and entertaining address.

(To be continued.)

The Electric Light Speculations.

The New York *Sun* of Feb. 8 published a notice of the capitalization of the various electric light companies which have made their appearance in this vicinity during the last three years. The notice also deals with the fluctuations in prices which have marked the dealings in this class of securities. It should be here stated that since this notice was published in the *Sun* the quotations of shares in the parent Edison concern have improved somewhat. On Feb. 19 a fair figure would be $400 per share. The notice is as follows:

The stocks of the electric light companies made their first appearance in Wall street about three years ago. The stock of the original Edison Company was the first that was dealt in, and it has sold at prices that have never been reached by any other. The shares of other companies speedily followed those of the Edison into the street. A most remarkable speculation in them immediately attended their advent. None of them have ever been listed by the Stock Exchange, and though most of them have been called in the room for dealing in unlisted securities, the transactions in them there have been small compared with the sales that have been made in the street. Those sales have been negotiated or made through what are known as outside brokers or brokers in unlisted securities. One or two of these brokers, notably Mr. A. J. Sapcrtas, have made a specialty of dealing in electric light stocks. Mr. Saportas has followed the movement in those stocks from its inception, and has dealt more extensively in them than any other broker. The speculation started with a boom. Prices, particularly for the Edison stock, fluctuated widely and rapidly. The memorable bull speculation that then prevailed in the Stock Exchange, as well as outside of it, may have been partly responsible for the initial movement in electric light shares. The most potent reasons, however, were doubtless general ignorance or understanding about the true value of the inventions and discoveries than being made

in electric lighting, and the mystery with which those developments were surrounded. Since then the several companies have been demonstrating what they are capable of doing, and the subject of electric lighting has been studied and investigated till prices for those shares have gradually drifted to figures that doubtless approximate their intrinsic value.

In the following resume of the market for electric light shares, the figures given are of sales that have been made through brokers. Both higher and lower prices may have been obtained at private sales.

The Edison Electric Light Company, the parent company and pioneer in the field, was originally organized with a capital of $100,000. This was increased to $105,000, and then to $200,000. The company owns about 51 per cent. of the stock of the Edison Illuminating Company, which was organized to use the Edison inventions in this city, and of the stock of the Edison Company for Isolated Lighting. The value of these holdings is taken into consideration in estimating the value of the shares of the parent company. When its capital was $100,000, its $100 shares sold as high as $5,700. Three shares sold at that price. The purchaser of these shares is reported to have sold them at private sale on the same day for $5,000 a share. The original seller paid $2,000 a share. He therefore made $6,100, and the second seller made $3,000. All of those transactions, it is said, took place in one day. One of the first transactions in this stock was the sale of five shares for $1,000, or $200 a share. On the day after this sale the purchaser sold two of the shares for $500 a share, thus recovering the amount of his purchase money for the lot. He afterward sold the three remaining shares for about $8,000, which was his profit on the venture. At times the price jumped up $100 a share in an hour. The son of the president of one of the largest corporations in the country sold twenty shares that cost him $3,000—that is to say, $100 a share—for $25,000, or $1,175 a share. The purchaser sold the stock shortly afterward for $1,575 a share. The stock is now selling at the lowest figure it has touched since it came upon the market, namely, $250 a share. A sale was made at that figure not long ago. The price has twice been offered by the borrower of the company's capital, as the increase in capital has been offered to the stockholders at par. At the present market value of the shares of the Edison Illuminating and of the Edison Isolated companies, it is estimated that the stock of the parent company is worth about $150 a share, merely as representing the interest of each share in the aggregate market value of the stocks held by the company.

The capital of the Edison Illuminating Company is $1,000,000 and the par value of its shares is $100. Fifty-one per cent. of its stock was given to the parent company for the Edison patents, which it is entitled to use exclusively in New York city. The company proposes to light the city by districts. Its first district is bounded by Spruce street, Park row and Broadway, and the East River. It has equipped an engine house in Gold street, not yet succeeded in furnishing any light to speak of, though it has about 7,000 lamps which have been lighted at times. The stock of this company has sold as high as $125 a share and as low as $30. The former price was reached before the company had got much of its plant, and the latter a few months ago. The last sale is reported to have been at $50 a share, and it is now offered at $50, $10 a share being bid for it.

The Edison Company for Isolated Lighting was organized with a capital of $500,000, which was subsequently increased to $1,000,000. The par value of the shares is $100. The object of the company is to furnish light to private buildings or establishments. Fifty-one per cent. of its stock is owned by the parent company, which has also issued to it for the patents and privileges. When the capital of the company was $500,000 its stock first sold up to $240 a share, and then as low as $175 to $180 is bid. The price at present, however, depends to an extent upon the number of shares offered or bid for. This is the only Edison Company that has paid a dividend. One of four per cent. out of the operations of the last year has recently been declared. Though the parent company has thereby paid a dividend, large profits have accrued to the stockholding company. Each year of new stock at par at times when the premium was very great.

The Edison Electric Light Company of Europe was organized about two years ago, simultaneously with the other offshoots of the original company. Its capital is $5,000,000 and the par value of its shares $100. It has a monopoly of the Edison system in Europe. Its stock sold soon after it came on the market at $165 a share, and has declined to $40. The present quotation is $10 bid, $25 asked.

The capital of the United States Electric Lighting Company is $1,500,000. Its shares, of the par value of $100 each, sold about three years ago at $300 per share. During the extreme depression in this class of stocks about six or seven months ago its stock sold at $85.50 a share. The last actual sale was at $125, and at present $130 is bid and $150 is asked. The company has just declared its first dividend. It is five per cent. in cash, but whether it is to be considered as an annual, a semi-annual, or a quarterly dividend cannot be learned.

The patents of the United States Company are used exclusively in the city by the United States Illuminating Company, which has a capital of $1,000,000, only one-half of which has been issued. The transactions in its stock have not been large. This last was at $102 per share.

The Brush Electric Company of Cleveland sustains practically the same relation as the Edison to several minor companies. It has a capital of $5,000,000 in $100 shares. The stock sold recently at $110, and it is said that it can be bought at that price now. The present bid price is $100. It has never sold below its par value. The company has paid quarterly dividends of two per cent. for three years.

The Brush Illuminating Company of New York uses the Brush inventions and system in this city. It furnishes, it is said, over 1,000 lights nightly in the up-town district, which it supplies at an average price of 80 cents a light per night. It began furnishing street lights to the city at 49 cents a light per night, but the price has been advanced to 70 cents. The cost to the company is said to be 50 cents. It is reported that the company will earn $100,000 net this year. The capital is $1,000,000, and the $100 shares have sold as high as $125, and about three months ago had dropped to $70. The current quotation is $100 bid and $110 asked.

The Brush Illuminating Company of New York owns most of the stock of the Brush Electric Light Company of New England, which uses the Brush system throughout the Eastern States. This stock is not dealt in, but it is supposed to be worth about $600 or more a share. The company has just declared an extra cash dividend of 50 per cent, making a total of 58 per cent. that it has paid within a year. The report is current that the New York and New England companies contemplate a consolidation.

The Fuller Electrical Company manufactures electrical machines. It has a capital of $670,000, of which $500,000 is common stock and $170,000 preferred. The par value of both classes is $100. The common stock has sold from $21 to $22 a share, and the preferred from $61 to $70 a share. Present quotations are $20 bid for the common, offered at $23, and $75 bid and $100 asked for the preferred.

The American Electric Light Company has been distinguished chiefly for the counter charges of fraud that some of its officers exchanged a few months ago. The company has a capital of $500,000 in $50 shares. Some of those shares have sold at $35. They are now offered at $4.75.

The Brush-Swan Electric Light Company is the last organized enterprise of this class. It combines all the Brush and Swan inventions, and uses electricity generated by the Brush process in the Swan incandescent lamp. The capital of the company is $600,000, and the par value of its shares is $100. Sales have been made at $150 a share, and it is now quoted at $105 bid and $150 asked.

For the common protection of their patents, all of the leading electric light companies formed some two years ago the Gramme Electric Light Company. The shareholders are the American Electric Company of New Britain, Conn.; the Brush Electric Company, the Edison Electric Light Company, the Fuller Electrical Company, the Jablochkoff Electric Light Company, and the Weston Electric Light Company. The stock has no marketable value.

While the prices that now prevail for the shares of most of the electric light companies are the lowest that have ruled, it will be observed that there has been considerable recovery in the case of those companies which have demonstrated their ability to make returns upon the money invested in them. Those, however, are few in number, and, with the exception of the Edison Isolated, are companies that furnish only the large lights that can be utilized chiefly for out door lighting or for the illumination of large buildings. The small light that is required for general in-door illumination has not yet been furnished for general use, nor has any return been made upon the money invested in its development and introduction. Where bills have been rendered according to some persons who have paid them, been larger than a gas bill would have been for the same amount of service. So far as speculation is concerned, however, the inquiry for electric light shares is, according to the best information, the same amount of service. So far as speculation is concerned, however, the inquiry for electric light shares is, according to the best information, increasing and the volume of the transactions larger as compared with three or four months ago, when trading with them was at a standstill. This, doubtless, is largely due to the first dividends recently declared by two or three of the companies.

AND WHAT WILL HAPPEN NEXT?—The Board of Aldermen of Brooklyn, N. Y., have calculated the people of that city by actually passing a resolution which will prove of great service. It is a rare matter to be able to say such a thing of any board of aldermen; but in the case of the Brooklyn board it is simply wonderful. At a late meeting of that body they decided to require the gas companies of the city to equip their meter-takers and collectors with badges. This step was taken for the protection of householders from sneak thieves, who, representing themselves as employees of gas companies, gain admission to houses for the purpose of plundering.

Feb. 16, 1883.
American Gas Light Journal.

Mr. Edison on Storage Batteries.

There appears to be one point at least on which our "own Edison" and those engaged in the manufacture, storage and distribution of gas have thoroughly agreed upon. This unanimity of opinion centers upon the idea that the so-called storage batteries, whereby electricity is to be delivered to consumers, already bottled up and ready for use—somewhat after the fashion, at present in vogue around New York city, of furnishing "bottled milk"—is a delusion and a snare, when commercially considered.

A representative of the Boston *Sunday Herald* called upon Mr. Edison, some time ago, with the object of ascertaining his views upon the electric light in general; and the outcome of the interview furnishes some very interesting reading. Mr. Edison, in considering the subject of "storage," made use of some plain language, and we reproduce some of his remarks, regretting that lack of space prevents us from giving the interview in full. In answer to the question as to what he thought of the utility and value of storage batteries, Mr. Edison said—

"The storage battery is, in my opinion, a catch-penny, a sensation, a mechanism for swindling by stocking companies. The storage battery is one of those peculiar things which appeal to the imagination, and no more perfect thing could be desired by stock-swindlers than that very self-same thing. In 1870 I took up that question, and devised a system of placing storage batteries in houses connected to mains, and charging them in the day time, to the thing patented in 1879 (I forget the date of the patent) but there is nothing in it. I rung all the changes on it. My plates were prepared like Plante's. The method of preparing them for charging is more tedious, but it is better than that of Faure, after preparation. You know the first storage battery was sent from France to Sir William Thompson, who was at first astounded by it. He was asked to endorse it, consented and took a retainer; but on investigation he became convinced that there was nothing in it, and returned the retainer to the French company. The fact is, the more he investigated the more he found out the fallacy of the whole business. On account of what Lalouchere calls a swindle, this secondary battery has been used by the ass companies in England. One company alone, on the strength of an accumulator and an incandescent lamp copied from mine, by one George Lane Fox, floated subsidiary companies, whose aggregate capital was over thirty millions of dollars, and immense sums were paid by these companies to the parent company for rights. Within the last few months the bubble has burst, the shares, upon which $25 have been paid, are offered at $2, and their prospectuses as to the value of the accumulator and the right to the incandescent lamp of Mr. Fox, it appearing, from the proceedings before Mr. Justice Chitty, that another company had a right to the lamp, and this company acknowledged that it was a piracy of the Edison lamp, and were paying royalty to the Edison company for the right to use. The indictment was in Justice Chitty was brought by a stockholder in a subsidiary company to cause the return of his subscription on the above account. The judgment was in his favor. This was the great Brush electric light bubble, in which millions were lost, and caused the now celebrated article of Lalouchere. One of the leading spirits in the bubble is in this country at the present time attempting to do the same, but Carlyle's saying about thirty millions of fools probably didn't apply to foreign countries.

"Scientifically the thing (storage) is all right, but commercially an absolute failure, as one can imagine. You can store it and hold it; but it is gradually lost, and will all go in time. Its efficiency, after a certain number of charges have been sustained, begins to diminish, and its capacity and efficiency both diminish after a certain time in use, necessitating an increased number of batteries to maintain a constant output. Owing to corrosion of the sustaining plates of the battery, the effect of local action and other causes, so many to enumerate, the yearly depreciation of the battery is not less than 30 per cent. of its first cost, if used daily. The facts are that there are two or three companies that have been organizing subsidiary are light companies throughout the country for some time past. In this arrangement the parent company made money by selling machinery, etc., to the working companies, but the latter companies are not making money; and have nearly ceased giving new orders. Now the parent companies, finding the sell for machinery slacking, have come in with their secondary batteries. They now make this statement which is the cleverest thing I ever heard of. Here, gentlemen, you have a large investment in machinery, etc., for furnishing light, but are not making any money out of it. Now, we have something by which you can utilize your machinery. You can work day and night, and can do more than made in the day-time for incandescent lighting, and in the night have your plant for are lighting direct. That sounds good and fair, does it not? The board of directors discuss the offer and think it a good thing. Then they conclude to go into it. You probably know what the wisdom of the average board of directors amounts to.

"I will tell you where the fallacy in this arrangement lies. It consists in the fact that the cost of batteries to store this extra electricity that could be produced in the day-time would be twice as much as the station that produces it; so that, if the company has already invested $100,000, and agree to utilize their machinery in the day-time, by the addition of storage batteries, they will find that to carry out their desires it will cost them $200,000 for the batteries. I will guarantee that not one board of directors in a hundred will see it, and the parent concern will not tell them of it until after they have purchased. It seems to be natural with boards of directors that if there is a wrong way to do a thing they will surely do it that way. Well, they have purchased the storage batteries, of course, at a cost of $200,000. On that investment, at the end of the first year, they have a depreciation of thirty per cent. To save themselves they will have to earn interest on their investment. They must earn enough to meet the extra depreciation on their plant running through the day, and will have to spend double the amount in coal to obtain the same output from batteries, for the reason that they interpose between the source of energy and the light a thing in which there is a loss both in charging and discharging, and a loss while standing, and that loss increases as the battery gets older, after a certain maximum is reached.

"The maximum of a storage battery is about fifty per cent. You get the maximum of current when you utilize the full capacity of the battery, the same as in a steam engine, where, if steam is admitted for the full stroke, 50 per cent. of the steam or power is wasted, but you obtain the maximum power from the engine; but this is also the minimum of economy. Hence to get the proper economy, engine builders only take one-third to one-fourth of the maximum power from their engines, but this adds to the investment, which is compensated for by the saving in economy, which more than pays interest on increased investment. When they say that 90 per cent. is obtained from the battery they tell you what is scientifically true. They say they get ten lights of 16 candles each per horse power of current. Now, this is true and untrue. If you get a horse power of current from a battery 2 will give you 10 lights of 16 candles; but to get that you have to put all loses through the battery, through the wires, through the dynamo, and all that. They start off with a horse power indicated in the engines. A certain amount of this is taken to move the engine and dynamo, and a certain amount is lost in the dynamo to convert power into electricity, because no machine is perfect; a certain amount must be lost on the wire connecting the station with the secondary battery; another amount is lost in charging the battery, due to its resistance and imperfection as a mechanism; another amount is lost during the interim between charging and use; another portion will be lost in discharging the battery through the lamps, and still another amount will be lost in the wire connecting the battery to the lamp. So that your horse power will dwindle down until it will give you only about three lamps; whereas, if you worked direct you would probably get six lamps."

American Gas Light Journal, July 2, 1883.

HOW THE ELECTRIC LIGHT AFFRAIS TO SOME PEOPLE IN ALBANY, N. Y.—Albany does not appear to be overjoyed with her electric lighting experiment, as witness the following from the Albany *Times*:

"Under the new charter of the city of Albany, the board of contract and appportionment may enter into a contract for lighting the streets of this city for a term of 999 years, or longer if they shall see fit. All other contracts are limited to two years, but this is entirely without restriction. Already gas has been entirely superseded in the streets, only two lamps being retained, on the theory that this will be regarded as fulfilling the contract of the city with the gas company, which does not expire till next fall, when very likely the theory will be tested by tedious and expensive litigation. The electric light shines from the river front to the intersection of Madison and Western avenues. In the winter the service is excellent; in the summer, owing to the height of the poles on which the lights are placed, much of the illumination is cut : f by the foliage of the trees, and as a whole, the city is thus practically little better lighted than it was by gas. In the vicinity of the pole there is too much light, but in the shadow the darkness is dense. The electric light is also expensive. It will cost the city $6, where gas cost $1. This is a great increase. Had the proposition been made to put up five gas lamps, where there was only one before, a perfect howl would have been heard; but had it been carried out, we should have certainly had a much more even and probably quite as satisfactory a light every way. But Albany has the electric light, and differing from almost every other, if not every other city in the United States, she has paid for the outfit. For once, this conservative old town has gone too fast. The electric light is an experiment. Other cities which have partially adopted it find that they can not afford any such extravagance. For instance, it being rumored that in Cleveland, Ohio, which, next to Albany, has been cited as a city in which the new light had made the most rapid advance, it was about to be abandoned, the editor of the *Times* made inquiry of the mayor of that city, who replied as follows:

CLEVELAND, May 21, 1883.

DEAR SIR: Cleveland does not do much in way of electric lighting—and then present contracts expire, will probably d scontinue, if for no other reason than the lack of funds; the system costing the city about five times more than gas. Very respectfully yours, JOHN H. FARLEY, Mayor.

"The other day we published extracts from the very sensible veto message of Mayor Manning of Buffalo, returning, without his approval, a resolution providing for the extension of the electric light through certain streets in that city, and based on the ground, among others, that they could be lighted with gas at 60 per cent. less.

"It will be said, of course, that 'Albany wants the best;' but she will have to pay accordingly. She is in pretty deep already, but is to be lumped that she will not go in over her head, as also surely will, if the electric light contract is relet for a long term of years. The excuse will be made that we have bought the 'plant,' and it is too late, nothing can be done, and it doesn't matter whether the next contract is for one or twenty. Not so. The elephant is a great asset, and it took a good deal of money to pay for him; but let us not be our hands so we can not shop his bond off, if his appetite become too ravenous. Despite our city charter, no shrewdly worded as to allow of this gigantic jobbery, the board of contract and appportionment are city, and thousands of dollars may be lost to it by a long contract. It should be removed yearly, at most. No one can tell what twelve months will bring forth in the way of inventive age. Experiments may yet demonstrate that the electric light can be produced at one-tenth the present cost; and then how rash and ridiculous would appear a contract under which the city pays yearly $200 a lamp."

MAXIM LIGHTS FOR LANCASTER, PA.—It is stated that the Maxim Electric Light Company are to erect 250 lights for purposes of street illumination in Lancaster, Pa. Sixty of the lamps are to be in position by the 10th of August, and the remaining sixty are to be ready by September 10. The Lancaster *Intelligencer* says we must learn from the experience of other places; well, if they will not be taught, let them "pay the piper."

The Manufacture of Patent Fuel in France.

Commercial Agent Gifford, of Nantes, has submitted to the Department of State an interesting account of the manufacture of patent fuel out of the coal dust which was formerly rejected as worthless, and which is now burned in immense quantities in France as coal bricks. The millions of tons of coal dust, the waste of our mines, renders this process of some interest, as the subject has long occupied the attention of large consumers of coal. After importing the dust from Wales and paying duties and cost of landing, the manufactured article in France costs $4.42 to $4.87 per ton. It is claimed, besides its advantages for manufacturing and locomotive purposes, that it is superior to other coal for domestic purposes. For some years the Orleans Railway Company has bought annually 60,000 tons. The cost in the United States, it is claimed, would be less.

The process of manufacture is given as follows: "It is extremely simple. The coal dust is mingled with pitch (*brai suberac*) derived from coal tar, and the mixture poured into cups attached to a belt, each cup containing just enough material for a brick of the size desired. The belt in six movement passes this material through a chamber where it is exposed to hot steam, which fuses the two substances into a homogeneous mass. This is poured by the descent of the belt into moulds, where it is subjected to an enormous pressure by a hydraulic press, or by machinery act in motion by a steam engine. The brick is square in form, its thickness being about one-third of its other dimensions, and, as manufactured here, weighs 5, 10, or 15 pounds."—*Coal Trade Journal.*

Public Lighting in New York City.

The officers designated in section 1 of chapter 478 of the Laws of 1879, met in the office of the Mayor, at 12:30 P.M., on Monday, April 17, 1882.

All were present viz.:

Hon. Wm. R. Grace, Mayor; Hon Allan Campbell, Comptroller; Hon. Hubert O. Thompson, Commissioner of Public Works.

The minutes of the meeting of March 27, 1882, were read and approved.

The Secretary presented the following report:

BUREAU OF LAMPS AND GAS, March 28, 1882.

DEPARTMENT OF PUBLIC WORKS,

To the Honorable the Mayor, the Comptroller, and the Commissioner of Public Works:—

In compliance with the resolution adopted on the 27th inst., directing the Secretary to examine and report upon the several proposals received on said date, I respectfully submit the following report:

First—As to gas lamps. * * * * *

The rates are the same as now paid all the gas companies under the existing contracts.

The United States Illuminating Company propose to light by voltaic arc lights, of 2,000 candle power, at 70 cents per night for each lamp, the streets and parks shown in the following statement, and was the only bidder for furnishing electric lights to same. The same streets and parks, however, are included in the proposals of the New York, Manhattan, and New York Mutual Gas Companies.

District bid for by the United States Illuminating Company, with the estimated number of electric lamps stated to be necessary to light the same; also the estimated number of gas lamps which can be displaced:

	Number Electric Lamps.	Gas Lamps Displaced.
Broadway, from Battery Park to 14th street	22	256
Battery Park	12	144
City Hall Park	10	110
Fifth avenue, from Washington Park to 14th st.	8	43
Washington Park	12	152
Total	94	705

—or one electric lamp to seven and a half gas lamps.

1 electric lamp per night	$0 70
7½ gas lamps, at $17.50 per year, 4.8 cents per night is	0 36
Excess per night for 1 electric lamp over 7½ gas lamps	$0 34
Or 1 electric lamp per year at 70 cents per night is	$255 50
7½ gas lamps per year at $17.50 each is	131 25
Excess per year for 1 electric lamp over 7½ gas lamps,	$124 25
Or, 94 electric lights 1 year at 70 cents each per night is	$24,017 00
705 gas lamps at $17.50 each per year is	12,337 50
Excess for electric lights for 1 year	$11,679 50

The Brush Electric Illuminating Company presented two bids. One was for furnishing voltaic arc lights of 2,000-candle power (French measurement) for streets, and clusters of six 2,000-candle power lights for two parks, at the rate of 70 cents per night for each 2,000-candle power on the streets and parks shown in the following statement, and it was the only bidder for electric lights on those streets. The Manhattan, Metropolitan, and New York Mutual Gas Companies included these places in their respective proposals.

District bid for by the Brush Illuminating Company, with the estimated number of electric lights stated to be necessary to light the same; also the estimated number of gas lamps which can be displaced:

	Number Electric Lamps.	Gas Lamps Displaced.
Broadway, from 14th to 34th street	18	99
4th avenue, from 28th to 34th street	17	
Park avenue, from 34th to 42d street	25	294
4th avenue, from 42d to 59th street	16	
Madison avenue, from 27th to 59th street	33	186
5th avenue, from 14th to 59th street	41	264
8th avenue, from 14th to 59th street	46	300
14th street, from 4th to 8th avenue	9	53
23d street from 4th to 8th avenue	9	44
34th street, from 4th to 8th avenue	10	44
42d street, from 4th to 8th avenue	10	59
57th street, from 4th to 8th avenue	11	41
59th street, from 4th to 8th avenue	11	31
Madison Square, 1 pole, six lights, equivalent to 16 street lamps	16	141
Union Square, 1 pole, six lights, equivalent to 16 street lamps	16	85
Total	272	1,632

—or one electric lamp to six gas lamps.

Or for each portion of those spaces and such number of lamps, at said price, as may be prescribed by the Gas Commission.

1 electric lamp per night	70 cts.
6 gas lamps per night at 4.8 cts. each	28.8 "
Excess per night for 1 electric lamp over 6 gas lamps	41.2 cts.
Or, 1 electric lamp per year at 70 cents per night	$255 50
6 gas lamps per year at $17.50 each	105 00
Excess per year for 1 electric light over 6 gas lamps	$150 50
Or, 272 electric lamps 1 year at 70 cents each per night	$69,496 00
1,632 gas lamps 1 year at $17.50 each	28,560 00
Excess for electric lights for 1 year	$40,936 00

The other bid of the Brush Company was for lighting the High Bridge and its approaches by from 16 to 32 electric lights, more or less, at $1 each night, but they were not furnishing the steam, or $1.50 each lamp if steam is furnished by the company. On this bridge and its approaches are 24 gas lamps bid for by the Harlem Gas Light Company at $19.50 each per year.

The following shows the district now lighted by the Brush Electric Illuminating Company:

	Number Electric Lamps.	Gas Lamps Displaced.
Broadway, from 14th street to 34th street	53	
5th avenue, from 14 street to 34th street	16	253
14th street, from 4th avenue to 5th avenue	1	
34th street, from Broadway to 5th avenue	3	
Union Park, 1 pole, 6 lights, equivalent to 16 street lamps	16	16
Madison Park, 1 pole, 6 lights, equivalent to 16 street lamps	16	
Total	75	434

In the new bid the company reduce the number of lamps now on Broadway by five, which would make the total number of lamps in present district 70, against 434 gas lamps displaced, or 1 electric light to 6.2 gas lamps.

70 electric lights one year at 70 cents each per night	$17,885 00
434 gas lamps one year at $17.50 each	7,595 00
Excess for electric lighting in present district	$10,290 00

The total result of the United States bid and the first Brush bid is as follows:

266 electric lamps one year at 70 cents each per night	$62,033 00
2,337 gas lamps, one year at $17.50 each	40,897 50
Excess for electric lights	$20,635 50

THE STATIST.

HAMMOND ELECTRIC LIGHT AND POWER SUPPLY COMPANY.—At a meeting of the Board of directors, held on August 16th, it was resolved to call up the remainder of the capital. The directors have since issued a circular giving formal notice in reference to the calling-up of the remaining £2 10s per share. The calls are as follows:—£1 5s. payable September 21st, and £1 5s. payable January 1st next. It states that, in spite of the prevailing very profitable use made of electricity has this year been gradually giving place to public favour and, on the threshold of another lighting season, the directors are rejoiced with so many applications for installations on hire that there is prospect of supplying very profitably the share capital which hitherto they have refrained from calling up.

PILSEN, IRON, AND GENERAL ELECTRIC LIGHT COMPANY (Limited).—The annual general meeting was held on Wednesday, the Earwaker, W. Barwise presiding. In moving the adoption of the report, the chairman observed that the most material point was with regard to the necessity of the call of 10s. a share which the directors had made. When the company was formed, the directors fully expected to derive from the sale of concessions, not only in the United Kingdom, but also in the colonies, a large amount of capital, which would have enabled them to carry on their manufacturing and other operations without calling on the shareholders. With this expectation they reduced the amount on allotment from £3 to £2 a share. Circumstances had, however, changed almost since the birth of the company. The expectation of an early sale of concessions had been deferred, and there had been a revulsion of public feeling, not only with regard to electric lighting companies, but also with regard to electric lighting generally; and the action of Parliament, when as it might have been in the interests of the public, had necessarily been a check upon the operations of the electric lighting companies. After congratulating them on the provisional orders which they had obtained, he alluded to the dismissal of the two petitions which had been presented for winding-up the company, and strongly condemned the manner in which they had been promoted. Within the past few days a very important contract with a Government department of them had been nearly completed. They were negotiating with respect to other contracts, and he hoped by their next meeting that they would be able to report that they were doing a profitable business.

THE STATIST.

GUERNSEY ELECTRIC LIGHT AND POWER COMPANY.—At the meeting the chairman said the company having only been formed in May, where had been but a short time to do anything beyond organising. A report had been prepared, according to which there were applications for 23,147 shares, and 20,000 out of 27,597 were allotted among the shareholders, leaving 3,597 shares to be allotted before a settlement could be obtained on the Stock Exchange. There was no doubt they would be readily accepted for among the shareholders. The directors had disposed of a concession for Scotland, and there were negotiations.

American Gas Light Journal, July 16, 1883.

The Electric Light in Liverpool.

The manner in which the Corporation of Liverpool intend to avail themselves of their power to light by electricity the streets and public places of the city has been at length settled, at least to the extent of the first "experimental experiment" in the most important thoroughfares. Advertisements requesting tenders for the proposed lighting having been inserted in all the leading newspapers, local and otherwise, the Corporation eventually found themselves in possession of two proposals—from Messrs. Siemens Bros. and the British Electric Light Company respectively—to which their choice was necessarily confined. Messrs. Siemens Bros. asked £5200 for lighting the selected district from sunset to sunrise for a period of twelve months, with an extra allowance of £2250 for fixing and removing the apparatus.

The British Electric Light Company offered to do the work, in their own way, for the same period, for £2805 10s. The latter tender was accepted by the City Council at their meeting on Wednesday last, and the contractors are to be ready to light up by the 1st of March. The price to be given for the electric lighting is nearly twice as much as is now paid to the gas company for the present service, which includes several Sugg's and Bray's powerful burners, and a number of four feet per hour ordinary street lamps. The city engineer, in his report on the electric lighting proposals, remarks that if the necessity for increased illumination is to be taken for granted, five sixty 2000-candle electric lamps proposed to be fixed by the British Electric Light Company will, in terms of illuminating power, be considerably cheaper than gas. This is certainly one way of putting it, but it is not the right way. In the first place we all know that the light of thousands of candle power vary readily from electric lighting contractors, when they know perfectly well that their lamps will never be put into a photometrical test and tested to a tenth part of a candle, in the same manner as gas is examined daily.

Would the contractors for supplying Liverpool with lamps of 2000-candle power consent to a fine whenever their light fails to yield this power, or even half of it? Again, the proposed 20 lamps are to supplant 216 gas lamps, and we are grievously mistaken if it is not found that some portion of the roadway lying midway between these new lights will be no better illuminated than it would have been had the same value been given for the gas left to experience to decide, for it may be supposed the Corporation will take steps to assure themselves that they are getting the full value for their money.

A striking peculiarity of the electric light, often remarked in other cases, is brought prominently forward in the engineer's report, the difference between lighting the selected district from sunset to midnight, and between sunset and sunrise, is only about £160 for the year. In other words, it only costs this amount to keep the generating machinery and carbons going for the few extra hours per night; but, of course, at the same time the full amount of illumination must be kept up, for with electricity there is no medium—it is either in full blaze or nowhere. This fact illustrates the disadvantageousness of the arc-light, and at the same time suggests what might be done with gas if the cost of brilliant lighting is to be insisted only during the few hours of darkness in which it is really required, and no more than the night only drives. As Mr. Clement Dunscombe, the city engineer, remarks, the illuminating power of the proposed electric lights is on the contractor's own valuation, but in a sense, considerably cheaper than that supplied by gas in the same thoroughfares; but it may be suggested that the power of a lighting medium expressed in the gross, and its power of illuminating other objects, are very different things. If the corporation of Liverpool are content to trust the lighting of their streets to a string of light-beacons of the height of those afore named, they will find out what little difference means, and may eventually learn that they will find out what possible power, in close proximity to the object desired to be seen by its aid, is quite as useful as a light of ten times the reputed power a hundred yards off, and carefully hooded up out of the way.—London *Journal of Gas Lighting*.

American Gas Light Journal.

Electric Lighting Companies in England.

That "all is not gold that glitters" is shown from the proceedings in one of the English courts, on which the *Journal of Gas Lighting* makes the following comments.

"A crushing blow has fallen upon the Brush concessionary companies, the probable effect of which will be to break up the entire fleet. On December 8th Justice Chitty had before him an application by a shareholder in the Great Western Electric Lighting and Power Company to have his name struck off the register of proprietors, and the money paid in respect of his shares returned, on the ground of misrepresentation in the prospectus. We have already commented in these columns upon the nature of this insecurity, which consists in claiming an exclusive license for the Lane-Fox incandescent lamps, whereas there was really a prior assignment of this valuable property to another and independent electric lighting company. Several of the concessionary Brush Companies fell into this blunder, and all of them are now in trouble on the same score. We have already observed how, in consultation with their constituents, the Directors of those similar concerns practically agreed in describing the Lane-Fox patents as worthless, and the representations in the prospectus relating to them as consequently unimportant. The same opinion was used on December 8th before the learned Judge in the Chancery Division, but with most disastrous results. With strong common sense, as well as with legal acumen, the Judge decided that it was not competent for persons who had framed a prospectus which from being to end had recommended as one of its leading attractions this particular invention, to afterwards say, for the purpose of upholding their prospectus, that the invention was of little or no value, and therefore not a chief attraction in the document in question. The application was granted with costs; the sums paid for the shares to be returned to the applicant by the Company. As these shares were probably allotted at par, and are now at a hopeless discount; and as there are numbers of other disappointed speculators ready to seize a chance for hanking out upon similar terms, the condition of the Brush companies altogether is not to be envied.

"While the subsidiary Brushes are almost in *articulo mortis* the great parent concern is supposed not to be free from embarrassment. At the end of August last the company declared, an interim dividend of 10p per cent.; and it was also announced that there was a great reserve of cash in other quarters. Yet in the brief space of four months after this high water mark had been recorded, a call of £3 per share has been made, which is calculated to amount to £81,000.—The quoted value of the partly-paid shares still keeps at a very respectable figure; but it is asserted, by persons ably well-informed parties, that 'the market is only sustained by the process of underpinning on the part of those whose present interest it is not let it down with a flop.'"

THE STATIST.

BRUSH ELECTRIC LIGHT AND POWER COMPANY OF SCOTLAND.—The directors state that the present was the first ordinary meeting of the £300,000, in 60,000 shares, of which the first 30,000 were issued to vendors for the purchase of the Brush patents for Scotland. The remaining 30,000 were offered to the public before the shares had been made in the most equitable manner possible. The applications for the concessions for having been granted. The directors had also received a quotation by the Stock Exchange Committee, a proceeding, in fact, which would depend on the work they obtained in Scotland. Applications for tenders for their work were continually coming in daily. They had been successfully delayed by the low prices obtained in Scotland, which entirely prevented the liquidation of the old company, which was now completed. In reply to questions, the chairman stated that they now were lighting the Waverley Station at Edinburgh, and that they had tendered for the lighting of the Tay Bridge and Forth Bridge stations. They also hoped shortly to do work for the mills. The managing director stated that they had paid £12,000 in cash and £40,000 in shares for the patents. He thought they had acted wisely in not proceeding too fast.

ELECTRIC CABLES, SYNDICATE, AND APPARATUS MANUFACTURING COMPANY OF SCOTLAND.—The chairman stated that this was the statutory meeting called in compliance with the act. They were now in possession of the patents in connection with the set. They were in factory ordered, and they hoped to be able to begin in a few weeks to manufacture dynamos and lamps. Their prospectus came out when the forces concerning the electric light was at an end, and they had not been so successful as had been hoped in getting their capital taken up; but they considered it wise to go to allotment, and in the meantime to go on with a capital which, though comparatively small, was sufficient. They were waiting with a well-organised manufactory to take advantage of the time when the best electrical machinery would be before the public.

METROPOLITAN ELECTRIC LIGHT AND POWER COMPANY.—The chairman at the special meeting said he would simply move that the resolutions agreed to at the former meeting, amending the articles of the association so as to bring them into harmony with the regulations of the Stock Exchange Committee, be adopted. He understood a settlement had been granted, and after that resolution was carried there would be a quotation. The resolution was carried, and the first statutory meeting was then held. The statement put had not much information to afford. Up to the present time the work in hand had been that of organisation and preparation for the work which would most successfully be before it when the dark days came on. The application for shares numbered 282,000, of which there were duly allotted 100,000 out of that number there had been 9100 shares allotted to persons, who as well known as a competent organiser, had been appointed managing director. With regard to the Bill before Parliament, he looked upon the compulsory sale clause as unobjectionable. Replying to questions, it was stated that the directors had a most substantial interest in the company's shares. The only contract [illegible] went in answer to the Camberwell Vestry's advertisement was one from this company.

[*Jan.* 8, 1880

NATURE

MR. EDISON publishes through the columns of the *New York Herald*, an elaborate and detailed account of his labours with his new form of electric lighting. Minutely describing the course of his studies, Mr. Edison says that he has made the discovery that the carbon framework of a small piece of paper is the best substance for incandescent lighting. A piece of cardboard, known in the trade as "Bristol," is cut, with a suitable punch, into strips in the form of miniature horseshoes, about 2 inches long, and one-eighth wide. A number of these strips are placed in a wrought-iron mould, separated from each other by tissue paper. The mould, after being well covered, is placed in an oven, where it is gradually exposed to a temperature of about 600° F., so as to allow the volatile portions of the paper to pass away. The mould is then removed to a furnace, kept there till it retains almost a white heat, and subsequently allowed gradually to cool down. On opening the mould, the charred remains of the cardboard must be taken out with great care, in order to prevent them from falling to pieces. They are placed in a small globe and attached to the wires connecting the generating machine. The next thing is to extract the air, by means of the pump, from the globe; that being accomplished, the globe is sealed, and the lamp is ready for use. It should be observed that the new lamp requires no complex regulating apparatus, such as characterised the earlier efforts. In fact, Mr. Edison finds that all previous labour in regard to regulators was practically wasted, and furthermore, that electricity can be regulated with absolute reliability in a manner precisely similar to that in which the pressure of gas is now produced. The system now adopted by Mr. Edison in connecting the wires admits of a given number of lights being extinguished without affecting those of other burners. In the same way as we would shut a certain number of gas burners and permit others to draw a supply from the meter, the electric light can be obtained or shut out. From the description now given it appears that the apparatus primarily used by Mr. Edison was in the shape of a large tuning-fork, constructed in a manner that both ends would vibrate when placed near the poles of the great magnet. Experience has demonstrated the impracticability of that apparatus, and it became necessary to search for other means. One experiment was made after another, which had the tendency to lead gradually to the adoption of the system now employed in the generating machine, and which Mr. Edison terms the Faradaic machine. It is briefly described thus:—Two upright iron columns 3 feet in height, and 8 inches in diameter, covered with coarse wire and resting upon a base, form the magnetic poles. Fixed on an angle, so as to admit a free revolution between the poles, is a cylindrical armature of wood, wound parallel to its axes with fine iron wire. This cylinder is made to revolve rapidly between the magnetic poles, and by means of a belt, driven by an engine, strong currents of electricity are generated in the wire surrounding the armature, and these currents are carried along the wires to the electric lamp.

Jan. 8, 1880]

NATURE

WE learn that Mr. Edison is attempting to construct a portable electric lamp which shall, including the constant battery employed to generate the current, be no larger than an ordinary moderator lamp.

[Jan. 16, 1883.]

American Gas Light Journal.

Gas vs. Electric Light in Down-Town Stores.

A correspondent of the *Sanitary Engineer*, who signs himself "X," makes the following communication to that publication:

Dear Sir:—Perhaps the following statement about the comparative cost of the Edison lamps and gas in a printing establishment (E. P. Coby & Co.) in this city, may be of interest just now, when the public is waiting, with some anxiety, the outcome of the effort to supplant gas by incandescent lamps in down-town stores.

In the establishment in question, the Edison lamps were put into the counting-room, first floor, on trial, to get a basis on which the cost could be afterward adjusted, and for this first month's trial the lights have been free. Within a few days, however, the company have sent out a statement of the amount of light given between certain dates, and the value of it on the basis on which hereafter they will charge their consumers, viz., $1 per 1,000 candles, which, according to the company, is about equivalent to gas at the present rate—$2.25 per 1,000 cubic feet. This, however, does not seem to be the case, at least with this establishment, as the following facts will indicate.

There are seven of the Edison incandescent lamps in the counting-room, of the ordinary size in down-town stores, to replace five gas burners. Owing to defects in the carbons, which have usually left one of the lamps useless, it has been necessary to light one or sometimes two gas burners in addition to the electric lamps. Under these circumstances, a statement is rendered by the Edison Company for the period from October 10 to November 13. Total amount of light furnished was 13,246 standard candles, for which, had the company charged their proposed price of $1 per 1,000 candles, the cost would have been $13.25. Messrs. E. P. Coby & Co. estimate that, taking both cloudy and fair weather together, the lamps have burned possibly five hours on an average daily.

At about the same time this statement was received from the Edison Company, the Mutual Gas Light Company rendered their bill for gas used in the press room and composing rooms. Connected with one meter are 25 six-foot burners on the two floors, and also the one or two which are used in the counting room. Of this number 23 are regularly lit, including those in the counting room, and burning on an average 1½ hours per day. The gas furnished by the Mutual Company, as appears from the weekly statement in the *Sanitary Engineer*, has an illuminating power of 25 and upward. The price of gas is $2.25 per 1,000 cubic feet, and the bill for the burners enumerated, from October 23 to November 22, was $10.35—representing a consumption of 4,600 cubic feet of gas.

Now, assuming that 6 of the 7 electric lamps were always in good order and lighted during the 5 hours per day when artificial light was necessary, the case would stand thus:

Six lamps, 5 hours each, = 30 hours per day; 23 gas burners, 1½ hours each, = 34½ hours per day,

Number of days from October 10 to November 13, 34; total hours of electric lights for that period, 1,020.

Number of days from October 23 to November 22, 30; total hours, gas burners, for that period, 1,035.

Cost of 1,020 hours, electric lamps, $13.25; cost of 1,035 hours, gas burners, $10.35, or about 30 per cent. in favor of gas.

The hours in which the gas burners were lighted have, in the opinion of the gentlemen named, been rated low as compared with the hours during which the electric lamps were burned, and in reality the facts would be rather more favorable for the gas.

As to the quality of the light furnished, it is the opinion of Messrs. Coby & Co. that the gas burners gave more light than do the lamps. An experiment made by turning off one of the lamps at the rear of the office and turning on a gas burner, and then reversing the test, seemed to prove their opinion correct; certainly the gas light appeared to illuminate that part of the office better than did the lamp.

It is to be noticed, in conclusion, that this comparison is with gas at $2.25 per 1,000 cubic feet—a price which it is believed is much above what the gas companies are able to furnish gas at, if they choose to do so.

I have submitted these facts to you for your opinion, fully recognizing that the data given are few in number to base a general opinion as to the cost of electric light and gas on. Still, as we have here, side by side, the bills of both the gas company and the electric light company for the same season of the year, each bill rendered without any thought that it would be used for comparison, the figures cited may be taken as a finger-pointing to the real facts in the present dispute between gas and electricity. X.

[Jan. 2, 1884.

American Gas Light Journal.

TRYING TO INTRODUCE THE EDISON LIGHT AT CHILLICOTHE, OHIO.—Mr. C. B. Story, representing the Edison Electric Light Company, is engaged in an attempt to form a company for the purpose of introducing the Edison incandescent light at Chillicothe, Ohio. The capital stock of the proposed company has been placed at $50,000.

[April 28, 1883.]

THE STATIST.

MAXIM-WESTON ELECTRIC COMPANY.—At the annual meeting the chairman observed that the question had been frequently raised as to how it was that the company had now arrived at the position of not having capital to carry on its business. This state of things, he explained, was to be attributed to their having had an entirely new business to conduct, to their having taken over a very extensive contract—the City lighting—by which they had had a serious loss, to their having to pay the promoter of the company £70,000 before they could commence business, and to their purchasing the Lontin system without it having an incandescent lamp. In this last respect they had been unlike other companies. They had been obliged by the terms of purchase, when offered the Maxim-Weston patents, to buy the latter, notwithstanding that they had already had an arc system. He then referred to the circumstances attending their failures to float subsidiary companies, except for Lancashire, and stated that perhaps their greatest mistake had been in not at the outset having a larger nominal capital. On the City lighting they had lost £4,405, principally owing to the difficulties they had had in getting the cables properly to carry the electricity from the other side of the river. The losses had been £6,064, and on exhibitions they had spent £1,868. After a long discussion, in the course of which the past management of the company was condemned, the motion for adoption of the report was rejected. The directors intimated their willinguess to retire. The report of the committee which had sat respecting the company's affairs was read, stating that the business was a good one if properly managed, but intimating that the money had been frittered away. The meeting was adjourned for a fortnight.

April 21, 1883.]

THE STATIST.

MAXIM-WESTON ELECTRIC COMPANY.—The report for the year ended March 31st, 1883, states that a very large change has taken place in the holders of shares, and refers to the large sum of £113,819 expended in the purchase of the various patents. An agreement has been concluded with an influential syndicate for conditional concessions for the various Australasian colonies, and there is a probability of the company realising from these concessions the sum of £17,000 in cash. For the Lancashire company concession £10,000 worth of fully paid-up shares have been received from that company, and when the unallotted shares are disposed of a further sum of £10,000 in cash becomes payable. £19,625 in shares have already been received for concessions or infringements of the company's patents. Nearly the entire capital is, it is stated, represented in patents, plant, and shares, and it is evident that unless more capital is raised, the operations of the company must be restricted to a point at which no dividend could be available. The directors therefore propose to increase the nominal capital of the company to £500,000, to be issued as required.

January 20, 1883.]

THE STATIST.

ANGLO-AMERICAN BRUSH LIGHT.—In their report the directors refer to the non-payment of dividend, and state that the company have stocks on hand the cost price of which is £93,000, but the sale of which at large profits has been interrupted by the action of the Electric Lighting Act. The capital had been increased to £245,000 by the issue of 700 fully paid-up shares, as compromise to American vendors in regard to mutual claims in connection with the Belgian and Russian patents. The value of all the patents of the company is now stated at £179,466. The purchase of the Russian, Italian, and Scandinavian patents is not yet completed, and the company have an interest of one-third in the future profit, on account of the French patents. In reply to our request for a copy of the report, the secretary writes to express his regret that he is unable to forward us a copy, as in consequence of the great number of applications the stock has become entirely exhausted.

A circular has been issued, stating that the report is so unsatisfactory that it is intended, at the meeting on January 23rd, to move for the appointment of a committee of investigation.

[January 13, 1883.

THE STATIST.

DEVON AND CORNWALL ELECTRIC LIGHT AND POWER COMPANY.—An extraordinary meeting was held during the week to consider the present position of the company, and if deemed expedient, to pass a resolution for winding-up the company. The chairman stated that at the present time the company was sued by 37 shareholders for the return of the money paid by them on their shares. The directors had considered it only right to call the shareholders together, as it would be very unfair for a portion of the shareholders to get back 20s. in the pound at the expense of the other shareholders, who would have to pay another call on their shares to meet these claims. The Board believed it would be to the advantage of the large majority of the shareholders that they should consent to an order being made for winding-up, and concluded by proposing a resolution, which was agreed to by the shareholders. He added that the amount in hand was between £4,300 and £4,400, and that there were unpaid calls to the extent of £3,000. The company had no liabilities.

Feb. 8, 1883]

NATURE

THE Jablochkoff light of the Avenue de l'Opera having been extinguished, the Place de Carrousel is the only street now electrically lighted in Paris at the expense of the Municipal Exchequer. But the electric light is every day finding new fields of display; a building company who are erecting a large structure in the Paris will manufacture the light on their own premises for their own use, and sell it to the tenants at moderate rates.

Jan. 1, 1885]
NATURE

THE *Times* correspondent describes a visit he made to Inspector Mr. Edison's new electric light at Menlo Park. Two of the lights had been burning continuously for ten days without injury to the batteries, and enchanted horsecars in the little place of which furnishes the light. Candlepower, he states, seems sufficiently steadily, successfully emulating quite rough usage, such as dropping, shaking, turning the current on and off thousands of times, and raising the intensity of light to that of 200 candles. Of all the wonders he saw, however, Mr. Edison will put about 800 lights at Menlo Park, while the inventions immediately go into practical operation in New York city. The globe containing the horseshoe is exhausted to one-millionth of an atmosphere by the Sprengel pump, measured by the M'Leod gauge. By successfully dividing the electric current Mr. Edison gets individual lamps of 16-candle power, each lamp having its own resistance. Light is turned on or off, and the current regulated with the same ease as gas is, while the current can be transmitted on wire as small as No. 26. The central regulator contains an even current, while the meters accurately measure the supply furnished to each consumer. Mr. Edison feels that the best generators are of five to seven horse power, each one-horse power maintaining eight lamps. Each lamp costs about one shilling to manufacture, while a supply equivalent to 10,000 feet of gas can be produced for twopence or less. Mr. Edison maintains the cost of furnishing light thus—the consumption of 1 lb. of coal in a steam engine will maintain eight to ten lamps one hour. Mr. Hilliard's system also furnishes electric power for small industries, such as running sewing machines. Mr. Edison's light is bright, soft, mellow, regular, free from flickering or pulsations, while the observer gets more satisfaction from it than from gas. Mr. Edison lights at Menlo Park, therefore, will be a source of much interest to the scientific world, making it available for every lighting purpose for which gas is used.

[March 27, 1879.
NATURE

THE Select Committee of the House of Commons appointed to inquire into the subject of the lighting of towns by means of electricity, and to which the Liverpool Lighting Bill was referred, has continued to go into the question, settle the principle, and then leave the thirty-four private Bills which ask for powers to light by electricity to be dealt with by the regular Committees of the House of Commons. The inquiry will consist names on the 21st inst. As the evidence will be lengthy and the committee will probably report late in the Session, it is expected that no powers will be granted this Session for lighting by electricity.

THE Werdermann light was tried by M. Becquerel in his lectures on electricity, delivered at the Conservatoire des Arts et Métiers on March 19. This apparatus, which will be tried very shortly in Paris, has been introduced into France by Dr. Cornelius Herz. Mr. Werdermann has arranged round the chair of the professor and himself with the utmost regularity every time they were lighted. The opinion of M. Becquerel was very favourable indeed; he has witnessed the experiment of a steadier source of light, of exceptional brilliancy in the flame. He reserved the question of cost in comparison with gas, and confined himself to making a comparison between Werdermann and the competitors. M. Jules Jamin, perpetual secretary of Sciences a system of his own, which has been described in the *Comptes rendus*, and will be tried by the Jablochkoff Company. Other systems are said to be preparing so that the partial failure of Lontin is giving rise to a renewed electric light agitation in Paris. The members of the Municipal Council have determined, to give fair play to any rational experiments.

As the result of the experiment of lighting the Holborn Viaduct with the electric light, it has been found that the cost is twice and a half less than of gas, while the illuminating power is seven times greater, whilst the former decided not to renew [illegible]

Dec. 17, 1883.

American Gas Light Journal.

HARTFORD (CONN.) WILL NOT TRY THE "ARC" LIGHT.

Some short while ago a proposition was submitted to the local authorities of Hartford, Conn., by the Hartford Electric Light Company, which had for its object the illumination of the city's streets with the "arc" light. The proposal of the electric lighting company was to supply any number of lights that the authorities might deem requisite; such lights to burn from sunset until daylight, and to be charged for at the rate of 65 cents per light per night. The subject matter of the proposal was referred by the Hartford Board of Council to the Board of Street Commissioners, with instructions to report back to the former body as to the desirability and feasibility of entering into such a contract. The Street Commissioners reported that they deemed it inexpedient, at the present time, to go into any extended use of the electric illuminant, owing to the great cost of the same; but suggested that, by way of experiment, a certain number of the lamps be erected in prominent positions of the city. In the opinion of the commissioners, it was adjudged that one electric lamp would take the place of four gas lamps, and concluded their recommendations by saying that, "An actual trial will be the only way of demonstrating the power of the light, and proving its practical value for this particular use."

Appended to the report of the Commissioners was the following resolution:

"*Resolved*, That the Board of Street Commissioners are hereby authorized to establish such numbers of electric lights about City Hall square, on Bushnell park, and in parts of Main, State, Allyn, Trumbull, Pearl, and Asylum streets, as they shall deem requisite, not exceeding, in the whole, 20 lamps."

It was not to be expected that Mr. John P. Harbison (who is a member of the Board of Aldermen) would give a ready concurrence to the passage of this resolution, and he did not. Moreover, he came prepared with figures and statements showing why such a course should not be pursued, if due attention were to be paid to the best interests of the city's treasury. He noted how the proposed electric lights, at the rate of 65 cents per night, for 320 nights (estimating 35 nights out of the 365 as being sufficiently illuminated by the moon) would cost $214.00 per light, as against $139 per light for gas, at last year's rates, in accordance with the statement made by the Street Commissioners that one "arc" light would displace four gas lamps—an annual difference of $2,500 in favor of gas, even for this initial attempt at installing 20 lights in central portions of the city. Another thing that Mr. Harbison could not understand was why the city should be charged 65 cents when the same arc lights were already furnished to business establishments at 40 cents. A probable answer to this objection might be found in the reply that the latter are calculated to burn only until midnight, whereas the cost for the proposed city lamps was based on an all-night service. Mr. Harbison further said that, in the course of his inquiries on the subject, he found Boston (Mass.) was paying but 67 and 56 cents per night for an all-night service, and very pertinently propounded the question, why was it that Hartford was asked to pay 65 cents for an article that was being supplied by the same electric light company in Boston at so much lower figures. Mr. Harbison also warned the Council that the time was close at hand when public opinion would require the erecting of laws making underground electric conductors obligatory upon all those engaged in the supply of electricity for purposes of illumination, arguing that it would be unwise policy to embark in a business, the leading features of which would soon have to be changed. He further cited the fact that the gas company was a Hartford corporation, managed and controlled by Hartford capital, and had always been willing to do the fair thing by the Hartford authorities, as testified by the numerous voluntary reductions which it had made in the selling price of gas.

When the question, as to the indefinite postponement of the resolutions to enter into the contract recommended by the Street Commissioners, was placed before the Council, the arguments adduced by Mr. Harbison evidently had the effect of convincing the members that this was the wiser course to pursue; and the motion to indefinitely postpone was carried by the requisite majority.

The rate of 1875 and 1870 mark the third stage in the organic life of gas companies, and seems to have definitely settled the system adopted in London. A series of clauses in these acts define minutely the conditions under which an increase of capital will be permitted, the manner of using the reserve, etc.

The entire financial control is placed in the hands of an auditor of accounts, who must be a competent and independent person appointed by the Board of Trade. He is the possessor of very considerable powers. What over papers or documents he wishes must be furnished him; twice a year he has the right to prescribe the manner in which the accounts must be kept; no dividend can be declared until the accounts have been approved by him.

Testing the quality of the gas belongs to the Gas Referees, a sort of supervising commission also appointed by the Board of Trade, and consists of three competent and impartial persons, one of whom must have a practical knowledge of and experience in the manufacture of gas; they direct the manner to be taken for testing the quality, the degree of purity of the gas, etc.

The ordinary gas furnished must have an illuminating power such that a burner consuming 5 cubic feet per hour will yield a light equivalent to that furnished by 16 sperm candles, 6 to the pound, and burning 120 grains per hour. These conditions are somewhat different from those prescribed by the act of 1860; the chief difference consists in the illuminating power, determined in the number of candles, which is increased from 12 to 16, or 33 per cent. In reality, the increase in the illuminating power required is far greater than 33 per cent., because the standard burner used in 1860 was inferior to that adopted in 1868, which, with the same gas and the same hourly consumption, gives a superior light—the difference equalling 2 candles.

The standard burner used in the photometric tests is Sugg's London Argand, which was the burner used by the Gas Referees under the act of 1868, and has since been officially adopted at the conclusion of a report from the Gas Referees in July, 1871.

It will be of interest to note what the illuminating power of London gas is as compared with that of Paris, which is used as the standard for France.

In London, with a consumption of 141.5 liters (5 cubic feet) in the standard burner—Sugg's London Argand—a 16-candle light must be produced.

In Paris, with a consumption of 105 liters in the standard burner (Bengel), designated by direction of Messrs. Dumas and Regnault, the intensity of a regulating carcel must be obtained, or a light equal to 9.6 candles.

If the London and Paris burners were identical, or, at least, if they were gas under the same conditions, we would come to the conclusion, as the result of a single ratio, that 105 liters of London gas would produce a light

$$\text{equal to } 16 \times \frac{105}{141.5} = \text{or, } 11.8 \text{ candles,}$$

and that the same consumption of gas in Paris, giving only 1 carcel or 9.6 candles, the ratio of the standards would be $\frac{9.6}{11.8}$, or 81 per cent. The standard of gas in Paris would therefore be 81 per cent. lower than that of London; in other words, the standard of London gas being 16 candles, that of Paris would be equal to 16 candles × 0.81, or 12.96 candles. Such would be the result if the whole question were to be determined by calculation only.

This method of establishing the inferiority of the one over the other would not be accurate, because the London standard burner uses the gas to better advantage than the Paris standard; the kind of burner has, therefore, an undoubted influence on the result; and not to take this into account would be to commit a very material error—an error of the same kind that we would commit if we were to compare two grees of different illuminating standards; for instance, the Bengel burner with one gas and Ville's butterfly burner with the same gas. In that case we have what we would term to consume 105 liters of standard Paris gas in the first instance, and 127 liters in the second.

In this connection, then, the only conclusive experiments are those directly and carefully made. Professor Leclanc, tester of gas for the city of Paris, after making several experiments at the Paris municipal laboratory, embodied them in a report to M. Huet, Deputy Commissioner of Public Works, and gave, as the result of his labors, the following comparative statement: 141.5 liters (5 cubic feet) of Paris gas burned in a Bengel standard burner produced a gas equal to 14.7 candles: the inferiority of the Paris gas was thus proved to be only 1-12th, or about 8 per cent.

In experimenting at the same time with the photometer, Dussen's system, on the same principle as the official photometer of London, on several different occasions the Paris gas was found to be of a standard close to 16 candles.

There is only one other point that remains to be made clear—the value of

1. From the suburban companies only 14-candle gas is required.

the English candles in carcels. We have admitted all over that the value of the candle was $\frac{1}{9.6}$ carcel, or 0.1033 carcel. This is the value given by Schilling, which is quite close to that of $\frac{1}{9.5}$ carcel, or 0.1052 carcel, as given by Mr. Sugg, of London, and constantly used in England in comparing with French units. This value of the candle can largely be regarded as a fixed standard. As a result of tests made at the Exposition of Electricity in 1881, it was found that the number of sperm candles equivalent to a carcel varied from 8.8 to 9.5 for still-recent samples of the candle type. We learn, also, from a report presented in 1880 to the Board of Trade, by an English commission of which Professor Williamson was one, that candles taken from two different packages of the same make varied from 14 to 15 per cent. Recent experiments made by M. Mounier, operating upon 36 candles, showed still more remarkable variations. For instance, from 0.120 carcel to 0.102 carcel for the equivalent of a candle—quite a difference. Besides this there has been discovered a variation of 1.287 cascels in the consumption of 6 cubic feet per hour in the London standard burner, which corresponds to 12.2 candles, reckoning the candle equal to 0.12 carcel (the average of 36 experiments on 14); it will correspond to 14.9 candles, reckoning the candle equal to 0.103 carcel, Sugg's value.

It is difficult, in view of such variations, to speak with certainty on the average of a small number of experiments; we ought to await repeated trials, specially made at London with Paris appliances, and, notably, with the same kind of photometer, before we can say it is a fixed fact. We believe, however, that we are not far from the truth in admitting, *provisionally*, the approximate value of 14 English candles for the illuminating power of Paris gas as compared with London gas of 16 candles.

The pressure of gas ought to be at least equal to 1 inch of water (25.4 millimetres) from sunset to midnight, and 0.10ths of an inch (18.24 millimetres) from midnight to sunrise.

With reference to its purity, the gas furnished should be entirely free from sulphuretted hydrogen; the tolerance permitted in the act of 1860 is no longer permissible.

Some time during the week succeeding each quarter, the chief inspector sends a report to the Corporation, to the Metropolitan Board, and to the company, setting forth the illuminating power, the degree of purity, and the pressure, as established by the daily tests.

The before mentioned acts of 1868 set forth and establish the penalties incurred by the companies when the gas furnished does not meet the requirements in the illuminating power, as well as in the pressure and purity.

The above is a very rapid sketch of the general system under which three of the four great gas companies of London operate; the fourth Company (the London Company), which is the least important, remains under its old system with the Gas Light and Coke Company, as regulated by the act of 1860.

[To be continued.]

Opinion of Prof. Henry Morton as to the Practicability of Placing Electric Light Conducting Wires Underground.

In a late issue of the New York *Daily Times* there appeared the following communication, from the pen of Professor Henry Morton, in regard to the above-named subject. The Professor says:

In considering what should be done or left undone in reference to the raising of wires to supply electric lights in the streets of New York several questions present themselves as requiring answers before a decisive conclusion can be arrived at. What is the present extent of the business involved? What advantages or inconveniences do actually exist, or have been proved to exist, in the present systems during the two or three years of their past use? What remedies have been suggested, and what effect would the application of these remedies have upon the continuance and extension of these uses of electricity? What light does experience in Paris, London and elsewhere throw on this subject? What possible dangers or inconveniences have been suggested as likely to be encountered, though not yet experienced, and what probability is there that these anticipated dangers will ever be realized?

In the first place, let us consider what is the present extent of the use of electricity conducted through the streets of the city of New York. In the first place, we should observe that there are three general systems of distribution now in use:

First—The underground low tension system of Edison, used exclusively for incandescent lamps, each of which gives a light about equal to that of one gas burner.

Second—The medium tension aerial system, used by the United States Illuminating Company for incandescent lamps arranged in series.

Third—The high tension aerial system, used by the United States, the Brush, the Fuller, and other companies for arc lights.

[October 14, 1882.]

THE STATIST.

AUSTIN AMERICAN ELECTRIC ILLUMINATING COMPANY.—The chairman observed that it would be superfluous for anyone to enter into details of the working of a good deal that the Board was doing for establishing the business of the company, in the present state of the money market. The prospectus of 25,000 ordinary shares had been subscribed by the public. By a modification of the arrangement with the vendor, he had accepted for the patents transferred to the company £27,000, instead of £35,000, in cash, on account of the total sum of £50,000 agreed to be paid to him. The balance he had accepted in shares. The company possessed the Brush and Lane-Fox patents for Austria and Hungary, and the Brush patent for Germany. Considerable progress had been made in the Austrian and German kingdoms, where no patent laws at present existed. So far, however, as concerned their chief market in America, they were not yet in a position to carry on business in any other country. They had satisfied themselves that the Brush system was the best adapted for Austria, Hungary, and Roumania, for which the Brush system was suitable, and Brush lights were already in use in several considerable towns in Austria. Austria and Roumania contained together a population of over 42 millions, and assuming that on a rough percentage to allow for distance of electricity, a revenue of £1 would be derived for every £5 per head of population, the company would be receiving a large revenue when the working of the system of electrical distribution should be in local hands. In the opinion of the board, the profits of this company should take one third of the whole power in the first instance, and afterwards contractors and manufacturers in the different countries should be encouraged to form companies for the establishment of the systems of distribution which they believed would result from their pioneering. A committee of the Board, consisting of himself and two directors, had returned from a tour in Austria, Hungary, and Roumania, where they had been met by a most flattering general reception, and by every arrangement to engage in the Roumanian the committee had had several interviews with the Ministers, and given the company's prospectus to light up exceptionally well-to-do winter palaces and the grounds of his summer palaces at Bucharest. For this reason, which he mentioned, the directors were of opinion that it would be advantageous to the company to raise at this juncture a loan with which another company would be held.

LARGOMERSINO ELECTRIC LIGHT AND POWER COMPANY.—At the annual meeting the chairman stated that from that the company's rent had been proceeding very satisfactorily. The lighting of the Emiliani Theatre, the contract for which they took from the Municipality, was a loss. It was supposed that the working expenses would be 40 per cent, but that had not proved to be the case. The lighting, however, was a good advertisement for the company, and the annual loss had not been reduced from £700. It was about £500. Soon after the formation of the company, feeling that the time was favorable for establishing additional lighting and power for the moment, they turned their attention to manufacturing purposes, and to supplying installations in various places. The installations of the Casalino had gone on at their works on the Albert Embankment, and they were making them for cheaper and better than they were supplied by the French company. Their electricians had carried out many successful installations. At first there was much profit from the electric work, but they were now able to reduce the expenses day by day and to increase the profits. The only obstacle between them and the Board and Meyrlebone Vestries, which had at first refused to use the electric light, had been removed, and they (when he was told this if they got the business contracted for. The Board of Trade, as much money as they wanted would be supplied to them. However, in opposition to the wishes of the Board directed, a provisional order for the whole of the parish and the Swan Company's installation at the Paris authorities had made a new contract with the French company, paying them double the previous rent. The report referred to their works which had been carried on for the company, and they were asked to undertake. They could supply four or five times their present supply. They could supply four-fifths of the whole of the Metropolitan Board's work. With regard to the Swan Company's installation, it should have been shown to have been £300, not £2,000 as supposed, however, had been carried in the accounts of the company. The depreciation of the Swan Company's works, the worth of work, of which they had done about £2,000 worth, and which they had decided to leave £20,000 of their business leaving £ per cent. The directors intended for the future to take no remuneration till the company had earned a fair dividend. A long discussion followed, the general opinion being apparently contented that if expenditure had been on too large a scale, having regard to the capital of the company, the fault was not in the direction in fixing £2,000 for the year, for fees were criticised by several speakers, some of whom argued that the fees were criticised by several Mr. Hay, and that the right course to take was to wind-up. The vote, however, was strongly opposed by other speakers, who maintained that the company was solvent, and that the preliminary difficulties having been now surmounted, it would be unfair to wind-up. The Board of the company, it was stated, was to meet in a few weeks to consider the matter, when a resolution would be proposed.

[November 4, 1882.]

THE STATIST.

BATTERY ELECTRIC LIGHT AND POWER COMPANY.—In moving the adoption of the report, the chairman stated to the meeting that the accounts were not quite in such a form as he was in a position to give information to a small meeting. Many grave difficulties had arisen in connection with the application of the light. They had, however, been making satisfactory progress. They had sent out to India, and the East various electrical appliances to the value of nearly £40,000. That was up to the end of September. The chief part of their expenditure had been for as lighting. They had now established contracts in India for as much as £4,000, which was very small compared to what it would have been had they not been interfered with by the Government, who had prevented them from carrying on their works. They had now a satisfactory contract with the Municipality of Bombay, and at the present moment they were doing an amount of street lighting which, he thought, it would be difficult to find elsewhere. Contracts for two years had also been entered into with the towns of Berwick and Surat for street lighting, which they were now successfully carrying on every evening. He thought the directors might take credit for the small amount of expense incurred—£2,000. The call of £1 per share, which did not come into the present accounts, had been well met, and the money derived was being spent on the inauguration of their manufacturing scheme. They had made an arrangement with the Indian and Oriental Electrical Engineering and Works Company, whose batteries they now possessed the use of throughout the whole field of their operations. The report was then unanimously adopted; and at a subsequent extraordinary meeting certain alterations were made in some of the articles of association of the company, principally to meet the requirements of the Committee of the Stock Exchange.

[November 11, 1882.]

THE STATIST.

RIVER PLATE TELEPHONE AND ELECTRIC LIGHT COMPANY.—The directors have obtained a circular to the shareholders, with information as to the company's position and prospects. These are reported to be very satisfactory, the subscribers already secured in Buenos Ayres and Montevideo numbering 600 and yielding a total income of £12,228, which would enable the full dividend of 8 per cent. on the preference shares to be paid. As it is sound there is ample room for the profitable employment of further capital, it has been decided to issue a further 2,750 shares of the pre-ferred shares, existing shareholders having the option of taking them at par, £2 10s. per share to be paid on application and the balance on allotment.

[November 4, 1882.]

THE STATIST.

AUGUST 21, 1882.

THE TIMES.

ELECTRIC LIGHTING.

TO THE EDITOR OF THE TIMES.

SIR,—It will scarcely be necessary for me to call your attention to the fact that the electric lighting, to bear out Sir Joseph's Paul Gotch, Mr. Martin's-le-Grand, will be illuminated by means of the Edison-Swan system, the supply of electricity being derived from the company's central station on Holborn-viaduct, at a distance of about 1,000 yards.

Installations are also being made in America by the principal firms of Edison and Swan, and by the Edison-Swan Company, and with the electric light having been laid down in the streets and in many private houses, offices, and everything being on the most complete scale. The electrical works have been of a most satisfactory nature, and during the past week in Regent-street by the Edison and Swan Company, a display has been made in the streets and in many of the houses and offices in the Hanover Square district, which was most successful, and was illuminated by the Edison-Swan electric light. The electrical engineering profession will be present.

I am, sir, your obedient servant,

ARNOLD WHITE.

The Edison Electric Light Company (Limited), Secretary, Colonna-street, Queen Anne's-gate, August 20, 1882.

A Difference of Opinion as to Cost of Electric Lighting between Mr. Lane Fox and "Engineering."

We published in our last number a criticism, by *Engineering*, upon certain glowing predictions of Mr. Lane Fox, made in his lecture delivered before the Royal United Service Institute. Mr. Fox thinks that *Engineering* hardly does him justice, and sends the following letter to that publication, in which he attempts to justify the statements made by him at the Institute. We also republish what *Engineering* says in answer to Mr. Fox's latest communication.

To the Editor of *Engineering*—Sir: In the "Electric Lighting Notes" of your last issue, you say, in criticising my lecture at the Royal United Service Institution, "In the first place, taking his own data we work out the cost for him, with coal at 20s. per ton, to be rather more than a halfpenny instead of a farthing." In the same way you might have worked it out, "taking my own data" with coal at 40s. per ton, and then you would have found the cost to be a little over a penny; and further with coal at 4s. per ton (the actual price of good coal delivered by rail in Glasgow) you would have found, always taking my own data, that the cost was a little under half a farthing. But taking the price of coal as the average rate throughout the kingdom, as I have taken it, you will find that my estimate of a farthing is not so far out.

Next you say that "An ordinary gas jet costs one-fifth of a penny per hour." I have put it at a farthing. Well, let that pass. You go on to say that "to-day there would be a difficulty in getting a supply of incandescence light at the price of gas." You might, indeed, have gone further, and added that with perfect truth that there would be a difficulty, and a very great difficulty, in getting a supply at all.

Finally, you say, "We wish that Mr. Lane Fox had been more explicit with his audience, and had furnished reasons which would have enabled us to share his sanguine anticipations." If you had read my lecture before criticising it, you would have found that your wish might have been gratified, for, indeed, the chief object of my lecture was to indicate "the possible directions in which future reductions is to be looked." My reason for thinking that we have not arrived at a final stage in electric lighting, and that it is what it comes to, is simply that we have not yet had any opportunity of testing electric lighting on a large scale by a properly organized system of low tension distribution. When such systems are established on a scale similar to those of gas, as I hope and believe they will be before long, I have no doubt that you, in common with the rest of the world, will be able to share my "rosy anticipations."

I am, sir, your obedient servant,

HENRY G. LANE FOX.

[In the lecture we ventured to criticise last week, we find that Mr. Lane Fox crystallizes his convictions on the subject of electric lighting by incandescence, in the following sentences: "An ordinary gas jet is equal to twelve candles only, so that for the same price twelve times as much light can be produced by electricity as by gas." We used not repeat the substance of our criticism, but we may say that Mr. Fox has, at most, but one supporter in argument it by a few distinctive made from careful estimates prepared by responsible engineers. Mr. Lane Fox has obtained all his results by placing his figures too favorably for electricity and too unfavorably for gas. The foregoing it will be seen that the various deductions stand as follows, the first two substantiated by careful and detailed figures, the third resting only on vague and general statements so far as appears from Mr. Fox's lecture.

	Cost of Incandescent Electric Light.	Cost of Gas to give Equivalent Luminous Duty.
Simmons	.149	.156
Cooke	.134	.140
Lane Fox	.0208	.260

—Ed. *E.*]

Bituminised Bricks.

The London *Builder* states that, in a recent issue, the *Deutsche Bauzeit.* ung called attention to an experiment in street paving in Berlin. Bricks of the dimensions of 8 by 4 by 4 inches (in the quality of the usual so-called Klinker bricks, and therefore) have been employed which have been impregnated with asphalt by a patent vacuum process. By this mode of treatment, after the expulsion of air and water has taken place, the bricks absorb from 15 to 20 per cent. of the bitumen, and the porous easily destructible substance is changed into a tough elastic mass, said to be capable of resisting pressure and concussion in an exceptional degree, and resisting the ingress of moisture. The bricks are then laid upon a concrete foundation, six inches in thickness, by means of hot tar.

The traffic at the point in question has always been heavy, so no less than 1,000 light vehicles per hour are said to cross the spot chosen for the trial, in addition to 1,300 tram-car journeys over this portion of the roadway. No

Statist, Nov. 10, 89.

THE STATIST.

BRUSH MOTIVE POWER ELECTRIC LIGHT AND POWER COMPANY.—An extraordinary meeting the chairman stated that a small number of shareholders—60 out of 500, and representing only 140 shares—had taken advantage of what they alleged to be a technical misstatement in the prospectus of the company, and had requested them for the return of their money. A friendly and large shareholder, however, who they might have noticed, had a petition to submit to the company, but that petition was less on desire whatever that the company should be wound-up. He only rose for the purpose of saying that he would support it. 19 shareholders alluded to having any private letter the rest of the shareholders, supposing that the statement in the prospectus turned out to be material, and the money was ordered to be returned to them. It had been stated that the object of the meeting was that the company was going to buy for their directors an exclusive concession for the Anglo-American Brush Corporation's patents outside and for the Lane-Fox lamp. It was not, and could not, be done in this way, and the exclusive right in the very valuable concession of the Brush dynamo machine. It was, however, very hard to say how the word "exclusive" came to be used in their prospectus as applied to the right to the Lane-Fox lamp. He did not know how it occurred that, the Anglo-American Brush Corporation had not mentioned the fact that Mr. Lane-Fox had given a license to the British Brush Light Company to use his lamp; but it was clear that the Brush Midland Company could only use that lamp upon terms with the British Electric Light Company in their district. It was a very curious fact that on the Board of one, if not more than one, of the subsidiary companies the word was used "exclusive" as applied to the Lane-Fox lamp, there were directors who were also directors of the parent Brush Company. He did not think that the directors could be supposed to know that such a license existed. What legal opinion they had taken about the word "exclusive" the Company or any one else he could not tell; but they might rest assured that if the company went to law to settle the question, the necessary steps should be taken with that object. It was to be clearly understood that the Lane-Fox lamp was not paid for with very valuable consideration for the use of the Brush dynamo machine; they paid nothing whatever for the use of the Lane-Fox lamp, and perhaps it was owing to the fact that the mistake as to the use of the word "exclusive" in connection with it had escaped the notice of the many solicitors through whose hands it had passed before it was passed. What they had to consider was whether they had been misled, was whether they had been injured from the want of the exclusive interest of the license for three months, and they might. To consequence of the proceedings which had taken place in this attention, there were two courses open to them—either to accept the loss or costless business. If they were to go into liquidation they would have a certain amount of assistance—say to the value of £2,000—and their present assets would go to the value of £1,000 cleared from the parent Brush Company. He, in fact, if they were to go into liquidation, getting assistance to forward sensible proceeding, the proceeding would be suicidal. The prospectus was issued in the fields of fact, but they had to realize only upon its value in actual work for their results, and in that period they had got to go through the advertising, the shareholders, the solicitors, the expenses they had incurred in making installations in several places, which they had felt obliged to do by way of advertisements. They had successfully fighted up the town of Chelmsford with the very best and also some very good business in addition to this. Brighton, for instance, contracts—at Oxford Street, at Nottingham and at Leicester two. If they threw up the sponge, liquidation, there could be no doubt that they would be able to realize £1,000 cash, in his opinion, to pay them a very fair dividend. If, however, they could not do that they would pay a dividend they would not be able to pay a dividend if they concluded by carrying the following resolution, which he moved, having heard the statement of the chairman as to the position of the company, is of opinion that the interests of the company should not be sacrificed, notwithstanding that some of the company should have demanded the return of the proceedings of the shareholders towards the directors of the company, and therefore re-pellion." In answer to a question, the chairman stated with regard to the opposing shareholders referred to, that if the worst came to the worst, they would have to pay them, and declared it carried, with one dissentient.

HAMMOND ELECTRIC LIGHT AND POWER SUPPLY COMPANY.—An extraordinary general meeting is convened for the 15th inst., to consider resolutions for amalgamating with the company the Yorkshire and Sheffield Companies and Warwickshire Brush Electric Light and Power Companies, and the undertakings known as Hammond, Thompson, and Lees (Limited). The directors will also ask for authority to create and issue 10,000 deferred shares of the nominal value of £2 each, on the terms of the agreement already approved by the Hammond Company, and authorized to be carried into effect with the Ferranti Company. In the circular convening the meeting it is stated that the agreement with the Yorkshire and the Birmingham Companies provides for an amalgamation of the two companies, the Hammond Company forming their rights on the shares they hold in the Yorkshire and Birmingham Companies, and also agreeing to allot and issue to the Yorkshire and Birmingham Companies their shareholders fully paid £2 shares of the Hammond Company, in the proportion of one fully paid-up £2 share of the Hammond Company for every six £2 fully paid-up shares in the Yorkshire and the Birmingham Companies. The agreement with the Ferranti Company will provide for an amalgamation with the Hammond Company, by consideration of the issue to the Ferranti Company of 7,200 ordinary shares of the Hammond Company of the nominal value of £2 each, to be issued as fully paid-up, and 10,000 deferred shares, to be issued as fully paid-up, of the nominal value of £2 each, and which will only be entitled to dividend after 5 per cent. has been paid on the whole of the ordinary shares of the Hammond Company. The Yorkshire, the Birmingham, and the Ferranti Companies will, for the above consideration, transfer to the Hammond Company all their respective undertakings, works, property, rights, and effects, the Hammond Company undertaking to issue and pay all liabilities and the costs of all necessary agreements and of winding-up and dissolving the three companies.

LONDON AND PROVINCIAL ELECTRIC LIGHTING AND POWER (OPERATING) COMPANY.—An order has been made for the compulsory winding-up of this company.

THE STATIST.

EASTERN ELECTRIC LIGHT AND POWER COMPANY.—At the meeting the chairman stated that the sum of £10,000 had already been expended at Hastings under the authority of the Italian Company, and £15,000 had also been spent at Malta, Syracuse, and Genoa. The progress of the company had been very unfortunate. With regard to the future, they hoped to avoid any untoward thing their efforts to be found to carry on the business. If he thought the shareholders would find more money he would ask them to do so on debentures. He was perfectly satisfied that the company could be made to pay, and go on with very large profits. The meeting was going to be done. But that was the difficulty with the shareholders. The chairman replied that was suggestion of the appointment of a committee fell through, and the meeting closed, with a vote of thanks to the chairman.

METROPOLITAN BRUSH ELECTRIC LIGHT AND POWER COMPANY.—At the meeting the chairman said they had decided to put forward with their business and to let how alone. The Hathorn Davey would be a very important, and if it were successful they would proceed with their orders. For the practical carrying out of their work they had entered into an agreement with the Hammond Company. They would not make a call unless they saw their way to employ the money profitably. A shareholder observed that £375,000 had been paid for the concessions, and he believed they would be able to make some use "illegible." The chairman declined to enter into matters of investigation, but repeated that they were should be given to them. It was resolved that the report should be adopted, but that the consideration of the accounts should be postponed "until after the report of a committee of conference."

THE STATIST.

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION.—The directors have placed the Swan Electric Light Company, Limited, and the Lane-Fox. It has been completed, and in the hands of Mr. St. George Lane-Fox. It has been completed, and in the hands of Mr. St. George Lane-Fox. It has been completed, and in the hands of Mr. St. George

[December 2, 1882.]

THE STATIST.

SUBSIDIARY ELECTRIC COMPANIES.

We elsewhere report the proceedings of the Birmingham and Warwickshire Brush Electric Light and Power Company, and, at considerable length, the explanations of the Earl of Crawford and Balcarres at a meeting of the shareholders of the Brush Electric Light and Power Company of Scotland. In the course of the latter, the Earl referred to the history of the Company in the past, and not the least extraordinary fact in his statement is that applications were sent in for 272,281 shares, of which there were only 20,000 to allot. At the time caused bitter disappointment, but some of those persons who were loudest in their complaints of the smallness of their allotments are now rejoicing for a return of their capital, professing that they were misled by the terms of the prospectus. We understand that those who clamour for the return of their money are very few in number, and their holdings are small, but none the less does their agitation seriously inconvenience the Company, inasmuch as it paralyses its efforts to secure business.

At the meeting, the chairman was careful to point but the glorious uncertainty of the law. The information, as stated in the prospectus, respecting the exclusive rights of the Lane Fox incandescent lamp may be interpreted literally, whether the lamps are sold as "Lane Fox" or as "British." But even were a decision given in favour of those shareholders who ask for their money back, the disposition of the meeting was such that there seems every probability that the main body of the proprietors will continue to work and seek to extend the Brush system of electrical lighting in Scotland. In this policy they accord with the shareholders in other subsidiary Brush Companies who have lately been called together to consider the subject.

Although the progress of electric lighting has not been so rapid as most prophets predicted, there is apparently no reason for the panic recourse of wind-up companies before they have had any chance of obtaining business. It would have been just as reasonable thirty-odd years ago for shareholders in the new English Railways to have pulled up the rails and liquidated their assets, because stock speculators were carried on to an excess. Probably, had it not been for Stock Exchange movements in prices of Electric Companies' shares, we should have had none of the present outcry. We observe that some of the shares of the Companies are quoted in the market actually below the intrinsic value, even if the Companies had been ordered to be wound-up. A liquidation on the worst, should be a matter of a very short time, and inexpensive, if carried out by the officials of the Companies.

[December 30, 1882.]

THE STATIST.

A further decline has taken place in the shares of the Anglo-American Brush and Hammond Electric Light Company. The solicitors of the former Company have advised a contemporary that—"The Corporation never promised an exclusive Lane-Fox licence. No exclusive licence was ever granted by the Corporation, and the Corporation never received a single shilling for granting such licences in England, Scotland, or Ireland." They also state that the Corporation "is in no way accountable for the misstatements in the prospectuses of the sub-Companies."

[March 23, 1882

NATURE

On Wednesday evening, at 9 o'clock, Professor Abel and Rosseo, on behalf of the Chemical Society, the Society of Chemical Industry, and the Institute of Chemistry, received a large number of distinguished guests in the Crystal Palace, where refreshments were provided. Fifteen hundred invitations were issued and accepted, not merely within the limits of the United Kingdom, but in continental countries, and several eminent chemists from France and Germany came over expressly to join the gathering. The Crystal Palace was chosen as the meeting place because of the International Electrical Exhibition now being held there; and the party dispersed themselves about the various exhibits. It was a gala night at the Palace, and the different electric lighting systems were shown at their best. The magnificent display by Edison in the Concert Room and Entertainment Hall elicited much admiration; so also did the fine candelabrum of 96 Maxim lights, executed in cut glass by Messrs. Defries and Sons, and exhibited by the Electric Power and Generator Company. These lights are fed by a Maxim dynamo-electric machine capable of feeding 100 Maxim lamps of 20 candle-power each. The incandescent lamps of Mr. Lane-Fox, exhibited by the Anglo-American Brush Electric Company, the Bright system exhibited by the British Electric Light Company, and the Swan systems were visited in turn, as also were the suite of apartments in the northern gallery lit by Edison's lamps. The visitors scattered about the various stalls, and a special train carried most of them away to town at 9.30 p.m.

[April 28, 188

NATURE

THE *Daily News* New York correspondent telegraphs that the Aldermen have passed, over the mayor's veto, the ordinance giving the Edison Electric Lighting Company permission to lay mains in the streets. "The company will proceed immediately to introduce its new electric lamps in the offices in the business portion of the city around Wall Street. The consumption of the lamp is simple. It consists of a small balloon glass globe, four inches long, an inch and a half in diameter, with a carbon loop which becomes incandescent when the electric current passes through. Each lamp is of sixteen candle-power, with no perceptible variation in intensity. The light is turned on or off with a thumb-screw. Wires have already been put into forty buildings. The company will compete with the gas company, charging the same rates. If the latter reduces, the Edison Company will also reduce, and are prepared to go lower than the gas companies can."

It is known that M. Jamin, member of the French Institute, has patented an electric lamp in which the light is directed hyan electrical current. A public company has been formed with a capital of 8,000,000 francs for the working of the patent.

ELECTRIC LIGHT IN COLLIERIES

AUGUST 9, 1881, witnessed the first practical application in the United Kingdom of the electric light to the illuminating of coal-mines. The Earnock pit, near Hamilton, belonging to Messrs. J. Watson, has been fitted with Swan's incandescent lamps, arranged with water batteries of steel glass, air-tight, and provided with steel guards. The workings in which the lamps were fixed are 118 fathoms, or 708 feet below the surface. Twenty-one brilliant little lights placed at the pit-bottom, in the roads, and at the actual face of the seam where active operations were in progress, supply an illuminator of a very different character from the dismal glimmer of an occasional Davy. The electricity was generated by a dynamo-electric machine at the surface worked by a special 12 horse-power engine, and conveyed by two cables, first along telegraph poles to the pit mouth, then down the shaft to the workings, in one section to a distance of half a mile. The overhead wires are naked copper wires of 3 inch diameter, while those below ground are carefully insulated, and in the shaft are protected with an outer tube of galvanised iron. At suitable points at the circuit safety air-tight switches, the invention of Messrs. Crabtree of Glasgow, are inserted to afford control over individual lamps. The mine was visited two days after the initiation of the light by members of the Mining Institute of Scotland, with whom was Mr. W. Calloway, whose remarkable experiments on the explosive effects of coal-dust will be remembered in connection with the more recent report of Prof. Abel. The party were photographed in the workings. An experiment was made with a lamp to test whether in the event of its being broken by accident a surrounding atmosphere of explosive gas would or would not be kindled by the strip of red-hot carbon before it had had time to cool. Into a box containing about three cubic feet of explosive gas a single lamp, removed from its outer protecting case of iron and glass, was placed, and the current was turned on. The fragile bulb inclosing the incandescent carbon thread was then purposely broken, when the gas inclosed in the box immediately exploded. No such occurrence could possibly happen if the protecting case of stout glass is properly constructed. The risk of accident must be considered an immensely less than that of the ordinary Davy lamp, especially when it is remembered that with the brilliant light of the electric lamps they need no longer be carried in the hand or set down upon the floor near the actual spot where the coal is being got, but will be fixed overhead at a safe distance against the wall of the mine. The easel with which the light can be turned out during the firing of a blast is another point in their favour. The proprietor of the Earnock Colliery is greatly to be congratulated on the step he has taken. In 1880 the death-roll of the shafts by explosions of fire-damp in Great Britain reached the figure of 499 persons. We venture to predict that the universal adoption of electric lighting in fiery mines would reduce this figure to one-tenth of its terrible proportions. How many years will it be, we wonder, before the adoption of electric lighting will be made compulsory by Act of Parliament? And how many colliery owners will discover, we would ask, when driven in this course by compulsion, that in the long run they effect an economy by discarding the clumsy and unsafe "safety"-lamp, which will at once be numbered with the "dint mill" amongst the relics of the past?

AUGUST 12, 1882.

THE METROPOLITAN.

Electric Lighting at Pulham.—At a meeting of the Pulham Board of Works, on Wednesday, a deputation, headed by Mr. Lefevre, the chairman of the West Middlesex Electric Light Company, Limited, waited upon the Board with the object of asking them to grant a wayleave to lay down mains in the streets for the purpose of the company's wires for a space of six months as a trial. The company offered, free of cost, to supply two lamps equal to the light of sixteen gas-burners in the principal part of Broadway and Walton-street for the same period.—Mr. Wright said if the company would undertake to put up a similar lamp in Pulham Fen Town it would influence his vote.—Mr. Lefevre gave the required promise.—In reply to Mr. Sanderson, he said the expense would be borne by the company.—Mr. Stoddard hoped that a light would be thrown on the doings of the Board, as they had been very much in the dark lately. [Laughter.]—In reply to the chairman, Mr. Lefevre said one of the schemes was to supply the Cricketers' Arms with the light.—The Clerk intimated that he had been two similar applications from other companies.—Mr. Stoddard hoped the Board would not entertain the application. He said it was a most shameable thing that the paving and roads should be so frequently disturbed.—Mr. Sanderson would support the scheme. He mentioned that if the cost was double to that of gas, the illuminating power was much greater.—The Clerk here read the West Ham Electric report on the subject, which recommended the Board to sanction the scheme.—Mr. Allen suggested that as it was a highly important question, it should stand over for members to fully consider the matter, and notice could be issued.—Ultimately the application was acceded to, on the company consenting to certain conditions.

South Eastern Electric Light and Power Company.—At a special meeting of the South Eastern (Small) Electric Light and Power Company (Limited), held on Wednesday at the City Terminus Hotel, Cannon Street [Mr. Edward Wright in the chair], a resolution was passed altering the articles of association of the company in certain particulars. The chairman observed that their work up to the present had been of a constant and expanding and organising, for the business which they had no doubt was before them. They applied to the Stock Exchange for the 3rd of June for a settlement, which was granted on the 29th of that month, but they could not obtain a quotation until £5,000 of the capital had been paid up. They had not, however, thought it wise to call up the £1 a share which was due at the end of June, as they had no immediate necessity for utilising the money advantageously. After referring to matters in connection with the organisation and staff of the company, which were working to conclusion, as regarded offices and staff, with the exception of the secretary, he alluded to the successful work which they had at Eastbourne, and to the large installation which they had carried out at Penge Park, and they were also in the Great Eastern Railway yard. They had had numerous applications in reference to installations and the use of electric power, but they had been very busy over the distribution of the mains, and would begin power by day from their mains, and the means of supplying electricity by day and night, and also to a battery or accumulator. Such a system difficulties he believed would now shortly disappear. These matters would be dealt with at once, and formed a control to take into consideration their common interests. The delegates had already met and had established their future mode of procedure. With regard to the Electric Lighting Bill, he expressed his satisfaction at the amendments which were made in the provisional order objected, however, to the compulsory purchase clause.

The Edinburgh Electric Light Company of New York sent out circulars last week to house owners and tenants of their first district, bounded by Spruce, Nassau, and Wall streets and the East River, giving notification that the street conductors are now all laid, and the company is prepared to make the house connections. It is stated by the Vice-President that the lighting of the district will take place by the 1st of September or earlier.—*American Sanitary Engineer.*

On Tuesday night the electric guard at Coventry was illuminated with the electric light, and, at the request of some of the inhabitants, it was decided to utilise it on the following evening for an exhibition football match. The light was equal to 10,000 candles, but the denseness of the shadows added to have rendered it impossible for a great deal of skill to be exhibited.

After a time they die. Their ill-health under these circumstances is apparently due not merely to the want of food, since they die sufficient trouble the small Entomostraca on which they feed can be supplied to them, but to the very fact of confinement in a small receptacle. They require a large bulk of water. Flavitatile organisms can be kept in a small vessel by means of a constant stream poured through the vessel, and organisms which inhabit small pools present no difficulty. But insertive forms are very difficult to deal with. Should the Medusæ reappear this year, it is my intention (with the permission of the authorities) to partially submerge a vessel with freely perforated sides in the large tank, the bottom of such vessel to be imperforate, and the vessel itself two feet in diameter and three feet in depth. If a sufficient number of the first brood of young Medusæ can be cultivated in this vessel through the summer, both males and females (unless the females have some altogether unsuspected history) will in all probability arrive at maturity, and reproduce in it as they clearly enough have done in the Regent's Park tank between 1880 and 1881. It will then be possible from time to time to examine carefully the contents of this experimental vessel. I need not say that I should be very glad if others would carry out a similar experiment.

E. RAY LANKESTER

ELECTRICITY AT THE CRYSTAL PALACE

II.—*Edison's Electric Light*

THE centre of interest as the exhibition of electricity in the Crystal Palace, formally opened on Saturday by the Duke and Duchess of Edinburgh, will unquestionably be the show of Mr. Edison. His electric light in the Entertainment Court and the Concert Room is by far the finest ever yet made, and is of itself a spectacle to be remembered. No expense has been spared to demonstrate the power and beauty of his incandescent lamps, and the divisibility of the current to meet the needs of domestic lighting while Messrs. Verity and Sons have seized the occasion to illustrate their skill to show how eminently adapted the electric light is for ornamental purposes. The heated filament of carbon inclosed in a vacuous bulb of glass is well fitted for all kinds of domestic illumination by reason of its pure and absolutely steady glow, its healthiness and freedom from noxious fumes, and its comparative coolness. But in addition to its superiority over gas, oil, and candles in these respects, the Edison exhibit also proves in the most striking manner its superiority as a decorative light, and its unrivalled capacities for enhancing the artistic pleasures of our homes. Realising giving off an cute colours, the incandescent lamp lends itself to the designer's fancies in a way which no other illuminant can; and we may expect something like a revolution in household decoration by its introduction, as well as a new development of the brass-worker and the glass-blower's art.

Before considering the apparatus employed by Mr. Edison at the Crystal Palace for the production and distribution of the light, we shall briefly describe the results, readily a small cluster, the principal object of interest is a magnificent chandelier suspended from the middle of the ceiling. This beautiful object is in itself a work of art, and sustains ninety-nine incandescent lamps. It is ceiling. This beautiful object is in itself a work of art, and sustains ninety-nine incandescent lamps. It is constant feet in diameter at the lower end; while its weight is half a ton. In device it represents a tapering bouquet of flowers springing out of a golden basket. The stem of each flower springs from a circular brass plate within the basket, and bends over towards the spectator, presenting its calyx of coloured glass, in which is fixed an incandescent lamp. The foliage is all of hammered brass, richly gilt, and here and there is mingled with the sun-flower or tiger-lily, and some rambling sprays of fern. The corolla of the flowers containing the lamps, and acting as their shades, are in the form of tulips and hyacinths, made of glass, and tinted with a variety of colours—pearl, white, ruby, clear olive, and clouded blue. Each lamp projects from the heart of the flower like an enlarged pistil, and throws its light outwards and downwards into the room below. The lights are controlled in three sections by turncocks, like gas, and thus a graduated effect can be obtained, or all the lights may be put on or off at will.

On each side of the stage, which is furnished with a row of twenty-four footlights, there is a pretty candelabra[1] mounted on a short marble column, and representing a vase-bush springing from a golden urn. The stem of the bush is entwined with China roses, and crowned with five upright lamps or candles, like the fruit of the tree. On the left of the stage is hung an exquisite little chandelier or lustre of Venetian glass, which, though far less imposing than its gaudier neighbour in the centre of the hall, is chaster and more elegant, and better fitted for an ordinary drawing-room. It is about four feet high, and consists of loops and festoons of crystal drops on gilded chains, encircled at the bottom by a ring of fourteen lamps; and inclosing higher up a single incandescent bulb of ruby glass under a bell shade of the same material. The use of coloured glass for the vacuous bulb itself is illustrated here, and shows how the light can be tinted to harmonise with any interior furnishing, or suit the taste and eyesight of individuals. The influence of the glowing carbon in a transparent bulb is not too strong for the ordinary eye to look at with impunity; but the presence of weak sight may have it reduced by the use of clouded bulbs, and students, or those suffering from diseases of the eye can employ bulbs of green or blue glass. Photographers, too, can have recourse to ruby lamps in the development of their negatives.

On the right side of the stage there is a third chandelier of gilt brass, with twelve naked bulbs, a number of single lamps on stands or movable brackets, like gas-jets, with turn-cocks, and either naked or shaded by flat conical reflectors of opal glass. Specimens of these are shown in Figs. 1 and 2. Then there are ball-lanterns of brass, inclosing clusters of bulbs, window-lights, a very handsome billiard lamp, containing six set of twin lamps, shaded from the eyes of the players by opal glass reflectors and crimson fringes, and two handsome drawing-room shade-lamps of the same pattern, each containing a cluster of eight bulbs inside, and one lamp supplemented by four pairs of naked bulbs outside. Bulbs are also shown burning under water, either clear or tinted, to illustrate the use of the incandescent system in fire mines, and there is a specimen of a regulator lamp by which the power of the jet can be graduated at will like a gas-flame, by simply turning the cock. This lamp is shown in Fig. 3, the lower being the regulating socket by inserting the resistance of a series of vertical carbon rods into the circuit. This is done by turning the screw-piece at the base of the cylinder inclosing the circuits and keep them cool.

In the top of the lamp the novelty is the form of the contact surfaces to prevent sparking or breaking the circuit. These are conical, the small cone seen on the top of the figure being forced away from a conical cup on turning the screw plug. The large surfaces of the cones prevent simultaneously separating, and prevent a large spark. A safe-guard for the lamp against a too powerful current is provided in a short fusal wire, seen running from the left of the figure. When the current is too strong this wire fuses, and the current of the lamp is interrupted.

[1] Electroliers and electrosliers would be the corresponding terms.

In addition to these lamps Mr. Edison also exhibits some very handsome sconce mirrors supplied by Messrs. Verity and Sons. One of these is a novelty in its way, since the bulb lighting it is inside the frame, and therefore

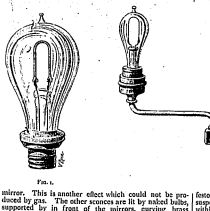

FIG. 1.

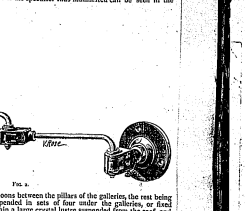

FIG. 2.

mirror. This is another effect which could not be produced by gas. The other sconces are lit by naked bulbs, supported by in front of the mirrors, curving brass brackets in which the rolling idea of foliage and flower or fruit is elegantly worked out.

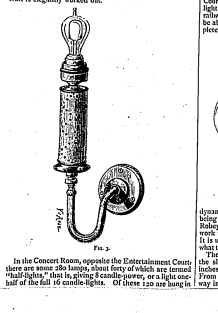

FIG. 3.

In the Concert Room, opposite the Entertainment Court there are some 280 lamps, about forty of which are termed "half-lights," that is, giving 8 candle-power, or a light one-half of the full 16 candle-lights. Of these 120 are hung in festoons between the pillars of the galleries, the rest being suspended in sets of four under the galleries, or fixed within a large crystal lustre suspended from the roof, and looking like a nest of diamonds. In the Entertainment Court and Concert Room together there are nearly 600 lights, and the same number in the side avenue leading to the railway station, have yet to be lighted. In all there will be about 700 lamps required when the exhibit is complete. To drive the 500 lamps now going there are eight

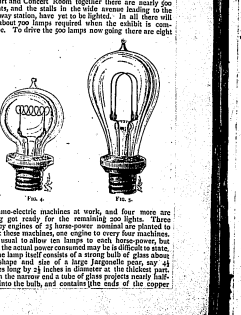

FIG. 4.

dynamo-electric machines at work, and four more are being got ready for the remaining 200 lights. Three Rabbeth engines of 25 horse-power nominal are planted to work these machines, one engine to every four machines. It is usual to allow ten lamps to each horse-power, but what the actual power consumed may be is difficult to state.

The lamp itself consists of a strong bulb of glass about the shape and size of a large Jargonelle pear, say 4½ inches long by 3½ inches in diameter at the thickest part. From the narrow end a tube of glass projects nearly half-way into the bulb, and contains the ends of the copper

After a time they die. Their
cumstances is apparently due
food, even with sufficient trouble
on which they feed can be supp
very fact of isolation in a small
a large bulk of water. Fluviatile
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ponds present no difficulty. Ma
difficult to deal with. Should
years, it is my intention (with the
lies) to partially submerge a ves
sides in the large tank, the latter
perforate, and the vessel itself
three feet in depth. If a sufficien
of young Medusæ can be collec
the summer, both ends can be
have some altogether unsuspe
probability arrive at maturity, a
clearly enough have done in
between 1876 and 1881. I wa
time to time to examine exper
experimental vessel. I need
very glad if others would carry

ELECTRICITY AT THE

II.—Edison's Ele

THE centre of attraction at th
in the Crystal Palace, fer
by the Duke and Duchess of
tionably be the show of Mr. E
in the Entertainment Court
is by far the finest ever yet
a spectacle to be remembered.
spired to demonstrate the po
incandescent lamps, and the di
to meet the wants of domestic
Varley and Sons have seized
trate their skill and show how
electric light is for ornamental
filament of carbon inclosed in a v
well fitted for all kinds of domest
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candles in these respects, the Ed
in the most striking manner its s
light, and its unrivalled capac
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cate colours, the incandescent l
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can; and we may expect somethi
household decoration by its intro
development of the terra-cotta
art.

Before considering the appa
Edison at the Crystal Palace for
trification of the light, we shall be
To begin with the "Edison
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magnificent chandelier suspende
ceiling. This beautiful object is
and sustains ninety-nine incande
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half a ton. In device it repres
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each flower springs from a circul
basket, and bends over towards t
to him its calyx of coloured gla
incandescent lamp. The follow

conducting wires or electrodes. The inner end of this tube is closed by a flat keel of solid glass, but the wires pass through this into the upper part of the bulb, where they are connected by an electrotype of copper to a fine loop or arch of carbonised woody fibre cut from the siliceous skin of the bamboo cane. Mr. Edison exhibits specimens of bamboo from China, Japan, and South America, as well as fibres from Brazil, which he has tested in seeking a good and durable carbon for his lamps. He shows also a number of samples of the carbonised loops made by simple charring in a crucible or by treatment after the Sherbolier process, as well as loops of pure graphitic very carefully cut. What the particular bamboo is that he has finally adopted we have never been able to learn, but it is probably a variety of the "Shikishashikee" of Japan, which yield a very close and even skin. The carbon loop is about ¾ inches high, and 1 inch wide, and is so fine that its electric resistance is about 100 ohms, in the "16-candle lamps," and about 50 ohms, in the 8-candle lamps. All the lamps at the Crystal Palace are plain single loop lamps; but sometimes Mr. Edison combines two or more loops, as shown in Figs. 4 and 5. These loops can either be coupled up "in series," or "quantity," and

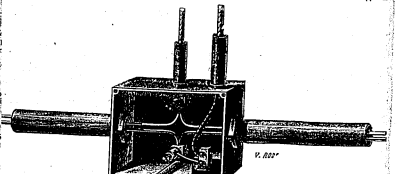


FIG. 6.

cross-section, like a segment of a circle. Two of these, the outgoing and return wire, are inclosed a little again in the same iron pipe and insulated by a black compound resembling Thomson's vax. Branch-conductors in the form of cables for side-streets are connected to the mains in a joint-box shown in Fig. 6. This consists of an iron box in which the mains are connected to two iron terminals. One branch cable is connected to one of these terminals direct, and the other through a short piece of lead to the other terminal. The lead acts as a fuse-wire in fusing if the current is too powerful. The box is hermetically sealed, to keep the inside dry. The conductors led into the houses are of a still smaller size, having a diameter of from two to three millimetres; but throughout the whole system the going and returning wires keep together, and the lamps are simply connected across between them. In each lamp, too, there is a similar safety connection of lead to protect the carbon if the current is too strong.

The incandescent system has evidently been brought to great perfection by Mr. Edison, backed as he is by plenty of capital and skilled assistance. Although the idea of it is not new, and was patented in England by Mr. Starr in 1845, Mr. Edison deserves great credit for working it out in so practical a form. Starr described a vacuous bulb of glass containing a thin rod of carbon rendered incandescent by the passage of the current, and Mr. Edison found in this the rough pebble which he has cut and polished with so much success. Moreover, he saw the merits of the incandescent system for domestic lighting at a time when other electricians were giving all their attention to the arc light; and therein showed his genius and foresight. For it is evident now to electricians that while the arc light is well enough adapted for the lighting of large areas, it is unsuitable for small interiors. The practical success of Mr. Edison's system is not thus for a complete justification of his early promises, for the cost is still an unknown quantity, as far as the public are concerned, and there are strong reasons for believing that it will not nearly be so low as the startling figure held out in 1878.

instead of making the loops plain they may be coiled into a spiral form. The air being exhausted from the bulb, there is no oxidation of the carbon after a short time and Mr. Edison claims that his lamps will last 1000 hours. This at an average rate of between three and four lighting hours per night would give a life of nine months to each lamp; but the estimate may be found a little partial in practice; for though the carbon does not burn, it is doubtless slowly dissipated by the wasting action of the gases and the energy of the current. As Mr. Edison claims to make the lamps at a shilling each, their durability is not so very important as it might at first appear. The Edison dynamo electric machine consists of two vertical electromagnets inclosing between their lower pole pieces of soft iron, a revolving armature. In the armature the usual coils of insulated wire are replaced by longitudinal bars of copper of trapezoidal section insulated from each other by brown paper. These bars are connected to the slips of the commutator in such a manner as to give a continuous circuit through the bars and a continuous current to the brushes when the armature revolves. The main conductor conveying the current from the machine consists of a solid rod of copper in

NOTES

At the annual meeting of the Geological Society the medals were presented as follows:—The Wollaston Gold Medal to Dr. Franz Ritter von Hauer, Director of the Austrian Geological Survey; the Murchison Medal to Prof. Jules Gosselet, of Lille;

ELECTRIC LIGHTING

I.

ONE of the greatest experiments ever made in street illumination by means of the electric light was commenced on Monday night in the City of London. The extensive area of the City authorities in this direction is the more commendable, inasmuch as they had previously tried electric lighting on the Holborn Viaduct and in Billingsgate Market with very poor success. In fact, in those two instances the experiment was a decided failure.

Now however, gaining experience from the advances that have been made in other directions, and especially from the great success attending the illumination of several railway stations, the City authorities have resolved to divide the City into three districts for the purpose of experiment.

1. The London Bridge district; embracing London Bridge, Adelaide Place, King William Street, the front of the Royal Exchange and Mansion House, the Poultry, a part of Cheapside as far as King Street, the upper part of Queen Street, King Street, and the Guildhall Yard.

2. The Blackfriars Bridge district; embracing Blackfriars Bridge, New Bridge Street, Ludgate Circus, Ludgate Hill, St. Paul's Churchyard (south side), and the remaining portion of Cheapside beyond King Street.

3. The third district has not been lit up, and therefore need not refer to it.

The first district is being lit up by Messrs. Siemens Brothers at a total cost of 2735*l.* for the twelve months, replacing 138 gas-lamps. The other district has been lit up by the Anglo-American Electric Light Company, on the Brush system, for a total cost of 1100*l.*, replacing 150 gas-lamps.

Before drawing any comparison between these two systems it will be just as well to describe how each has been carried out.

The Messrs. Siemens have applied to their (No. 1) district six powerful lights, fixed at a height of 80 feet from the street level upon tall latticed iron masts similar to those which are used on many railways for signalling purposes. They have also twenty-eight smaller lights, carried upon special iron posts, considerably higher than the ordinary lamp-posts, being 40 feet from the pavement. The powerful lights, fixed high up in air, are used more for the illumination of open spaces, and this system—a special feature of Dr. Siemens'—has been very extensively adopted at the Albert Docks, Blackpool, and other places. The central station of the Siemens system is in Old Swan Lane. Here three engines, supplied by Messrs. Marshall of Gainsborough, of their semi-portable type, and of 10-horse power each, fixed with an admirable automatic expansion gear (Harrnell's) specially applicable to engines used for electric lighting purposes, are fixed. Two of these engines are always at work during the time of lighting, but one is kept in reserve, ready at a moment's notice to replace either that may fail. These engines, by means of bevings and a counter-shaft, apply their power to various dynamo-machines of the well-known Siemens type. Each of the high lights is worked by a separate and distinct dynamo-machine, with which it is connected by separate conducting-wires. The wires throughout the whole of the City are of thick copper, very well insulated, and laid under ground in the customary manner of laying down wires for telegraphic purposes. The smaller lights are worked by alternating currents on the system with which we are familiar on the Thames Embankment applied to the Jablochkoff candles. In Swan Lane there are two of seven lights each, the lamps being arranged so that consecutive lamps are on the same circuit, and by that means, if any accident should occur to one set of lamps it would only extinguish one out of two lights in a street, and not throw the whole district into darkness, which would be the case if all the lights were worked on one circuit. The field-magnets in all the large dynamo-machines are excited by a similar dynamo-machine, while the magnets of the alternating current machines are fed by currents from a smaller continuous dynamo-machine. Each large machine absorbs between 4- and 5-horse power, but the alternating machines require much less. The furthest light from the generating centre—Old Swan Lane—is that in front of the Guildhall, which is nearly three quarters of a mile distant, involving a length of wire of 7200 yards (a return wire being used), whose total resistance does not exceed one Siemens' unit. The illuminating power of the high lights is estimated to be 6000 candles, but it is well known that this estimate of the illuminating power of an electric light is a very wild one. There is no doubt that the lights are very powerful, and a stream of brilliant illumination is thrown all over such an area as that in front of the Royal Exchange. The Siemens' lamps burn for eighteen consecutive hours, owing to the size and length of the carbons used. They are provided with reflectors which throw a bright cone of light down in a very effective way, giving to this experiment a very marked feature.

There is no doubt whatever that when it is required to illuminate a large area this is very much more efficiently and economically done by using one single powerful light high up in air, than by distributing several smaller lights over the surface. In the former case the light is more evenly, uniformly, and perfectly diffused, in fact it acquires the character of bright moonlight, while in the latter case the light is distributed in patches of intensity and darkness over the whole space.

When streets are dealt with the conditions are different, and it is here quite easy to show that economy and efficiency are provided for by properly distributing smaller lights along the street. The Messrs. Siemens have set to work to solve this problem in a scientific way, and Mr. Alexander Siemens, under whose control and management the system has been carried out, can show mathematically that to distribute light uniformly and properly a certain definite proportion should exist between the height of the posts and the distance at which they are apart. That this has been carried out is abundantly evident by the very even way in which light is distributed along Queen Street, King William Street, and Cheapside. Indeed it is difficult to see any break in the intensity of the light along the route—a proof that the practical application of the law very nearly approaches its theoretical limit. The theoretical point to be aimed at is that the height of the poles should be to half the distance between them as 1 is to the square root of 2. This has not been absolutely obtained, but a very close approach to it. The small lights only give an illuminating power, according to Messrs. Siemens, of 300 candles, and this probably is well within the mark. Comparisons between lights of low intensity are very easily and accurately measured; it is with when a power of many thousand candles is arrived at that the failure of comparison with a standard candle becomes evident.

The high lights have not been burning uniformly with that steadiness that success demands. Failures sometimes are not numerous, though they have been frequent. The smaller lights, on the other hand, have worked more uniformly, and have given considerable satisfaction. The strong shadows thrown by the high lights have a very weird-like effect in certain positions, and the vibration of the lamps gives to the shadows a life-like appearance at an unsteadiness that has led the unwary to imagine in many instances it at the pole itself was shaking. Could the shadows be removed from the effects of these high lights the effect would be very fine; as it is they detract enormously from the beauty of the lamps. The effect of the high lights in those standing below is excessively glaring, and doubtless in warmer weather will be more highly appreciated than it has been during the past week. It is when crossing streets, and especially when crossing Mansion House that these lights show their efficiency to advantage. It is quite amusing to see how the *gamins* of London have taken advantage of the combination of electric lighting and asphalte road to convert the whole City into a gigantic skating-rink. Hundreds of boys are to be seen every night disporting themselves on their roller-skates.

we breakfasted with them in one of the most picturesque nooks imaginable, and finally how we realised with difficulty that we were only three days' journey from London while breakfasting, under a bower of cacutha branches, off sheep roasted whole over hot ashes and basted to baks in the earth, manipulated with hunting-knives and wished forks, flat circular cakes of Indian bread serving as for plates, and gigantic wooden bowls of *kous-kous* as a second course.

The amicable attitude of these once savage aborigines seemed to us to re-echo the key-note of the Algiers meeting of the French Association; to proclaim loudly and with no uncertain sound that the "conquête pacifique de l'Afrique septentrionale par les Français" has indeed become an accomplished fact.

G. F. RODWELL

ELECTRIC LIGHTING

II.

THE second district of the City which has been illuminated by electricity is that embracing Blackfriars Bridge, upon which there are seven lamps; Bridge taking three lamps; Ludgate Hill four lamps; Ludgate Circus and St. Paul's six lamps; and Cheapside, as far as King Street, eight lamps; thirty-two lamps in all, replacing 130 gas-lamps; and moreover, all these lamps are fixed upon one circuit, which is operated practically by only one machine, and that lived more than a mile away, at the manufactory of the Brush Company in York Road, Lambeth. The total length of this circuit is over 20,000 feet. It consists of a copper cable made up of seven best copper wires successfully secured, and they are about to replace their conductor by a better one. They will have to pay dearly for their neglect of common experience.

So far the experiment has shown that the practical lighting of streets by electricity is not only feasible but practicable. Moonlight has certainly been thrown into the shade, for the streams of light are better illuminated by electricity than by fair Luna. It is quite possible to read a letter or to see one's watch at any point in King William Street. Indeed the smallest object can be seen anywhere on the whole length of the road. Running-over has been rendered impossible.

In the outside districts not specially favoured are clamouring for electric lighting, but much has yet to be learnt before the system can be determined as final. For instance, we have the Lontin system to be tried, and we should certainly like to see that most energetic and successful engineer, Mr. Crompton, test his system in the London streets. Incandescent lamps are looking up and deserve a trial.

The Brush system of lighting has not yet been settled.

It would seem that a compromise between the centre-fixed system of Siemens and the distributed system of the Brush Company will have to be resorted to before the problem of proper street illumination. But instead of carrying lamps irregularly down streets on ribbons lamp-posts it would almost seem that the ancient street mode of suspending lamps across streets from housetops would be a better mode of illuminating streets. Take, for instance, Cheapside. If that street had suspended above it, at the height of 40 feet or 50 feet and at about every 100 yards, a Brush lamp fixed on the top of a graceful iron arch, or suspended on wire ropes between the tops of the houses, nothing could possibly be greater than the effect. Light shadows thrown across the street might even be a convenient mode of suspending the wires forming the circuits, for overhead wires have a considerable advantage over underground wires in this, that they cool more readily than wires that are surrounded by gases to pass through. More than that, they require no insulation, and the money thrown into their insulation could be thrown

† Continued from p. 9.

ELECTRIC LIGHTING MEMORANDA.

The hitch in the boasted progress of electric lighting, which consists in the fact that the London householder—or, for that matter, the householder anywhere—is apparently as far as ever from any possibility of obtaining a supply, has been the occasion of some more writing in the columns of *The Times*. A gentleman living in South Kensington complains that having just built a couple of new houses, for himself and a friend, which he has had "wired" for electric lighting, there is as yet no prospect of having the wires utilized. The editorial authorities of *The Times* have given heed to this lament; and an article has been published which, for its happy assurance of knowing all about it, and blaming everybody all round, might be ascribed to the illustrious head of the Home Office. The writer shrewdly enough suggests that the reason Electric Lighting Companies have not done more in the way of private trade, is because most of them are wrongly constituted, and the rest are not ready to begin. In this case it is proposed that the Vestries should do the work themselves, irrespective of the existence of patents—and, it may be added, of ignorance on the subject. Anything more loosely-argued, and altogether purposeless, than this article in *The Times* can scarcely be conceived. The manner in which it overruns facts, and history, and common-sense is, as we have already remarked, worthy of Sir William Harcourt; but not, it may be added, of anybody else. What would be said in *The Times* of the rashness of a public body who should, as now advised, rush into an enterprise from which it is acknowledged that even speculative traders manifestly shrink?

The advantages of mast-head lighting, which *Engineering* still affects to believe is successfully practised in the United States, may be tested under specially favourable circumstances at the Fisheries Exhibition. A pole, 110 feet high, is erected in the grounds, carrying six arc lamps, all of 6000 candle power. This is the nominal value, which may perhaps be divided by four to get the average *best* performance. The circumstances are specially favourable to the lighting, since the grounds are merely gardens, with only a few fountains and trees to cast shadows. Still it is confessed, even by those who are ready to credit American reports concerning the efficacy of this system of lighting, that "great care is needed "in passing from the patches of light into those of darkness, "because the gloom is for the moment too dense to be pene-"trated by the eye." It is admitted that, if the space thus lighted were devoted to business or rapid circulation, a much more useful result might be gained by a more equal distribution of the lights. This is nothing more than we have always said. Mast-head lights must, for many reasons, be the worst of all methods of lighting; and it is inconceivable that what is absurd here should succeed in America. Still it is not improbable that, in a week or so, *Engineering* will have another announcement to the effect that tower lights are finding an extensive application in the United States.

Somebody has been writing to the *Freeman's Journal*, with the reasonable complaint that electric light companies have neglected their opportunities in the smaller towns, where gas is generally very dear and not of the highest quality. The burden of the complaint is that no electric light company has taken in hand the lighting of a small town in a manner to justify their boast that they can supersede gas in and out of doors. It may be observed that the work hitherto done by electric light companies in small towns—and they have tried many, from Godalming up to Norwich—has not been of a particularly satisfactory character. We are willing, however, to assume for the nonce, that this depressing result has come, not from the attempt to do too much but too little. An experiment of the kind here contemplated might well have been arranged a year or two ago; and the challenge to this effect was repeatedly thrown down by the friends of gas lighting, but never accepted by their rivals. Now most of the money of the latter is gone; and there is small likelihood that any of them will risk what is left, in the vain attempt to perform a task manifestly beyond their powers. At the same time, it is perfectly true that the successful lighting of the smallest provincial town would now do more than anything else to re-establish the fortunes of discredited electrical pretenders.

It will surprise and disappoint very few people in or out of Leeds to hear that the project of lighting the Municipal Buildings by electricity (at a cost of some £10,000) is suspended, and in a fair way of being definitely abandoned. For some time the Committee charged with the care of this enterprise have been working in a half-hearted manner, as their increasing acquaintance with the subject revealed its difficulties. It has long been evident that the Committee could easily spend the ratepayers' money; but that anything like a satisfactory result would follow has been very doubtful. Under these circumstances, the Committee have leaned to the side of caution; for which they are at present being roundly abused by a noisy minority. Against all this, however, they have the sufficient plea that they have kept the money intrusted to them; a circumstance that is quite enough to draw down upon them the scorn of electricians. If the £10,000 had gone in learning that electric lighting is unreliable and costly, the electricians would never have complained; as it is, the ratepayers must thank the Committee for ascertaining this truth without first wasting their money.

Metropolitan, (London) Aug. 19, 82.

The Urban Sanitary Authorities at Cleethorpes have determined to adopt the electric light for the district, and terms have been agreed upon for supplying the light for three years.

Mr. James Whitehead, chairman, and Mr. Augustus A. Stenger, have resigned their seats on the board of the Brush Midland Electric Light and Power Company (Limited).

Experiments are being made on the Alsace-Lorraine Railway to light the tunnels by electric light during the passage of the trains, the necessary force being given by the locomotive.

The *American Sanitary Engineer* states that the Brush Electric Light Company are erecting four 125 horse power engines at Nashville, which are to be capable of generating electricity for 500 arc lights of 2,000 candle power each. Only three engines, however, will run at any one time, the fourth being held in reserve.

The same journal also states that Atlantic City, N.J., was first lighted by electricity on the evening of July 21. On the "board walk" the lamps are located about 200 feet apart, and at longer intervals on Atlantic-avenue and other streets.

The Edison lamp factory has been removed from Menlo Park, the inventor's home, to East Newark (N. J.), to secure larger buildings, increased facilities, and more convenient accommodation for workmen. The tools and power now in the factory are sufficient for the manufacture of 1,200 lamps per day, but the ultimate capacity is stated to be 40,000 lamps per day, requiring from 3,000 to 4,000 workmen.

The St. Louis Tunnel Company have decided to utilise part of the power of their steam engines, which is more than enough to drive the fans of the tunnel, to create a current for electric lighting. The engineer of the company has been testing his engines, and finds surplus power sufficient to maintain 30 lamps of 2,000 candle power each.

An installation of 50 Swan incandescent lamps has been completed at the establishment of Mr. Howrons, provision merchant, of 279, Edgware-road. The work has been carried out by Messrs. Edmundson and Co., of 19, Great George-street, S.W., agents for the Swan Company.

ELECTRIC LIGHTING MEMORANDA.

The glorious muddle of the Commissioners of Sewers of the City of London about the electric lighting of the City still continues without prospect of improvement. At the last meeting of this august body, the report of the Select Committee specially charged with the matter was brought up; and it disclosed a most lamentable state of affairs, the only relief to which was that, very little having been done, not much money has yet been wasted. Having made and rescinded several resolutions during last year, the Commissioners (on the 9th of January last) appointed their Committee, with directions to prepare a draft Licence framed on the principle of the Commissioners becoming undertakers for the supply of electricity, while contracting for the actual work to be done by "reliable" Electric Lighting Companies. In other words, the Commissioners wanted to keep all the credit of introducing the new system, without incurring any risk. The Committee found, however, as soon as they had put themselves in communication with such Electrical Companies as chose to apply for a share in the work, that the prevailing idea with these latter was to divide up the district, and take the profits, leaving all the responsibility with the Commission. In this strait the authorities called in Mr. W. H. Preece and Mr. Musgrave Heaphy, who condemned all the proposals of the Companies as eminently vague and unsatisfactory. After this Mr. Preece was asked to prepare a model specification, embodying the Commissioners' ideas—so far as they could be said to have any—upon which five of the competing Companies were to be asked to tender. These negotiations occupied so much time, however, that—in the natural course of events—at least four out of the five have been placed beyond the possibility of doing any more work, and are now probably engaged in providing for their own obsequies. Meantime, Mr. Preece has not completed his arrangements, and has asked the Commissioners to spend £200 in experiments which he finds necessary in order to determine certain data for his specification. This is now to be done; and, therefore, by about this time next year the matter will have made another step towards a settlement. Who shall doubt, after this, that electric lighting is making rapid strides in the City of London?

When mentioning last week the circumstances of the English users of the Gramme patent dynamo, we might have added that the legal proceedings in respect of the American patent are creating considerable sensation. It is tolerably well known that while all workable dynamos are practically, if not legally, infringements of the Gramme patent, the originality of the latter has been much disputed. The principle of the machine is the same as that described in an Italian publication, *Il Nuovo Cimento*, in 1864, by Dr. Antonio Pacinotti, Professor of Physics in the University of Pisa. The owners of the Gramme licence in America have chosen to test their rights with reference to the Arnoux and Hochhausen Electric Company; but the decision will, of course, affect many other patents. To further complicate matters, the Gramme patent expires some time next year; and as this is at least as good a machine as any other in the market, the prospect for shareholders whose money has gone in the purchase of patents does not look bright. When this period of protection expires, it may be expected that the world will be flooded with cheap dynamos on the Gramme system. While the electric light will then be obtainable at a cheaper rate, such patent-right companies as still remain extant will find their opportunity gone for ever.

The Brush Electric Lighting Company of Scotland is being voluntarily wound up. This might be regarded as a good riddance for our northern friends, if the concern had been Scotch in anything more than name. The second and last ordinary general meeting of the proprietors was held in Old Broad Street, City, on Thursday last, when the Chairman had many excuses to offer for the failure of the enterprise. One of these, and the best, was the general excellence of Scotch gas, and the unwillingness of the people to displace it for the electric light. Unprejudiced hearers might have gathered from this admission an impression that the light rather than the people must have been to blame for this; and, further, that as the respective qualities of the two systems of lighting are the same now as they always were, the Company need not have waited so long, nor have looked for any other cause for their failure. Still, it would never do to acknowledge that gas, and gas alone, had beaten the Company; so a few more abuses were levied at the Board of Trade and the Electric Lighting Act. As to this complaint, the best popular reply we have yet seen is given by a west country paper. It is there said that such an "excuse is absurd. All that the Companies ever pro-"mised to do they might have done under the Act, if the "public showed any confidence in them. To describe the "Act as 'bristling with pains and penalties' is ridiculous. "It contains nothing but bare security for public rights. If "eight or ten millions of money has been wasted in the rush "of ignorant people into an enterprise so delicate and diffi-"cult as electric lighting, the ruined investors have them-"selves to thank;" and also, we are sorry to be obliged to add, the thoughtless incitements of equally ignorant people connected with the Daily Press.

A New Safety System of Electrical Distribution.

A great deal has been said, in technical and other journals devoted to the cause of electric lighting, respecting the new system of electrical distribution invented by Messrs. Gaulard and Gibbs, and shown by them at the Westminster Aquarium. Electric lamps are generally maintained upon conducting wires in series or parallel arc; that is to say, the current is either sent through all the lamps in a circuit, as in the Brush system, or the lamps are made to bridge over the interval between two leading conductors kept at a certain difference of potential, or pressure. In both systems the lamps draw their supply direct from the distributing wires, and are therefore immediately dependent upon the generating station for the quantity and intensity of current available. The object of Messrs. Gaulard and Gibbs's invention is said to be to obviate this state of dependence, by enabling the consumer to convert, by means of an appliance on his own premises, and under his own control, the current conveyed by the main conductors into an induced current suitable to his own needs. Briefly described, it is the induced or secondary current only that is intended to be used by the consumer under this system. The idea is that a copper wire, when traversed by an alternating current produced by a dynamo, will induce another current in a coil or coils of insulated copper wire suitably placed in relation to it. The instrument by which this principle is exemplified in the present instance consists of four columns of coiled wire mounted on a stand, the wire being so connected as to allow the induced current to be modulated for the different purposes of arc or incandescent lighting or the supply of motive power. This is effected by turning a handle which causes the primary or existing current to traverse the whole or any portion of the number of cylinders, somewhat in the same manner as the strength of a medical galvanizing machine can be moderated by altering the position of the core, or armature. The great advantage supposed to be gained by this system lies in the use of a closed primary circuit from the dynamo; because it is contended that so long as a circuit is closed there is no possibility of danger from it, no matter how high the potential. And the economic success of electrical distribution lies in the use of strong currents, which, on the other hand, are plainly inadmissible when dangerous to life. If, however, the strong current is not used directly, but only to excite much less intense currents in allied circuits, these latter might, without risk, be introduced into houses. The working of the new system is claimed to be satisfactory as regards steadiness; but as it is essentially a method of exchange, and therefore introduces one more source of loss, as well as an additional expense for apparatus in comparison with the direct supply, it must naturally be more expensive, while not at all more reliable than the latter.

ELECTRIC LIGHTING MEMORANDA.

The last electric lighting venture which has drawn down the damnations of the Editor of *Money* is the London and Provincial Electric Lighting and Power Generating Company —a concern ecstatically puffed in these columns as enjoying the right to use the Gramme dynamo, the Jrrisford incandescent lamp, and the Chertsprue arc lamp. For these rights and privileges the Directors of the fledgling Company engaged to pay the vendors the modest sum of £70,000; of which £10,000 was to be in shares and £60,000 in cash. The market was becoming glutted when the subscription for this valuable property was opened; and therefore the public contributions amounted only barely to the amount due to the vendors. The Company were thus left without any working capital at all. Notwithstanding this unpleasant circumstance, the Directors proceeded to allotment—a transaction which is stigmatized by our financial contemporary as a gross contravention of the spirit of the Companies' Acts. Under these conditions, the utmost the Board could do was to defer the payment of a portion of the purchase-money, amounting in all to £12,000; otherwise no business whatever could possibly have been done. As it is, the machinery, plant, and office furniture belonging to the undertaking are valued at only £2650—and this is all whereby patents valued at £70,000 are to put in operation! On the past year's working there has been an admitted loss of nearly £1000; though the particulars of the amount are not published. It is suggested that probably the greater part of the money has been liberally squandered in Directors' fees, and so forth; yet the Board are anxious to impress upon the proprietors that their fees are still in abeyance to the extent of £900. Unless the shareholders are unusually generous, this sum will hardly be realized at present; for the faces of working the concern cannot be played much longer.

Really, the simplicamus of *Tat* goes towards the speculative electricians is most persistent. Last week the Editor remarked the notorious Mr. Robert Hammond to occupy the letter part of a column with a letter vaunting the advantages of electric lighting, and purporting to make the position of the system "quite clear." The only line that is at all clear about it, however, is that Mr. Hammond means to show the shareholders who pay his salary that he can earn it as well by letter-writing as by lecturing. Of course, Mr. Hammond does not write to "advocate any particular system," or to "extol any particular patentee," but to give a friendly lift all round. His history is incomplete, for he does not explain how it is that all the Electric Lighting Companies have lost so much of their money. Yet no man knows more about the lighting question. His allusions to the future are also very unsatisfactory, for he promises "during the coming twelve months a period of probation, which it is it is to be hoped will be the last" before the question of electric light distribution on a large scale is completely set at rest. A good many other things will be "set at rest" before this point is reached; the majority of the present order of Electric Lighting Companies and their promoters being among the number.

The authorities of the quiet town of Colchester are greatly troubled respecting their pavements. It appears that they have entered into engagements with one of the Brush Electric Lighting Companies for an installation, which is described by a local newspaper as the most complete and advanced lighting undertaking in the whole world. The first result of the Company's operations, however, has been to disorder the principal thoroughfares in the most reckless manner; for the cables intended to be placed therein are ready, and some streets have been dug up twice when, by the exercise of a little common foresight, once would have sufficed. Even for, as usual with this class of Companies, excuses and pro-

ELECTRIC LIGHTING MEMORANDA.

Of all modern Electric Lighting Companies formed for the purpose of carrying on business in London, the most respectable, in a business sense, has been the Jablochkoff. While the others have been all talk and no public lighting, this Company has been carrying out contracts under the Metropolitan Board of Works, and for several pieces of business in different parts of London. It is the oldest of the modern lot; and it might be supposed that, if there is any profit in the lozinges to which it is devoted, this concern would have found it by the present time. Yet, from the Directors' report and statement of accounts just issued, the Company appears to be in precisely the same case as their rivals. When the Jablochkoff promoters sold the business to the present Company, the price paid was £165,469, for which they obtained a patent licence, a wooden shed on the Thames Embankment (containing a 30-horse portable engine and dynamos), and a contract to light the Embankment at a heavy annual loss. Besides all this, they had "hopes" of doing a large and increasing trade all over the country. Those hopes have not been realized, and the past year's operations have resulted in a loss of £14,499, which is called a "suspense account"—probably because it is unwilling to be written off as a dead loss. Of this sum no less than £7776 is in Directors' fees, salary, and "sundries;" which shows how difficult it is to conduct such a business, and how so much money in it, in so short a time. Directors and staff must indeed have worked hard. Our contemporary *Money* is very wrathful in its comments on these accounts, which are qualified as patently showing the concern to be on its last legs. It certainly does not look well for the prospects of the "Jablochkoff" system of lighting in England. It will soon become a question as to how to be done with the Thames Embankment experiment. Will the Board of Works carry it on at a cost of something between £600 and £700 a year above the contract price?

The principal topic of interest in connection with electric lighting is the amalgamation of the Swan and Edison interests in this country. This was effected at two extraordinary general meetings on Monday and Tuesday last week, when the proposal was sanctioned by the proprietors of both Companies. The financial arrangements are of a complicated character, and not to be easily explained in the space at our command. It appears that up to the present time, on business in Great Britain alone, the Swan Company have spent £188,917, and the Edison Company have laid out £100,000. It was, of course, unnecessary for the purpose in view to show how these amounts were made up. The Edison Company will receive the Swan Company in respect of an obligation to pay to Mr. Edison half of their profits over 6 per cent.; and this obligation Mr. Edison has decided to abandon. Consequently, he will receive the proportion of deferred shares in the United Company. The capital expenditure of both Companies will be represented by shares, a proportion of which will be issued as partly paid, in the United Company. All the Directors regard the arrangement as "wise, reasonable, and just" to all parties; and so everybody is happy.

The usual course and consequence of experimental electric lighting has been very conspicuously followed in the case of Pentonville Road, which the Maxim-Weston Company contracted to light for the Vestry of Clerkenwell. At first high descent lamps were used, but proved miserably ineffective, and are lamps were substituted. It has been known for some time that the Company did not intend to renew their tender, and wished to sell their plant to the Vestry at about half price. Meanwhile, however, the main conducting cable broke down, and the lighting came to a premature end on the 27th ult. Under these circumstances, the Lighting Committee of the Vestry formed the natural conclusion that the electrical plant would be dear at any price; and the use of gas was forthwith resumed. The brilliant electric lamps, however, had left in the minds of the Committee the usual craving for better light; and they have decided not to return to their old 6-feet gas-burners, but to indulge in better lanterns and burners consuming 16 cubic feet of gas per hour. The proposal has not yet been adopted by the Vestry; but its existence is a sufficient indication of the good that comes to gas from electricity. The additional revenue to the Gas Company for the thoroughfare in question, under this arrangement, would be £2230 per annum. Some discontent at the prospect of the increased outlay is being expressed by ratepayers of richer and less favoured parts of the parish; but it has been learnt by the majority, at the cost of the unfortunate Maxim-Weston Company, that if streets are to be well and reliably lighted it must be done by gas.

Considerable jubilation has been expressed in certain of the electrical journals over improvements recently effected by Dr. Hopkinson in the Edison dynamo. Everybody knows that the Edison dynamo was always the best machine of its class in the market; but we at first were somewhat startled to learn that Dr. Hopkinson had succeeded in increasing threefold the efficiency of the dynamo. Having re-designed the machine, Dr. Hopkinson has managed to strengthen the magnetic field; and now a machine which was formerly employed for 60 lamps will keep up 200 lamps of equal brilliancy and power. Results are, however, it is made apparent that this wonderful improvement is a small matter after all, for the motive power to perform the high duty must be correspondingly increased, just as though three machines were used instead of one. Moreover, it is admitted that the electrical efficiency of the improved machine is a trifle lower than the results given by some other Edison dynamos of the same size.

The principal advantage derivable from the new pattern is, therefore, a slight saving in friction due to working one machine instead of three. As it is to be understood that the Hopkinson modification forms the basis of at least one more patent, it is difficult to see that these improvements, however theoretically interesting, can have the slightest beneficial influence upon the practical development of Edison lighting.

Metropolitan (London), Jan. 1883.

Mr J. W. Swan, inventor of the well-known electric incandescent lamp bearing his name, is about to leave Newcastle and take up his residence in London, with the view of directing the operations of the company.

At a meeting of the Fulham Vestry Committee on Wednesday, it was stated that the South-Eastern ("Brush") Electric Light Company was the only one that had made an application to supply the electric light to the town. Under one section the Company take powers to supply light as soon as it is known as the "Brush" system, for which the charge will be £4 10s. for the first 100 lights "and 30s. per" unit "afterwards." By a "unit" the Town Clerk explained, was meant sufficient energy to light a 20-candle-power lamp for 1½ hours. One of the members said this charge would be found to be exorbitant.

A novel application of the electrical transmission of power has lately been made at the Trafalgar Collieries, Forest of Dean, where an electric motor is employed to drive a pump in the underground workings. A dynamo machine is placed on the surface for generating the current for working the motor, and is connected to it by wires laid down the shaft and along the workings, a distance of some 500 yards.

On the 29th ult., the Mayor and Corporation of Leicester and the leading manufacturers attended at the hosiery manufactory of Messrs. Corah, Sons, and Cooper, Leicester, to witness the first introduction of the electric light into a textile factory in the town. The Brush and Swan incandescent systems are both used.

ELECTRIC LIGHTING MEMORANDA.

The latest of the deputations that have troubled Mr. Chamberlain in regard to the working of the Electric Lighting Act was one of electricians, or rather of would-be speculators in Electric Lighting Orders. The deputation complained bitterly of the determination taken by the Board of Trade to make sure of the financial position of licensed undertakers of electric lighting, by ordering the deposit with the local authority of the district in question of one-half of the necessary capital for every such installation. It was alleged that the effect of this stringent regulation would be to cause the abandonment of many schemes of this class. In reply, Mr. Chamberlain hinted that such a consummation was devoutly to be wished in many instances where bogus companies sought to acquire powers which, if granted upon the terms asked, would have placed whole districts in the hands of "people who had no "knowledge, no ability, and no means, and who were simply "speculators with other people's money." Incidentally, Mr. Chamberlain made a remark that will be regarded by many people as amounting, under the circumstances, to a good joke. He said he did not care to undertake the appointment of inspectors of the working of electric lighting establishments, because "he did not like the notion of centralization, of which "they had already too much." From this it might be inferred that the President of the Board of Trade, having in the present session made proposals for taking possession of the Patent Office and bankrupts' affairs, in addition to the already numerous ramifications of his peculiarly centralized department, will initiate no more propositions of the kind during the lifetime of this Administration.

It has been reported that the great fire at the Parliament House in Quebec was caused by the electric light, or the fittings in connection with it. Dr. Werner Siemens, of Berlin, has written to the *National Zeitung* admitting the possibility of this cause, and asserting that electric lighting apparatus is capable of producing fire, unless constructed with the greatest care and knowledge. He goes on to say that there are numerous Companies now engaged in the extension of this kind of lighting, which are without the necessary knowledge and experience; and, in their efforts to make electric lighting as cheap as possible, are overstepping the limits of safety. This observation is in strong confirmation of Mr. Chamberlain's remarks mentioned above; and it will strengthen the precautionary measures insisted upon by the Government to make sure that inexperienced electricians shall at least have the means of paying for any damage they may cause. Indirect testimony to the same purport is also unwittingly borne by a correspondent of the *Electrical Review*, who essays to defend the speculative companies from the charge levied by writers in the same publication, and quoted in this column last week. This writer, who is an official of one of the patent-right Companies, cites, as a proof of the progress of the work in the hands of these speculators, that "the class of work done now is very superior to that which "was formerly carried out;" and also that "repeated "failures have impressed on the minds of Directors the "importance of having practical men and a trained staff, "and, in the second place, there has been time and opportunity to instruct and to weed the staff"—which is precisely what Dr. Werner Siemens and others complain of. Is it any argument for the genuine progress of electrical science that a gang of scratch secretaries and self-styled electricians, who admittedly undertook work they did not understand—just as they might have joined the staff of a date coffee company, an Indian gold mining scheme, or a speculation in waterlogged tin mines—have had time to learn the rudiments of their new trade? Some of the Brush swarm, for example, may know more now than they did a year ago, when there was such demand for officers for the mushroom companies then springing into existence, that a "professor" who had travelled about to fairs and wakes with a galvanizing machine would have been sure of an appointment in the City almost as lucrative as his own business; but the Siemens or Jablochkoff systems were as good then as now. By this contrast we do not seek to imply that the Siemens and other old-established firms have not learnt anything during the past year, but that the others have had to learn everything that these knew before. That is the difference.

Dr. Richardson talks so incessantly about sanitation, and invests his favourite subject with so much interest and even romance, that he cannot help occasionally stepping over the faint line which with him divides fact from fallacy. In an article recently published in *Longman's Magazine*, the eloquent Doctor talks very wildly indeed about electric lighting and gas. He says with reference to the smoke nuisance: "So "soon as the electric light wins its certain way, so soon will "coal come to the fore and to the fire in the form of partly-"purified gas—cheap, ready to burn at a moment's notice, "and yielding heat without either smoke to obscure the air "or sulphurous acid vapour to injure vegetation." There are several errors of greater and lesser importance crowded into this bit of prophetical writing. Dr. Richardson is nothing if not a prophet; so we have no intention of tearing the mantle from him. It might be expected, however, that after so much experience as a seer, he would know his task better; for, on the whole, a very 'prentice prophet could do as well as this. In the first place, it would be more accurate to speak of the *un*certain way of the electric light; but this is of small moment. Dr. Richardson may be congratulated on the literary skill with which he implies that this is the "light of the future," without actually repeating such a very hackneyed form of words. He is strangely out of his element in respect of what may be expected from "partly-purified gas." Perhaps in thinking this somewhat obnoxious product would be especially cheap, he was not aware that the mere cost of purifying the gas now sold in London, even to the high standard enjoined by the Referees, is under a penny per thousand cubic feet. This is the result of speaking in general terms without knowing particulars. As to impure gas not yielding "sulphurous acid vapour," we fear Dr. Richardson's garrulity has, in this regard, run away with his chemistry. Why does not the Doctor speak to the Referees on this point? for, if impure gas is not to yield sulphurous fumes in the future, why are they so strict in limiting the proportion of sulphur in the gas now sold by the Metropolitan Gas Companies? How much trouble would be saved if Dr. Richardson were only a Gas Referee! Perhaps, however, if this appointment were to be made to-morrow, we should find the same discrepancy between the opinions of Dr. Richardson when in and out of office, as is betrayed by ordinary politicians all over the world.

THE COST OF INCANDESCENT ELECTRIC LIGHTING IN NEW ORLEANS.

A correspondent has kindly forwarded to us the following particulars, extracted from a New Orleans daily paper, as to the cost of a recent installation of the Edison electric light at a large hotel in that city:—

When the Edison light was started at the St. Charles Hotel, we announced the fact at some length to our readers. This being the first installation in this or the adjoining States, and there being much interest generally in the electric light for indoor or domestic purposes, we have been watching its working with considerable interest and have learned some facts in reference to it which seem of interest to the public.

When the proprietor contracted for the light, it was thought the engine used for the general work of the hotel could also be utilized to run the machine for generating the electricity; but, after two or three nights' experience, it was found that the power was too variable, and the light was consequently unsteady. So an engine was sent down immediately from New York, and put to work. Since then the light has been on every night without a moment's delay or interruption, and without accident or halt of any kind. At the end of the stipulated 30 days' trial the plant was turned over to the proprietor, he paying cash in full for the same, thus showing his satisfaction and confidence in the light; and the New York electricians returned home, leaving the apparatus in the hands of the ordinary *employés* of the hotel.

Upon inquiry as to the cost of the light, we get the following statement—The dynamo is made for 150 lamps of 16-candle power each, and uses about 21-horse power in generating the current, or one-seventh of a horse power to each lamp. The wearing parts of the machine are the commutator, which cost 60 dols., and lasts 1500 hours; the brushes, which cost 10 dols., and lasts 250 hours; and the lamps, which cost 1 dol., and last 600 hours, guaranteed. The engine, with a cylinder 8½ in. by 10 in., makes up to 310 revolutions per minute, the steam registering from 55 to 70 lbs. pressure; giving the dynamo 884 revolutions. The boiler in use supplies steam for the elevator, and, in short, for the whole house, and so the draught on it is very variable. Under these circumstances, it is not easy o estimate the cost of coal, but there is good authority for saying th at a horse power can be obtained with from 1½ to 3½ lbs. of coal. Allowing 4 lbs., assuming the wages paid for attending the apparatus to be 75 dols. per month, and the cost of coal to be 5 dols. per ton of 2240 lbs., we have the cost of the light at the St. Charles as follows:—

	Per Hour.
Coal for 21-horse power, 84 lbs.	0·18 dol.
Depreciation of plant, 4000 dols., at 6 per cent	0·11 "
" of 150 lamps, 1·6c. each	0·25 "
" of brushes	0·01 "
" of commutator	0·03 "
Cost of oil and attendance	0·43 "
Total cost per hour	1·07 dol.

This is for 150 lamps of 16-candle power each, or, in all, 2400 candles. Compared with gas, 100 feet of gas burned in the ordinary way gives, according to an English authority, light equal to 300 candles, requiring for 2400 candles 800 feet, costing at 2 dols. per 1000 feet 1 dol. 60c.; showing a saving in favour of electricity of 53c. per hour, or, at six hours, per day, of 98 dols. 58c. for the month.*

Now it will be said at once that this will ruin the gas companies; but experience shows the contrary to be the fact, where the gas business is conducted properly. No doubt, as Dr. Siemens recently stated, the incandescent light will be "the light of luxury." It will also be the light in large establishments, where steam power is being used, for there its economy will force its use. But the great mass of consumers will use gas, though not the dim light of the past. Much larger burners will be demanded, and increased consumption will be the result. This is the actual experience in England and in the North; but it may be different in a subtropical climate like ours.

As to the future of the electric light and gas there is but one opinion among well-informed people, and that is that each will occupy a sphere of its own—neither materially interfering with the other, and even at times one helping the other; as when gas is used to drive an engine to generate a current for the electric light, which is being done wherever the former is of fair quality and equable pressure. It is a remarkable and significant fact that Mr. Edison gets nearly three times as much light from a pound of coal as the gas companies; and herein lies the promise of its future usefulness. When the method of transforming the energy of coal into electrical energy is simplified and cheapened, the electric light will be more generally used. But that time may, and appears to be a long way off.

* The correspondent who sent this extract informs us that when he visited the hotel the electric lamps were giving about 12-candle illuminating power each, at their best; some being less—say about 10-candle power. As the illuminating power of the New Orleans Company's gas averaged 16·6 candles over the past year, the price being 2 dols. per 1000 cubic feet, this would make a material difference in the estimated cost for an equal quantity of light.—Ed. J. G. L.

Discontinuance of Electric Lighting at Norwich.—At the meeting of the Norwich Town Council last Tuesday, Mr. Willis stated that a communication received that morning had been considered by the Electric Lighting Committee and by the Parliamentary and Bye-Laws Committee, who thought it their duty to recommend the Council that the electric lighting be suspended for the present. The lighting carried on up to now had been merely experimental. The plant was not sufficient to take in that quantity of lighting which would render its continuance profitable to the contractors. Therefore they were anxious, under the circumstances, to retire from further contracts. Offers had been received from various companies to continue the lighting, if the Corporation would give pledges in respect of a certain Provisional Order being promoted in Parliament, and which it was hoped would be obtained. But the Committee were unanimous in feeling that it would be most unwise, for the sake of obtaining any present convenience, to pledge themselves in any way whatever as to the future. The electric light would be discontinued at the end of the month.

August 19, 1882.

THE METROPOLITAN.

Electric Lighting on Ocean Steamships.—The *American Gas Light Journal* publishes some interesting particulars in regard to the employment of the electric light on board ocean steamships.—It appears that there is no steamship as yet which relies entirely upon the electric system of lighting; but there are several that have introduced it to a greater or less extent, with a degree of success so far as the lighting is concerned, which our contemporary considers renders it well worthy of notice and commendation. The steamer *Servia*, of the Cunard line, is said to be the largest commercial steamer afloat, excepting the *Great Eastern*, being 530 feet in length, 52 feet beam, 40 feet 9 inches deep, and having a measurement of 8,500 tons. She is propelled by engines of 10,500 horse power, while her screw is 23 feet 6 inches in diameter. Thirty-nine boilers and furnaces, all told, supply the power for all purposes, and steam power is employed for every possible purpose, in order to reduce to the minimum the manual labour required. A large portion of the ship is lighted by Swan's incandescent electric lamps. In outer appearance, as most of our readers are aware, they differ practically in no respect from the Edison or Maxim lamps, being a similar glass bulb with the carbon filament within, which is heated to incandescence by the passage of the electric current through it. The method of putting on the bulbs is extremely simple. The current wires lead through a small wooden block, about an inch and a-half in diameter and four inches long, which is put into the ordinary lamp bracket in place of the oil lamp. These wires terminate just above the upper end of the block in hooks just inside a spiral spring attached to the wood. The wires passing into the bulb are also turned up in a hook at the lower end, just below the stem, so that all that is necessary to put a lamp in place is to place the stem of the bulb inside the spiral spring, press down gently and connect the hooks with each other, then the pressure of the spring maintains the wires in contact, and at the same time permits a certain amount of motion laterally in any direction, which reduces somewhat the liability to breakage that would follow greater rigidity in the attachment. There are on the *Servia* 140 lights, which are distributed through the "stoke-hole," or furnace-room, the engine-room, the ladies' cabin, the main saloon, the smoking-room, the music-room, the officer's mess-room, &c., in two of the companion ways or staircases leading on deck from below. The candle power varies from six to fifteen candles, according to position where they are placed. The state-rooms are generally lighted by the usual oil lamps in locked cases, so that perhaps about one-half the lighting of the ship is done by electricity. The lights in the stoke hole and engine room are 54 in number, and, of course, are in use day and night—the other lights being turned on at dark, when light is required in the saloons, &c., these latter being put out at 12 p.m. There are two cables leading from the dynamo-machine, one of 19 and of 14 strands; these are subsequently divided into smaller cables by separating the strands, and led to the separate sections of the ship where the light is used, and the lights in any division may be extinguished by switching out the wires leading to it. The light is beautiful, steady and agreeable, and the saloons are certainly better lighted than is usual with oil lamps. The current is furnished by two Siemens machines, one large one and one small one used as an exciter. These are driven by a Brotherhood three-cylinder engine, of sixteen horse power, which runs at 640 revolutions when the 140 lights are in use, and 556 revolutions when the 54 lights used by day and night are being employed. The number of revolutions is varied somewhat from time to time, according to the temperature of the room where the machines are placed, and resistance coils, placed near the machines, are used to regulate the strength of the currents as different portions of the lights are put on or off. The steam for the engine is furnished direct from the ship's boilers, and is at the same pressure as that used in the ship's engines. The outfit, therefore, consists of the Brotherhood engine, the two dynamos, about three miles of wire, and the lamps themselves. The average number of lamps that are broken or get out of order is 15 or 16 out of the 140 during each round trip.

Electric Lighting in the Fulham District.—At the last meeting of the Fulham District Board of Works, the seal of the Board was affixed to an agreement with the West Middlesex Electric Lighting Company, empowering the company to lay wires enclosed in pipes under the footways, throughout the parishes of Fulham and Hammersmith—the distance of roads in the district being 37 miles, and containing 29,000 houses. It is proposed to erect, at suitable points, central stations upon a large scale, within the two parishes, for the purpose of generating electricity. Gramme Dynamo machines will be used for this purpose. For street lighting Brockie's Arc Lamps will at present be fixed, and for shops and private houses, the Improved British Incandescent Lamp. The new light is extensively sought after in the district—many of the largest tradesmen being desirous of using it.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT. [Jan. 6, 1880.]

ELECTRIC LIGHTING MEMORANDA.

The prospects of electric lighting are discussed in a recent issue of the *Electrical Review*, in an article which begins by asking whether any real advance has been made in this regard since the close of 1882. It is considered that the gloomy period through which electric lighting companies are now passing gives more hope for the future than did the circumstances of the era of wild electrical speculation. This is undoubtedly true in one respect—it confines inventors to the "fathers of invention," and excludes the latter class, present. It is confessed that the number of solvent electric lighting companies remaining may be counted on the fingers of one hand; and that the only remunerative business for them appears to be in fitting up steamboats with incandescent lamps. As far as the great question of house-to-house lighting is concerned, our contemporary admits that there does not appear to have been the least advance. "We can still only point to the admirable installation of the Edison Company on the Holborn Viaduct, which, however, has not been augmented by any additional circuits." The spasmodic attempts to force upon the public attention electric lighting by means of primary batteries, are mentioned only to be condemned. The possible utility of primary batteries is admitted; "but they should not be brought forward as a "cheap means of producing electrical energy." On the other hand, it is admitted that "accumulators have turned out "decidedly disappointing." On the whole, however, the *Electrical Review* holds that such electric lighting as is done in the immediate future will be better done; speculation will give place to steady business; and "electric lighting will "eventually assume a position which, although it may never "equal that of gas, will at least be one of considerable "importance amongst the industries of our country." In this aspiration it may be hoped that our contemporary will not experience further disappointment.

Notice of application for prolongation of patent has been given on behalf of the inventors of the Gramme dynamo, where rights would otherwise expire in regular course on 26th of June next. The patent is now vested in the British Electric Light Company. It is understood that, if the monopoly should not be prolonged in this instance, the trade in dynamos will go to pieces; for the Gramme machine is equal to any other in the market, and whoever controls this system will practically rule the land and fix the prices for the remainder. When Gramme machines are made and sold in the open market for the ordinary trade profit, it is scarcely likely that users will give four or five times as much money for some new patented machines of merely imaginary superiority. No open market for the ordinary trade profit, it is scarcely for some new patented machines of merely imaginary superiority. There are sufficient electrical engineers to design new dynamos, and D'Arsonval will be able to satisfy the Judicial Committee of the Privy Council that they have not yet received sufficient compensation for their invention.

Mr. Oscar Offner, now styled Manager of the Consolidated Electric Company—which is the name assumed by the group of lime Brush Companies who are now trying to prop one another up—has been lecturing at Dudley, under the auspices of the Mayor and Corporation. Dudley is said to be one of the towns for which the South Staffordshire Electric Light Company have obtained a Provisional Order. This possibly accounts for Mr. Offner's presence, probably as a substitute for Mr. Hammond. The intended lectures will be wondering how, if his Company should hold his wondering they would put down generating plant in the centre of the town; and "their next course would be to place in different "parts of the town a storage of electricity . . . so that "if the machine broke down they would still have a constant "supply of electricity which was stored up just in the same "way that gas was stored in the gasholders." We have no particular desire to visit Dudley; but we should start off by the next train if we could believe that the well-known Brush lamps, which the old original Company cannot keep constantly going in London, were being marked there as Mr. pleasure, as there is usually a long interval between the appearance of the electrical lecturer and the establishment of the lighting station. And even if the Consolidated group of failures should keep afloat long enough to make a businesslike "course"—of the electrical gasbaldders—would appear might the people of Dudley was a deliberate hoax. He must have been done elsewhere, and that there was no reasonable prospect of it for Dudley. And as for his boast that his Company "could pay their way, and not charge customers more than they were now paying for gas"—where is the Brush Company able to "pay their way," to say nothing about the latter condition?

Mitchell's Gas (London) July 15th.

The directors of the Great Western Electric Light and Power Company (Limited) announce that the Swedish and Cornwall Electric Light and Power Company (Limited) have ratified the arrangements with the Company for paying the £11,000 for the subscribers and concessions as agreed.

The Stratford Electric Lighting, Power, and Regulator Company, Limited, announces that the shares offered to the public not having been fully subscribed, the deposits paid on application will further be returned at once without deduction. The company's offices have been ordered from New York, a full installation of their system will be shortly made.

The South Electric Light Co. of Ireland was registered on the 30th ult., with a capital of £250,000, to acquire a concession from the Anglo-American Brush Electric Light Corporation.

The electric light is being introduced in the town of Cirencester, near Cirencester. There are to be five large arc lights, four of these being along the cliff which overlooks the sea, and forty-two small incandescent lamps of the Latte-Fox pattern. The light is to cost the parish £1,300 a-year.

The Portsmouth Town Council have accepted an offer of the Edison Electric Light Company for the lighting of a district for six months, at the cost of gas—light for light.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT. [April 24, 1883.]

ELECTRIC LIGHTING MEMORANDA.

A correspondent of the *Electrical Review* has written with the useful object of exposing a few of the difficulties which still exist in connection with electric lighting supply and measurement on an extensive scale. His method in treating this trouble is declared to be to dispel the assurance given by some "electrical eminences," as he calls them, in lectures and otherwise, that the arduous problem no longer remains to be solved. As a matter of fact, according to this contributor, in question are "of the same magnitude as existed seventy years ago in the lighting of streets with gas." Because "the key to the whole situation is still an unknown one, which has hitherto engaged, with little success, the minds of many physicists and electricians. He says further that Professors Ayrton and Perry have tried eight different methods of generation or distribution with this object, but they failed through disregarding economy. In fact, the determining factor in measurement, therefore, this writer appears to believe that almost everything yet remains to be done. Another correspondent in the same journal laments that after the expiration of a year from the last reign for electric lighting companies, and notwithstanding all the capital that has gone in this way, "it has not yet been shown to the public that even a small "tenement of twenty houses can be effectively lighted and "dependent upon a constant supply of 'electricity, in the "same way that they are with coal gas." He, too, thinks that electric lighting fails fair to be generally regarded as an exploded idea.

A new publication called *Health* has appeared, as though there were not enough journals devoted to medical and sanitary matters. In the first number we meet with this statement: "The electric light has been supplied to a Vienna "hospital. This is as things should be." Why? Because "the problem of ventilation will be in greater part solved "when the electric light comes into general use." This sample of lunacy or careless writing does not promise well for the medium of the new venture. One would suppose that if the ventilation of a hospital is so defective that the products of combustion of a few gas flames cannot be removed, the general health of the patients calls for some more drastic reform than the introduction of electric lighting. It is evident that in thoughtlessly approving the dismissal of one of the best aids to ventilation ever brought into a hospital, or anywhere else, our contemporary manifested more than a common share of youthful indiscretion.

It may be gathered from a few remarks recently made in the House of Commons by the First Commissioner of Works, that the expense to the nation of the experimental Edison lighting in the smoking-room and library has been overstated. The Company are doing the work for the remainder of the session at little more than the cost of the gas formerly consumed, which would be about £100, leaving the ultimate permanent adoption of the system in the option of the First Commissioner. The arrangement was explained in the House in reply to a question by Lord R. Churchill, who by the tone of his inquiries seems to have suspected the existence of a job in this selection without publicity of one firm of electricians.

Metropolitan (London) September, 1882.

Domestic Electric Lighting in America.—We learn by telegram that on Tuesday evening Mr. Edison's system of providing an incandescent electric light for domestic purposes throughout a given district was put to a practical test in the City of New York. The district selected occupies an area of nearly a square mile. One square mile of supply is provided, and that furnishes the illuminating power for sixteen thousand lamps, the electric current passing through eighteen miles of mains. The result, according to the latest dispatches, is that the seventy thousands which the consumers have been able to make upon the new supply have been satisfied. Throughout the district lighted each lamp is independent of all the others. It may be recollected that in the course of the last inquiry before the Select Commission of the House of Commons, Dr. Siemens said it was impossible to supply electricity for domestic lighting, from one source, over a greater area than a square quarter of a mile. On Tuesday night although only five thousand lamps were lighted in New York they were in distributed over the entire district of the square mile. We are told further that in the district there are fifteen hundred consumers of gas, of whom eleven hundred have subscribed for the electric light. It may be added that Mr. Edison is described as acting in his business operations on isolated plant on the same principle; and the managers assure our informant that they are quite satisfied in respect to the commercial aspect of the question. In a future issue we hope to be able to furnish our readers with full particulars of these interesting and important installations.

The Jablochkoff Electric Light Company have taken large premises on the Albert Embankment, to be used as a manufactory for their carbon candles, and warehouses, and as a lighting contractors' office, whose erecting a building on site of the Victoria Embankment for the purpose of more effectually carrying out the contract with the Metropolitan Board of Works. It is stated that numerous applications have been received for the supply of the Jablochkoff light, to meet the demand for which several powerful engines and electric machinery are about to be established.

Improved Public Lighting at Brighton.—Since the introduction of the electric light the Brighton Town Council have had under consideration the better lighting of the town by gas, and the Gas Committee now recommend the Council to increase the consumption of gas in a number of the principal streets from 4ft. per hour per lamp, to 6ft., and in a further list of streets of secondary importance to 5ft. per hour. The recommendation, if adopted, will result in an additional consumption of 2,672,278 cubic feet of gas per year, at a cost of £632. This, however, does not represent the sum that will have to be paid above that of last year. That year the price of gas is reduced from 3s. 6d. to 3s. 3d., thus effecting a saving of £592 13s. 9d. in the cost of public lighting. Deducting this from £632, the additional cost for the increased light will be only £111 4s. 3d.

Electric Lighting at Eastbourne—From Eastbourne we hear that on Saturday evening last the sea-front and gardens for nearly two miles were lit up with the electric light, and that the new means of illumination proved most successful.

ELECTRIC LIGHTING MEMORANDA.

The subscribers to the great Brush electric lighting installation on the Holborn Viaduct have received a courteous intimation from the Secretary of the United Swan and Edison Company, to the effect that the supply will soon be discontinued, and they are therefore requested to inform the Company when it will be convenient to have their services cut off. Thus ends the enterprise from which so much was expected, and which has done so little beyond keeping itself in existence at a cost that will never be repaid. Of course, it will be said that this stoppage is only a preliminary to a recommencement of operations elsewhere in a more favoured district. But it will occur to most people that the position occupied by the Holborn Viaduct on the Viaduct was as good as they can hope to find in any other part of London. It is a central site, on a thoroughfare provided with subways, whence the extension of supply into the most thickly populated and opulent part of the City was extraordinarily convenient. The whole of the City of London was open to the introduction of the incandescent system from this centre of supply. Wherefore, then, retreat with the road to victory clear? The Company's circular states that the installation was intended to prove the scientific possibility of supplying incandescent lighting, and this having been done—the curious method of signalling a triumph. The subscribers who went to considerable expense to adapt their interior fittings for the Edison system will, of course, lose their money, which will constitute their reward for the entertaining spirit they displayed, and the patience with which they endured the eccentricities of the light. Their fate will scarcely be an encouragement to the subjects of the next attempt on the part of the United Company.

The South African Bread Company has had a meeting last week at which the shareholders completely upset the proceedings of the Directors. It was an extraordinary general meeting, convened for the purpose of passing a resolution, originating with the Directors, for the reduction of the capital £50,000, so as to convert the existing 5s shares into shares of £2 10s, which would leave an unpaid liability of 10s. instead of £2 10s, as at present. In moving the resolution for this purpose, the Chairman made a speech of the usual character; boasting that the bread dynamo was the best in the world, and stating that the lighting done by the Company was Kimberley was much better than anything of the kind that had been done in England. It is remarkable how distance lends perfection, and perhaps "enchantment is to the view" of electric lighting. Failures and disappointment close at hand are always explained away, and everything is reported to be so much better somewhere else. English people used to be told by the earlier Brush prophets that the place to see their lights in perfection was America. In the United States, the successes of the English electricians were equally held up to admiration. Not long since the Company of The Times stated that electric lighting in particular could only be seen to perfection at Mr. Phillipart recently informed the shareholders of his Accumulator Company that the Faure-Sellon-Volckmar batteries could drive tramcars in Paris better than in England. Now we are informed that the best display of South African Brush shareholders, however, seemed to think that the game was played out; and they declined to allow the Board to lavish the unrefilled balance of 10s. per share. They submitted an amendment, in the teeth of the Chairman's and his friends'; and as this was not put from the chair, they contemptuously rejected the Directors' motion. A poll was demanded, but, whatever may be the result, it is evident that the working days of the speculation are numbered, as the shareholders seem determined to enforce a return of so much of the capital as can be saved.

The public of New York have apparently awakened to the evil of allowing electric lighting companies to string their lines all over the city without restrictions based on considerations of safety for life and property, and have been told by many authorities that the only possible course to be followed is to compel the electric companies to put all their cables underground. The *Sanitary Engineer* recently summed up the prevailing idea, by declaring that electric lighting was not so much a necessity for social existence that the dangers of the exposed wires could be endured for its sake. The companies are therefore bidden to bury their cables; and when they reply that they cannot do this and live, the alternative is accepted with almost brutal candour. Meanwhile, however, it has been overlooked that underground wires are quite as dangerous as the others. This view of the case has been presented to the American public by Professor Sperry Morton, in a letter which is a model of its kind. He shows that of all the systems of electric lighting in use in New York, the Edison Company—with their underground wires and low tension currents—are chargeable with having caused the greatest damage. It is true that the total amount of injury to life or property from this cause is said to be insignificant; but it is a curious fact that "more than seven times as great loss has occurred from the 10 miles of underground wires than from the 800 odd miles of aerial wires, although the latter have been much longer in use." Professor Morton thinks that the chances of accidental contact with the wires would always be greater when the latter are underground. From the point of view of the companies, it is manifest that "it is impossible to carry on successful electric lighting on an extensive commercial scale with underground conductors," because of the expense. Professor Morton's ideal solution of the difficulty is the construction of subways—which postpones the satisfactory introduction of electric lighting to the millennium of the sanitary reformer.

The Metropolitan (London.) July 12.

Cost of the Electric Light.—Messrs. Samuel Brothers, of Ludgate-hill, have published some details concerning the electric light as employed upon their establishment. The dynamo machine is worked by an Otto gas engine of 3 horse power, which, when new, is in excess of what is required for the existing lights, and would be amply sufficient for a number of incandescent lamps which are about to be fitted up in the counting-house, private office, and fitting-room. The replaced lamps require no skilled attendance, and are attended to by the head porter. There are altogether 80 "Jablochkoff" arc lights, five of which are in the front, and the remainder are employed to light up 4,000 square feet of space inside. Each lamp has an illuminating power of 378 candles, equal to 35 ordinary gas burners, as verified by the scientific staff of the Jablochkoff Company, and when new the "Jablochkoff candle" consumed more than one penny per hour, and the gas consumed by the Otto engine costs only one penny per 5 amp. per hour. The total expenditure for arc lamps is £150, the lighting of the premises averaging three hours each night.

A keen competition is at present going on in Manchester between the gas and electric systems of lighting. The Manchester Royal Exchange is being lighted by the British Electric Company with 200 incandescent lamps.

The price of gas at Selkirk has been reduced from 4s. 7d. to 4s. 2d. per 1,000 feet.

The directors of the Brush Midland Electric Light and Power Company (Limited), have decided not to raise the call of £1 per share fixed for July 1, as sufficient capital is in hand for present requirements.

The Metropolitan (Brush) Electric Light and Power Company are now making a vigorous start, and already possess stations in Holborn and Westminster. They are receiving applications for their system of lighting from all parts of the metropolis, and intend, as rapidly as possible, to open out stations throughout the whole of the metropolitan postal districts.

THE METROPOLITAN.

The Electric Lighting Bill.—So far as general principles are concerned, the Select Committee appointed by the House of Commons to consider the various electric lighting schemes before Parliament this Session, and especially the Bill introduced by the President of the Board of Trade, have practically concluded their labours. The taking of evidence was completed by the middle of last week, and on Thursday afternoon the chairman announced that although the committee would meet again to determine on other certain points in respect of which they had not then come to a decision, they had absolutely determined to recommend the House to strike out of all Bills that have been presented this Session every reference to electric lighting. The committee met again on the following day, and, after further deliberation, the chairman stated to those present that the committee had passed fifteen resolutions embodying their conclusions in regard to the lines upon which they would recommend the House to amend the fifth of the Board of Trade. These resolutions are given below, and it will be at once seen that the Board of Trade proposals have in the main been accepted. The committee have adjourned until the 8th inst., to hear any arguments against Mr. Chamberlain's Bill as amended, but it is understood that they will not hear further arguments or evidence contrary to the principle of the resolutions. In our next week's issue we shall probably examine at some length the evidence submitted to the committee in the course of the inquiry, and consider the practical working of the powers proposed to be conferred upon the Board of Trade. For our own part we are not at present over-confident that the result of the committee's investigations, so far, is all that might be desired in the interests of the public. The President of which the committee have acted are apparently viewed with satisfaction by the gas interest, and that is a matter of suspicion.

The following are the resolutions adopted by the Committee of the House of Commons:—

1. That the Board of Trade be empowered to grant licences to local authorities, or to private undertakers, with the consent of such local authorities, to supply electricity within a defined area.

2. That such licences be for any period not exceeding five years, but may, at the expiration of the licence, be renewable with such consent as aforesaid.

3. That the Board of Trade be empowered to grant provisional orders, in addition to licences to private undertakers, without the consent of the local authorities, for the supply of electricity; but such provisional orders shall be subject to confirmation by Parliament.

4. That notice of any application for a license or provisional order be given by public advertisement in the district, and full opportunity be given to all parties interested to object to the grant of the license or Order.

5. That no application for a license or provisional order be granted until the expiration of three months from the notice of such application.

6. That no application by any local authority, for a provisional order under this Act, be proceeded with until it has been submitted to a meeting of the local authority, specially convened for the purpose by public notice.

7. That licences and provisional orders should carry with them a power to break up the streets for the purpose of laying the necessary mains.

8. That where it has been proved to the satisfaction of the Board of Trade that the area as defined by the Electric Lighting Order, is sufficiently supplied with electric light, and that the supply of gas has been proved to be unnecessary, the Board of Trade be empowered to make an order relieving, either wholly or in part, any corporation or gas authority from being compelled to supply gas within such area.

9. That local authorities be empowered to purchase compulsorily the undertaking of any company or persons authorised by provisional order to supply electricity at the end of 21 years, or at the end of any subsequent period of seven years.

10. That for the purpose of the purchase of the undertaking, the value of the land, buildings, materials, and plant, shall be deemed to be their fair market value at the time of purchase (due regard being had to their nature and their condition in their state of repair, to their suitability to the purposes of the undertaking, and (where a part only of the undertaking is purchased) to any loss occasioned by severance, but without any addition in respect of compulsory purchase, or of goodwill, or of any past or future profits, or of any similar consideration.

11. That licences and Provisional Orders should contain such regulations—(a) For securing the safety of the public from injury to life, or limb, for (b) the supplying of the undertaking a regular and efficient supply of electricity; (c) for fair rating; and generally, any power to be necessary; and where it has been found by the Board of Trade that public safety is likely to be endangered, that in all times there power to make such further regulations as may be required for securing the safety of the public.

12. That overhead wires be forbidden without the consent of the local authority, and where it has been proved to the satisfaction of two justices of the peace, or corresponding authority that any such wire is, or is likely to become dangerous to the public safety, they may make an order directing it to be removed upon such terms as they may think fit.

13. That local authorities supplying the electric light be required to keep separate accounts of such undertaking, and to publish them in detail for the information of the ratepayers.

14. That the Board of Trade be required to submit to Parliament an annual report of their proceedings under this Act.

15. That any undertaking which could be authorised by private Acts for the supply of electricity be subject to the conditions contained in this Act.

The Electric Light Company has secured the premises and machinery lately used by the Electrozone Manufacturing Company, and from thence the electricity will shortly be supplied for the purpose of lighting the Strand and the New Law Courts.

Messrs. Waterhouse and Winterbotham, solicitors to the Edison Electric Light Company, have written stating that the Swan incandescent lamp is an infringement of the Edison patents.

The Metropolitan (London.) June 24th, 1882.

We understand that Major Flood Page has resigned the post of manager of the Crystal Palace, and has accepted that of general manager of the Edison Indian and Colonial Electric Light Company.

Electric Lighting at Stafford House.—The electric lighting of Stafford House, the noble residence now leased to a very large party of guests by the Duke of Sutherland, will take its rank amongst the most efficient examples of the incandescent system. The work has been carried out by the British Electric Light Company, and from end to end and on the sixth floor midnight the staff consists of twenty-one-pair coals, were maintained with perfect steadiness and regularity, and with no perceptible heat in the large hanging lamps in the saloons, the noble picture gallery, 120 feet long, and the grand staircase. The total number (116) of the electric lights dispersed in numerous candelabra without a vestige of the conducting wires being anywhere visible, and the banqueting room, 60 feet in length and equally ample in its other proportions, was similarly fitted up, and equally ample in its results. Dynamos worked in duplicate, and of 30 horse power, were erected in the engine-room and manages; and not the least remarkable of these was a single 4-horse-power engine, which is used effectively a considerable portion of the garden. The motive power is a 20 horse-power Marshall engine, and there exhibited were three eight dynamos machines and two feeders. The machinery is altogether well planned and erected, running noiselessly, and with perfect regularity. The system of distribution of the current is excellent, and the working effective, and exhibits every appearance of prudence and simplicity. All the machines send their currents into one main conductor, and the nature of the currents is such that there is no danger to assistant of the hands with the unprotected wires. The switches are so arranged that each set can be cut off separately, and the lights in any of them further power can instantly be obtained from the main. The only apparent objection of one plug in a room of five or six; and if one socket should go wrong, the other feeders which is running vacant can be at once utilised, and the work be done. These arrangements and the beauty and steadiness of the lights were much admired. The Duke personally conducted his numerous guests, amongst whom were Sir Charles Bright, Mr. Siemens, Sir Samuel Canning, Mr. Crookes, F.R.S., and other eminent electricians; the Director of Military, General Campbell, K.C.B., &c.

Electric Lighting at the Crystal Palace.—The Crystal Palace authorities have decided to continue the lighting of the terrace throughout the summer months by the Jablochkoff electric lighting, and have sanctioned the extension of this system over the track of the new Electric Railway, which is about to be opened in the grounds.

Metropolitan (London) July 1, 82.

Electric Light and Power Generator Company.

The first annual meeting of the shareholders of this company was held at the Cannon-street Hotel on Tuesday, Admiral Sir E. A. Inglefield, C.B., F.R.S. (chairman), presided.

The report, stated that the total sum received for preliminary expenses, commissions, and underwriting, &c., was £6,669; that the amount spent on patents and experiments, work and improvements, was £9,806; and that the total expenditure for salaries, fees, and general charges, was £1,811, leaving a small sum of £6,052. Since the last meeting the directors had purchased the Wood and Maxim patents of electric lighting, each of which systems the directors believed to be second to none, and had fully answered their expectations. The endeavours of the directors during the past year, under review had been successfully applied to the dissemination of a knowledge of the above-mentioned systems throughout the country. A very favourable contract had been made with the Railway and Electric Appliances Company (Limited), and with the Islington Company. A second contract had also been made with the Commissioners of Sewers for the City, and others were confidently expected. Altogether the company possessed a valuable property, which, if carefully managed, must prove highly remunerative, and, he trusted, for a patent to be a good one and to be well worked without its being immediately remunerative to its possessor.

It was his duty to prove that the validity and excellence of their patents were unquestionable, and that the directors had done their utmost to make them remunerative. At the time that the company took over the patents they had been given to them by the City authorities for the lighting of a portion of the City, they had only the Lontin light. They intended to produce the light by May, 1883, at the rate of 40/- a month. They commenced literally without staff, workshops, or stores. They had, however, found premises near Southwark-bridge, where they secured. After the chairman explained the method of applying the light, the directors offered the incandescent lamp now well known to the Maxim light, and they were advised not to accept it for the chance of obtaining the price asked was very large, £100,000. The directors accepted it on receiving shares to the value of £54,000, of which £52,000 was to be paid in shares, and £2,000 in cash. Part of the agreement was that the company should also purchase the Wallace-Dick light, with a number of patents with it, which of course was to be paid for by a fresh issue of shares. The directors, however, had not yet completed those arrangements, as they were awaiting the result of experiments which were being made in America. The Lontin light was found to work best in the streets selected by the company, viz.: Queen Victoria-street, Queen-street, Cheapside, and Newman-street, Oxford-street. All of these places were worked from the station near Southwark-bridge, but the light during the season of long days was not in request, and it was found that it was carried also with less "noise" burning. This operation was found to be dangerous in the extreme, and the current was ceased. Immediately after the meeting the directors decided to store the light temporarily rather than sell it at a sacrifice. This difficulty, however, had been obviated by the use of double arc lamps, some of which they intended to employ in the City streets, and some of which they hoped to complete in the City premises. The Lontin light had been tried, and the result was successful. (Applause.) The chairman went on to describe the connections the company was preparing to grant to other companies, from which they expected a profit of £60,000 in one year. The company had secured the fifth in the gold ore of the Cooking, F.R.S., explained the position. Mr. Woodward seconded—Mr. W. Electrician to the company, and the circumstances under which he had said in the early days of the company. He said he was pleased at the favourable position of another company, which would relieve them to introduce their own. He was quite willing to resign his position, but he was bound to say that the success of the company was due to the energy and ability of the chairman. Sir Mr. Crookes had resigned with grace, as he was pleased to have been able to aid him so far. The report was then adopted. The retiring directors, Sir E. Inglefield and Sir H. Smith, were re-elected. Mr. Woodward, Mr. H. Davey, and Mr. Hedgeland were elected. A short extraordinary meeting was next took place for the purpose of changing the name of the company to "The Anglo-Varley Electric Light Company (Limited)." In proposing this, the Chairman (Sir E. Inglefield) was the more readily because the first started, the name, twenty-three electric companies had adopted the word "Light and Power," and one company had adopted the word "Electric Light Generating Company," which was only one syllable different to theirs. The alteration proposed would at once show the difference to opposites which the company possessed. The resolution was carried unanimously, and the meeting terminated with a vote of thanks to the chairman.

July 25, 82.

THE METROPOLITAN.

Electric Lighting in the City.—We have pleasure in giving insertion to the following communication:—

TO THE EDITOR OF THE METROPOLITAN.

SIR,—In your quotation of the 19th inst., you did me the honour to allude to a letter of mine published by a contemporary upon this subject, and as in the following remarks I have detailed the comparison of the cost of electric and gas lights as the principal consideration, you may consider them of sufficient interest to many of your readers to induce you to publish them. In the first statement of facts in the letter referred to, I showed the comparative cost of the electric and gas lights *per se*, and in the second the relative cost of the leading interest and depreciation of plant, &c., between the electric, and the latter result is the one which more particularly concerns the ratepayers and the possible users of electricity. In the concluding paragraph of my letter, I alluded to the greatly increased [illegible] of the electric illuminating power—and in explanation I would now say it is stated that the official report presented to the Commissioners of Sewers in 1881 that the illuminating power of the electric light supplied under the former contract was equivalent to be 100 Electric Jabloschkoff (Brush) 15 times illuminating power to be 100 Electric Jablochkoff (Brush) 15 times illuminating power to be 100 Electric Jablochkoff (Swan) 15 times, and in Electric the Victoria Embankment, an intense or open arc average 165 times that of the ordinary gas lamps with which the former comparisons of cost were made. In the former communication I quoted the present cost of gas in five districts to be £3/8/, against the lowest tender for electricity in those districts to be £3/8/, against the should be added interest and depreciation upon the cost of works and installation, which would increase the amount charge to £3/18/, or an addition of 10 per cent. upon the cost of gas, but for which a light possessing 165 times the illuminating power would be obtained. The power would also be much more illuminating—that measure for measure making the electric light of this power about one-eighth the price of gas for the same power, when obtained. In confirmation of these results I may add that the Hammond Electric Light Company offered to light the Strand district for £3,000 per annum, exclusive of the cost of installation (amounting to £7,250 and therefore equal to 40 per cent. and depreciation) the annual cost of which would be £2,775, or a little in excess of the lowest tender for electricity.

Since the introduction of the electric light much ingenuity has been exercised on the production of improvements in gas, and the result is in many cases very satisfactory, but, of course, the consumption of gas is increased. Some of the new burners, which give five times the quantity of gas, but probably not five times the light, have been tried in the Strand district, and the result would be £5,211 per annum (exclusive of any allowance for the new burners and times) for six times the illuminating power, equal to 1,000 gas lamps, which is a saving in such a case of £1,564 (or 30 per cent.) upon the illuminating power, or, say, 16½ per cent. upon the illuminating power, or, say, 16½ per cent. upon the illuminating power, or, say, 16½ per cent.

tions which may be contained in any such license, order, or special Act in relation thereto." Any time authority within any part of whose district electricity is authorized to be supplied, may, in addition to any regulations which may be made under the preceding provisions of the section for securing the safety of the public, from time to time make, rescind, alter, or repeal byelaws for further securing such safety; and there may be annexed to any breach of such byelaws such penalty not exceeding forty shillings for each offence as they may think necessary: Provided that no such byelaws shall have any effect unless confirmed by the Board of Trade and published.

7. Any expenses incurred by a local authority under this Act, and not otherwise provided for, may, be defrayed out of the local rate, and the local authority may from time to time issue such rates to be levied as may be necessary for the purpose of defraying such expenses.

8. A local authority authorised to supply electricity by any license, order, or special Act may from time to time borrow money for such purposes. Where any local authority is authorised by any Act to raise any money which they may be empowered to borrow for certain purposes by the issue of corporation or other stock, any money which a local authority may be authorised to borrow under this section may, if it is thought fit, be raised by them by the issue of such stock as aforesaid. This section shall apply to the Metropolitan Board of Works, except in so far as the Metropolitan Board of Works may be concerned in the borrowing of any money by any Vestry or District Board.

9. The provisions of the Companies Act, 1862, with respect to the audit of accounts annually, and shall sell copies of such annual balance sheet to any applicant at a price not exceeding one shilling a copy.

10. The undertakers may, subject to the provisions of the Act and for the purpose of supplying electricity, acquire such lands by agreement, construct such works, acquire such licenses for the use of any patented inventions, purchase inventions, machinery, apparatus, methods, materials, or other things, and such rights, powers, and privileges of all such acts and things as may be necessary and incidental to such supply.

11. Any local authority who have obtained a license, order, or special Act for the supply of electricity, may contract with any company or person for the supply of electricity within their district required for the purposes of such supply, or for the use of any electricity or meters belonging to such company or person by any special Act, or in any part of such area; but no local authority, company, or person shall by any contract or assignment transfer to any other company or person, or divest themselves of any legal powers given to them, or any legal liabilities imposed on them by this Act, or by any license, order, or special Act, without the consent of the Board of Trade.

12. The provisions of certain sections of the Lands Clauses Acts, the Gasworks Clauses Act, 1847, and the Gasworks Clauses Act, 1871, shall be incorporated with this Act. All offences, forfeitures, penalties, and damages under the said incorporated provisions of the said Acts or any of them may be prosecuted and be recovered in like manner as if the Acts respectively enacted the offences therein.

13. Nothing in this Act or in any Act incorporated therewith shall authorise or empower the undertakers to break up any street which is not repairable by such local authority, or any railway or tramway, without the consent of the authority, company, or person by whom such street, railway, or tramway is repairable, unless in the case of a street repairable by a corporation, where in a license, order, or special Act, or with the written consent of the Board of Trade, such consent shall not give any such consent until an opportunity has been given to such authority, company, or person to state any objections they may have thereto.

14. Notwithstanding anything in this Act contained, the undertakers shall not be entitled to place or keep any of the above ground, post, arm, or stanza set street, without the consent of the local authority, and the local authority may require the undertakers to forthwith remove any electric line placed by them contrary to the provisions of this section, or to alter or remove the same, and reinstate the expenses of such removal from the undertakers, a summary order for the same may be made by any court of summary jurisdiction on the application of any person aggrieved, and such electric line is or is likely to become dangerous to the public safety, may, notwithstanding any such consent as aforesaid, make an order directing and authorising the removal of such electric line by such person and upon such terms as they may think fit.

15. Subject to the provisions of this Act, and subject also to further specified conditions, the undertakers may alter the position of any pipes or wires below, above, or over any place authorised to be broken up by them, and may interfere with the exercise of any company, or person may in like manner alter the position of any electric lines or works of the undertakers, being under any street or place as aforesaid, which may interfere with the lawful exercise of any powers vested in such local authority, company, or person in relation to such street or place, subject to the conditions and restrictions

16. This is a clause for the protection of canals.

17. In the exercise of the powers in relation to the execution of works given them under the Act, the undertakers shall make full compensation to all bodies and persons interested for all damage sustained by them by reason or in consequence of the exercise of such powers, the amount and application of such compensation in case of difference to be determined, in arbitration as a supply on the terms and conditions of the Lands Clauses Acts.

18. The undertakers shall not be entitled to prescribe any special form of lamp or burner to be used by any consumer or person, or in any way to control or interfere with the manner in which electricity supplied by them is used, provided always that no local authority, company, or person shall be at liberty to use the electricity supplied to it by the undertakers for any purpose, or in any manner or so as unduly or improperly interfere with the supply of electricity by the undertakers to any other local authority, company, or person.

19. Where a supply of electricity is provided in any particular area for private purposes, every company or person within that part of the area shall be entitled, on application to the undertakers, and upon terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply.

20. The undertakers shall make such charges for the supply of electricity, to any such agreed upon, not exceeding the limits of price imposed by or in pursuance of the license, order, or special Act authorising them to supply electricity.

21. The undertakers may cut off the supply in cases of non-payment of charges for electricity.

22. Any person who unlawfully and maliciously cuts or injures any electric line or work shall be guilty of felony and liable to punishment accordingly.

23. Provides for punishment of persons stealing electricity.

24. Any officer appointed by the undertakers may at all reasonable times enter any premises to which electricity is or has been supplied by the undertakers, in order to inspect the electric lines, meters, transformers, fittings, works, and apparatus for the supply of electricity belonging to the undertakers, and for the purpose of ascertaining the quantity of electricity consumed or supplied, or where a supply of electricity is no longer required, or where the undertakers are entitled to take away and cut off the supply of electricity from any premises, for the purpose of removing any electric lines, accumulators, meters, or other apparatus belonging to the undertakers, repairing all damage caused by the removal thereof, or accruing.

25. Electric lines, &c., not to be subject to distress in certain cases.

26. This clause provides for the protection of the property of the Postmaster-General.

27. Where any undertakers are authorised by a provisional order or special Act to supply electricity within any area, any local authority within whose jurisdiction such area or any part thereof is situated may, within six months after the expiration of a period of twenty-one years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special Act, from the date of the passing of the Act confirming such provisional order, or of the special Act, and within six months after the expiration of every subsequent period of seven years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special Act, by notice in writing to the undertakers purchase, or at their option require the undertakers shall sell to them their undertaking, or so much of the same as may be within such jurisdiction, upon terms of paying for the value of all lands, buildings, works, materials, and plant of such undertaking wholly or mainly used by them for the purposes of their undertaking within such jurisdiction, such value to be in case of difference, to be determined by arbitration, and in the case of such lands, buildings, works, materials, and plant shall be deemed to be their fair market value at the time of the purchase, but regard being had to the nature and then condition of such lands, buildings, works, materials, and plant, to the state of repair thereof, and the suitability of the same to the purposes of the undertaking, and, where only part of the undertaking is purchased by severance but without any additional consideration in respect of compulsory purchase, or otherwise, of any lands, buildings, or plant which have been or be made from the undertaking, or of any similar consideration. The Board of Trade may determine any other questions which may arise in relation to such purchase, and may fix the time within which the purchase is to take effect, and from and after the date so fixed, or such other date as may be agreed upon between the parties, all such lands, buildings, works, materials, and plant as aforesaid shall vest in the local authority which has made the purchase, free from any mortgage, or similar charge affecting the same, but nothing in the undertaking, and the powers of such undertakers or attaching to the undertaking, and the powers of such undertakers in relation to the supply of electricity in the area of such provisional order or special Act as aforesaid within such area, and not thereof as aforesaid shall absolutely cease and determine, and shall vest in the local authority aforesaid.

28. Where any matter is directed to be determined by arbitration, such matter shall, except as otherwise expressly provided, be determined by an engineer or other fit person to be nominated as arbitrator by the Board of Trade.

29. Where a supply of electricity is authorised in any area within such area or any part thereof, such gas undertakers being under no obligation to supply gas upon demand, the Board of Trade may make an order directing that such gas undertakers may, in any district within such area, either wholly or in part, and upon such terms and conditions as they may think proper,

30. The Board of Trade shall report annually their proceedings under this Act.

31-33. These are interpretation clauses.

34. This is the clause for the protection of mines.

35. The undertakers or their undertaking shall not be exempt from the provisions of any general Act relating to the supply of electricity which may be passed in this or any future session.

36. Nothing in this Act shall affect the duty, license, duties, or special Act, or the exclusive privileges conferred upon the Postmaster-General by the Telegraph Act, 1869.

37 and 37. This Act shall apply to Scotland and Ireland with certain modifications.

August 26, 1882.

THE METROPOLITAN.

The Edison Light at the General Post-office.—An interesting and important installation of the Edison system of electric lighting has been completed at the General Post-office, and on Monday evening the 21st it was formally opened for public inspection. The large building on the western side of St. Martin's-le-Grand was illuminated by means of sixty Edison lamps. As our readers are aware, the Holborn-viaduct and many of the shops and business premises in the immediate vicinity have, for some time past, been lighted by the Edison Company from a central station, which has been established in a building situated a few doors from the village pump in Farringdon-street. The same system serves to supply the electricity for the rainbow-dance of the Alhambra, and, if we mistake not, the Criterion, we believe, is the greatest that has yet been made by Mr. Edison's representatives in this country from one centre, the distance from the dynamo-room on the Viaduct to the "Press-room" in St. Martin-le-Grand being 1,050ft. The importance of the work thus accomplished is obvious. The company claim that they can work in circles of half a mile radius, and the mile from Holborn-viaduct will include St. Paul's and the district around it, Blackfriars, part of Fleet-street, an important part of Holborn, including the Circus, the Mansion-house, and the whole of Cannon-street. The "Press-room" to which the Edison electric light has thus been supplied is a very busy one, and is used to afford our readers some further particulars of the same. As everybody knows, various attempts have been made to employ batteries for the production of the electric light, with more or less favourable results, but up to the present time it is not unsafe that a light has been obtained by this means possessing either the stability or the adaptability requisite in a light for every-day use, or produced at a cost at all comparable with that at which gas is, as a general rule, available. Mr. Crompton, we have learned a battery which he claims is entirely new in every particular, and which, he says, will supply every requirement so far as ordinary interior lighting is concerned. The invention is the subject of three distinct specifications, relating respectively to the battery, the fluid employed, and the special construction of the holding batteries. The object has been to provide a system of lighting which, while being used in large or small houses and of being easily managed by the most unskilled in matter mechanical, shall be entirely free from danger, and to meet the assumption that if the electric light is only to be obtained by the firing of a dynamo machine and engine on the consumer's premises, or even from a central station, the cost would be too great to be remunerative, there must be a very promising future for a method of rendering the light possessed by each accumulator as those claimed for this particular system. The invention relates to a fluid for the charging or construction of what the author terms a multiple carbon battery, the idea being to obtain greater constancy and electro motive force than hitherto, and also to the provision of improved means for filling and discharging the cells. Mr. Crod asserts that by the employment of his batteries any number of lights may be maintained for a period ranging from forty to sixty hours, without the batteries requiring to be recharged, and he says further that there is not another volaic battery in existence that will produce equal results, ingeniously conveyed as a means of checking accident from any increase of current; as the load, with any increase of heat, would melt, and thus extinguish the lamp herewith. The work of separating the "Press-room" of the Post-office from the electric light was carried out in about ten days. It may be added, as a matter of interest in connection with the Edison system, that the model exhibited at the Paris and America by the Edison Company, the wires for supplying the building between Gerrard-street and Shaftesbury-avenue having been laid down in the streets, and everything working on the ever-ready principle. The electric light, it is said, has been of a most satisfactory nature, and the secretary of the company writes that during the first week in September, the electric light will be simultaneously in up.

The Economy of the Electric Light.—According to the report of Lieut.-Col. Fenwick, R.E., the assistant director, especially entrusted with the charge of the Museum buildings, South Kensington, the employment of the electric light instead of gas, in certain portions of the Museum, has resulted in a considerable saving. In his report, issued some months ago, Col. Fesling stated that for some time previously the Lord President's Court had been lighted by means of sixteen Brush lamps. We now learn that since May he Raphael and Sheepshanks rooms have been lighted, as well as Lord Presidents' Court, and seven additional lamps being employed, making thirty-two in all. The working of an engine has been amply borne out. The machines and engine belonging to the Industrial Society, Limited, are illuminated by and the consumption of coal per hour of work is 7lbs. per horse power. Each lamp burns about 10 hours, when there were only 16 wages, as far as the only addition to this head has been for the additional attendance to this head has been for the additional attendance to this head has been for the additional attendance

It appears that the light obtained by means of this invention has recently been subjected to a series of photometrical tests by an electrician, Mr. Swinburne. Using a 5 day or two gaps, in an of practical a character, and so clearly and impartially states the present position of the matter as between the two rival modes of lighting, that we offer no apology for reprinting it *en masse* :—

Sir,—In the present state of uncertainty existing in the minds of many of the public as to whether the time has yet arrived for it to be prudent to incur the expense of substituting the electric light for gas in private houses, I send for your inspection some particulars of the lighting by electricity of a house I have recently had fitted in the way I set down for it.

Berechurch Hall is about three miles from Colchester, and in the latter end of last spring I determined to go into the whole question of the best and cheapest method of illuminating it. I had at that first instance an estimate drawn up of the cost of laying down gas plant, which was simple enough; but when I came to that of the electric light many difficulties presented themselves. Not only was there the widest divergence as to cost in the tenders sent in, but I found that it would be necessary for me to be acquainted with the various kinds of lights, the relative merits of the dynamo machines, the best kind of engine to drive them, whether accumulators should be employed, the manner in which the wires should be laid down, where they should be laid in the house, the precautions to be taken to prevent risk of fire, &c.; for upon all these the permanent value of the installation appears to depend. I saw at once that I would be reckless as well as economical to employ professional assistance. I therefore engaged the services of Mr. Heaphy, C.E., of the Phœnix Electric Office, to advise me upon the matter and superintend the installation of the plant. Mr. Heaphy is also engaged on different systems of lighting, the result being that I determined to adopt the Swan incandescent light. Mr. Heaphy is making a report to accompany the tenders of Messrs. Crompton and Co., to supply the same, after I had decided upon it. Mr. Heaphy is also up a regular specification and contract going into every detail, and giving me the power of rejecting any work or materials he was not perfectly satisfied with. We were arranged to have 200 lights of 16-candle power each, and four dynamos to supply them. As regards the latter, I have a preference for Crompton and Co.'s engine as it is a horse power less and wires to be handled, and the other details are the most possible ones. They were to be embedded in the floor—not unfrequently inside the rooms, from each other, and also from the floor of the room above, and the upper floor, every room, and, in short, every kind of metallic substance, excepting the wires themselves and the lamps, each light to be put in quasi equilibrium overhanging of the wires, as well as a leaf "cut out" of the ceiling.

The whole has been carried out as specified, and the result has been a success that has exceeded my expectations. The plant is quite as easy to manage as gas, and the witness, the purity, and the agreeableness are such that a return to any other method of illumination would be quite out of the question. The pictures, walls remain unsullied, while the cleaning of lamps, chandeliers and for an evening in a room electrically illuminated is lighted by gas, must be experienced before it can be appreciated.

I will now give details as to cost :—Estimate for gas plant, pipes in house, £200; cutting and making good walls and floors, £25; laying gas and brackets, £30. Total, £255. Estimate for gas plant, dynamo machine, £165; 150 lamps, £75; 2 switch boards, £10; 2 resistance coils, £5; 2 voltmeters, £5; 2 ammeters, £5; 2 governors, £6; 2 sets of spring good walls and floors, £25; laying wires in house, £60; cutting and making good walls and floors, £20; 2 counter-shafting, £25; foundations to engine and dynamos, £15; chandeliers, lacing wires, &c., and carriage, £30. Total, £456. The cost of the latter is nearly for the whole of the buildings, £201 more. The excess of the same for gas 1 has then 1 have no nuisance of flues, no smell in the manufactory, or damaged to my garden; and, in the event of an engine breakdown, I have to compound like engine, placed out of view, and which, when not driving the dynamos, could be utilised for pumping water to the top of the house, and can also be employed for sawing wood, or any other purpose of a like nature, employed for sawing wood, or any other purpose of a like nature.

I will now enlarge upon the annual working expenses, and, in making a comparison, I will assume that it would cost the same to manufacture 1,000 cubic feet of gas at Berechurch as it does here.

Electric light—200 18-candle power lamps, each working 1,825 hours per annum.—Cost of 200, per cm. £38 10s. 1d.; engine driver at 30s. per week, £78; record of hours, £3 5s. 0d.; engine driver depreciation 5s per cent., cost of machinery, £71; depreciation 5 per cent. on conductors, £7; total, £429 15s. 1d.

Now, for less than half this amount of light it costs me £200 expense when I say that, had I used gas at Berechurch giving an equivalent illuminating power, it would have cost me at least £200 per annum to produce.

This would show an annual saving of £171 15s. 11d. to me by using electricity. Having had 30 years' experience of lighting this house by gas—which, I consider a great improvement upon any previously known method—I am only too sensible of its drawbacks and, although I am not easily satisfied with a new light, I am well satisfied that I have adopted electricity at Berechurch.

I am, Sir, yours truly,
OCTAVIUS E. COOPE.

Rochets, Berechurch, Jan. 11.

Electric Lighting Companies.—A very elaborate and comprehensive return concerning electric lighting companies has recently been published in the form of a special supplement to the *Mercantile Shipping Register and Colonial Merchant Review*. It gives full details of the constitution, progress and resources of all the companies, with explanatory tables and remarks, which afford a financial history of their public and private life from their birth to the present time. As the aim of the authors has been simply to state facts, and to avoid making invidious distinctions by proportioning selves without comment; but to facilitate comparison and the formation of a just conception of the whole, the leading facts have been summarised in the form of tables, to only one of which, however, we are able to allude. This table, which is of an exceedingly interesting and instructive nature, is divided into four sections and a summary; the first deals solely with the British Companies, of which there are no less than twenty; the second relates to companies that are actually at work, or prepared to work, and of these there are twenty-three, or only three more than the Brush list; the third refers to companies that do not appear to have been proceeded with practically; and the fourth to companies mostly recent, about which information is wanting or not yet attainable. The first point to which attention is called in the extract to which the companies are indebted to their shareholders. The figures show that the total of the nominal capital issued, £2,288,834, was 41 per cent. of the nominal capital of the companies comprised in Groups I., II., and III. of the first section, of those comprised in Groups I., II., and III. of this issued moiety 25 per cent. has been allotted and fully paid up to vendors, &c., leaving 60 per cent.—*i.e.*, under 75 per cent. of the whole nominal amount—to be paid up by the public. Roughly, eleven twenty-thirds of this has already been paid, which is to say, in the case of these companies, which do not include syndicates, agency, or provisional associations, a sum equal to 11 per cent. of the total registered capital represents the actual amount of public money received, while 5 per cent. or the same amount forms the extent of liability on future possible calls. This is a total nominal capital of something under twenty-five millions sterling, less than two millions and three-quarters has been *bona fide* invested, while the amount of shareholders' indebtedness stands at a trifle over three millions. The next point shown by the, Tables is the amount that has been received by the inventors and the promoters. The cash consideration is less little over a million, or (excluding Group IV.) £1,060,645. The shares allotted to vendors, as fully or partially paid up, form a more important item, and one specially onerous to shareholders, for it will be observed that the liquidating nature of payments to vendors, a sum of but £1,141,091 is left as working capital to earn a dividend upon £3,356,670 share capital. In other words, to pay a 5 per cent. dividend all round, over 15 per cent. must be earned upon the money actually employed in the business. Even if all calls were made and paid, and the whole issued as working capital, even so per cent. would have to be earned. This return, as might have been expected, is somewhat startling to companies in good circles, and it has not unnaturally been argued that the figures given indicate a condition of affairs which should inspire the public with confidence in gas stock. We anticipate, however, that in the minds of many the facts and figures given will be deemed capable of a very different interpretation, especially when the circumstances under which each few of these companies were established are borne in mind.

Electrical Exhibition at the Royal Aquarium.—We understand that Mr. Maginess Heaphy, C.E., has been appointed to report upon the fire risk of the Exhibition, and has already inspected the installations as far as they have progressed, and given detailed instructions as to the safeguards to be adopted. All the electric companies will be glad to learn that it has been placed in his hands, Mr. Heaphy being not only a practical electrician himself, and having had the superintendence of later installations, but he possesses great knowledge and experience on all matters connected with fire risk, particularly that of hazardous buildings, a combination of knowledge at present absolutely unique. The fair and impartial course Mr. Heaphy has taken towards electric lighting, while never losing sight of the interests of the fire offices, has excited great confidence in the minds of the electric companies whose work he has had to officially inspect. His rules and regulations are very well known, and have undergone little, but what is not generally known that the fire risk of electricity is a very old one indeed, and that as long ago as five years back it was the subject of report to the Phœnix Fire Office upon the matter, that being probably the first official report ever made upon the subject.—*Electrician.*

Local Authorities and Electric Lighting.—At a time when electricity is considered as the power to be used for lighting in the future, and as the local authorities are now called upon to give an opinion as to the conditions under which Provisional Orders of Trade should permit a private company (if at all) to lay cables for supplying both public streets and private houses with electric energy, Mr. Mackenzie Knight has thought that a plain and concise statement of the subject, together with an explanation of the various terms employed by electricians and of some technical details, would be serviceable to the Members of Vestry in their deliberations on this important question. The result is a document of considerable merit even among the very many able contributions on the subject, which have been prepared by the officers connected with the various local Boards of London. In Mr. Knight's opinion it would be highly objectionable to have overhead cables in any street unless these are at a considerable height above the ground—*say* 25 ft.—and as regards the distributing boxes which undertakers are to be at liberty to place in any street during which in their mains are laid, he points out that the boxes or stations might be so situate as to be a serious annoyance to the public economy, and by the frequent opening of such boxes considerable loss might be caused to the traders in the main roads opposite to whose premises they are situate. As regards the time given to private Companies like Edison, Mr. Knight estimates that it would take at least 3l years before the first section could be completed, and 21 years before the total nominal capital of the regulations of the Provisional Order are applied. There are but a few of the many points in this important subject, which are elaborately considered in the Member's surveyor's report.

Electric Lighting on Shipboard.—An illustration of the extent to which the electric light is being adopted on board ocean-going steamers is afforded by the fact that during the past twelve months Messrs. Siemens' representatives have fitted up complete installations on no less than six large vessels, viz., the *Arizona* and *Alaska*, of the Guion line, the *Normannia* of the Compagnie Transatlantique, the *Antonia Lopez*, of the Spanish and Cuban line, the *Antinoë*, of the Peninsular and Oriental line. As this is a year's work of only one agent of one of the numerous firms of companies undertaking this class of business, the *Normannia*, which is not yet quite out of the hands of the fitters, will have 300 lights and the *Arizona* 250, which is completely illuminated by electricity throughout, her equipment including side lights and head lights, engine and boiler room lights, steerage lights, and hold lights. Siemens' dynamos are employed, but the Brush lamp is used in the saloon chance of a stoppage of the light do accommodates are being placed on board, and will be kept constantly charged. The *Arizona* has 300 incandescent lights; the *Antonia Lopez*, 70; the *Orient*, 160 incandescent and 4 arc lamps; and the *Antinoë*, 170 incandescent and 2 arc lamps. The fittings have been specially designed for use on shipboard. The whole of the arrangements have been contrived so that neither thought nor skill shall be needed by those who manipulate them, and so that they can be safely placed in the hands of the stewards and passengers. Even the generators and arc lamps are entrusted to one of the ship's engineers, and some of the installations are superintended by electricians.

1882.

THE METROPOLITAN.

Electric Lighting at St. Denis.—We have been furnished with some particulars of an installation which was completed some little while ago at the works of the Compagnie des Forges et Chantier at St. Denis, and which, though of no special importance as far as the system of the lighting is concerned, is deserving of some attention as being of a decidedly new character. While it was hardly to be intended that electric accumulators have in every respect fulfilled the anticipations of their original inventors, experience has shown that within yet unknown limits they are useful auxiliaries to dynamo-electric generators. These latter can be employed at the direct production of light during the hours of normal requirement, while during the rest of the day they are used to charge the secondary batteries for feeding incandescence lamps when desired. This mode of electric lighting, which enables the highest duty to be obtained from the generators, has hitherto been rather indicated than realised, and for this reason the first industrial application of the method at St. Denis merits special notice. The installation comprises a number of Weston arc lamps and also some Maxim incandescent lamps. The works in question are principally occupied with the construction of railway rolling stock, and the directors of the company desired to utilise to the maximum the power available for obtaining as much lighting power as possible. The engine at the works does not develop more than 80 effective horse-power, of which about 48 are absorbed by the various machines, tools, &c., leaving 32 horse-power free for electric lighting purposes. Under these circumstances it was not possible to maintain more than ten arc lamps, which, however, are being easily by a Weston machine, and the light afforded is exceedingly regular and satisfactory. During four hours each day the Weston generator is employed to charge 80 accumulators of the Kabath company, placed about 250 yards from the generator and connected to it by insulated overhead conductors. These accumulators, arranged in two series of 40 each, are able to supply each day during the period of lighting representative horse-power, the current necessary to feed 30 Maxim incandescence lamps distributed over the painting shops and drying sheds. As this installation has been in operation for nearly two weeks some particulars as to the cost of the lighting are available, and summarising the figures before us, we find that the arrangement, after allowing for depreciation and interest on capital, works out at about 12s. 6d. per day. It must be forgotten, however, that in this case the power is obtained for nothing. The cost of gas to produce the same amount of light, and at the Paris prices, would be about 14s. 9d. a day, or 2s. 3d. per day more. On the question of economy, therefore, there is a considerable balance in favour of electricity, besides which there can be no doubt that the new system is greatly superior as regards security from fire, a matter of very great importance in a factory containing large quantities of inflammable material.

The Electric Lighting Act, 1882. By W. CUNNINGHAM GLEN and ALEX. GLEN, (Knight and Co.)—Messrs. Glen are universally recognised as authorities on the Electric Lighting Act of last Session—a measure of the utmost interest and importance to local authorities throughout this country—is therefore likely to be very generally accepted by such authorities as a sufficient and reliable exposition of an exceedingly complex statute. The full text of the Act is given arranged in a convenient form for the purposes of reference. The authors have also thought it desirable to place some sections of the Tramways Act, 1870, which do not appear to have been entirely superseded. Notes and cross references, together with a few decisions, are inserted where they seem requisite or likely to be useful. Among the notes will be found a code of rules, recommended by the Council of the Society of Telegraph Engineers and Electricians, for constructing and keeping electric lines and other works in such manner as to reduce to a minimum the possibility of risk from fire or shock, and the waste of electric energy; also the explanation for the purpose of measuring electric currents. The Rules of the Board of Trade, also annotated, are appended, and the work concludes with a full and carefully-arranged index.

Anglo-American Brush Electric Light Corporation.—The poll re-opened after the meeting on the 23rd ult., at the Anglo-American Brush Electric Light Corporation's Chambers, 4, Throgmorton-street, Bank, Messrs. Thomas Hoyle, jun., and Frederick Wm. Thomas Hollis, last-seen two and Wm. Lee, the remaining proposers, having declined to act. Mr. G. Hoyle, on behalf of the report of the directors, and the effect of the proposed arrangements, that a committee of shareholders should be appointed to consider and report on the affairs, position, and general condition of the company, and if possible.—And the close of the poll, Sir H. Tyler, M.P. (the Chairman of the company) moved a resolution, adopting the report of the meeting to Monday next for the declaration of the poll and the consideration and concluding the business.—Mr. Lane-Fox seconded the motion, and it was carried.—Mr. J. Boultbee said he stated that it might be interesting to the shareholders to know that the poll showed a large majority in favour of the directors.

HARPER'S WEEKLY. JUNE 24, 1882.

THE MODERN "ATALANTA."

ALTHOUGH ever since the five Atalanta, so fleet-footed that she outstripped the swiftest runners of Boeotia, was transformed into a lion by Jupiter Aphrodite, the name has been given to many models of speed and beauty, it has never been more aptly applied than to the new steam yacht that the Messrs. Stevens of Philadelphia have just built for Mr. JAY GOULD. The keel of this yacht was laid on the 10th of last December, and her builders have promised to deliver her in New York on Saturday of this week, fully finished, complete in every detail, and ready for a pleasure. She will be 185 feet long, and will be principally modelled with over floating in Amelican waters, where beauty of model has more nearly attained perfection than anywhere in the world, but also in producing the strongest vessel of her size afloat in any waters, strength of construction having been considered everything else from the builders. Being one foot longer over all than Mr. DREXEL'S famous, and lately lost steam yacht, this new yacht is the largest in the American fleet, and is well fitted to introduce the Queen of the second the world for which she is intended.

She is to have a draft of 10 feet 6 inches keel over all, 22½ feet long on deck, and 21½ feet 6 inches on the water-line. Her extreme beam is 26 feet 4 inches, and her draught is 12 feet. Her bow, sharp and high, has a "clipper" stem-head, from which rake nominally to her length over all, and give her a peculiarly rapid appearance as she lies at her. Her run is long and handsome, and her clipper stern is surmounted by a light and graceful railing, and is the feature which adds more than any other to the beauty of a yacht in American eyes. From keel to water-line the two sides of the water-ship are lapped at the edges, the strut being laying successively, thereby securing their ends, and are laid flush, bended bottle, and the first bend being also countersunk flush, so that the outer surface is perfectly smooth. The planking is continued uniformly to the stern-post, which terminates in that of a greater height than is usual, and which are surmounted by a heavy rail of solid mahogany. The hull is painted black, sparkled over by the gilded eagle which forms the figure-head, and by the name in gilt letters on her stern.

The yacht is rigged as a three-masted schooner, with standing gaffs and lug sails, and a square-sail yard on the foremast. The fore-mast rises one mode expressly for her, and all her standing rigging is of the best charcoal iron. Her spreaders are of iron, and built as solidly into the hull as the iron deck that it has by possibility be carried away. The formal part of this house is a large many-windowed room known as the Saloon either side of this, adjoining the saloon, are two ladies' lavatories, or dressing-rooms, which are used *en suite*, or can be separated by the latter, and then become de parlor, large and airy, dressing of tapestry hangings; these lavatories are furnished with marble tables, plate-glass mirrors, exquisitely carved toilet-tables, for easy-chairs, and everything that wealth can provide of comfort or luxury. Of these rooms one is upholstered in white silk and the other in blue. Forward of these, on either side of the passage-way, are two more saloon-rooms, or four in all, each of which could, in an emergency, accommodate two gentlemen with comfortable quarters.

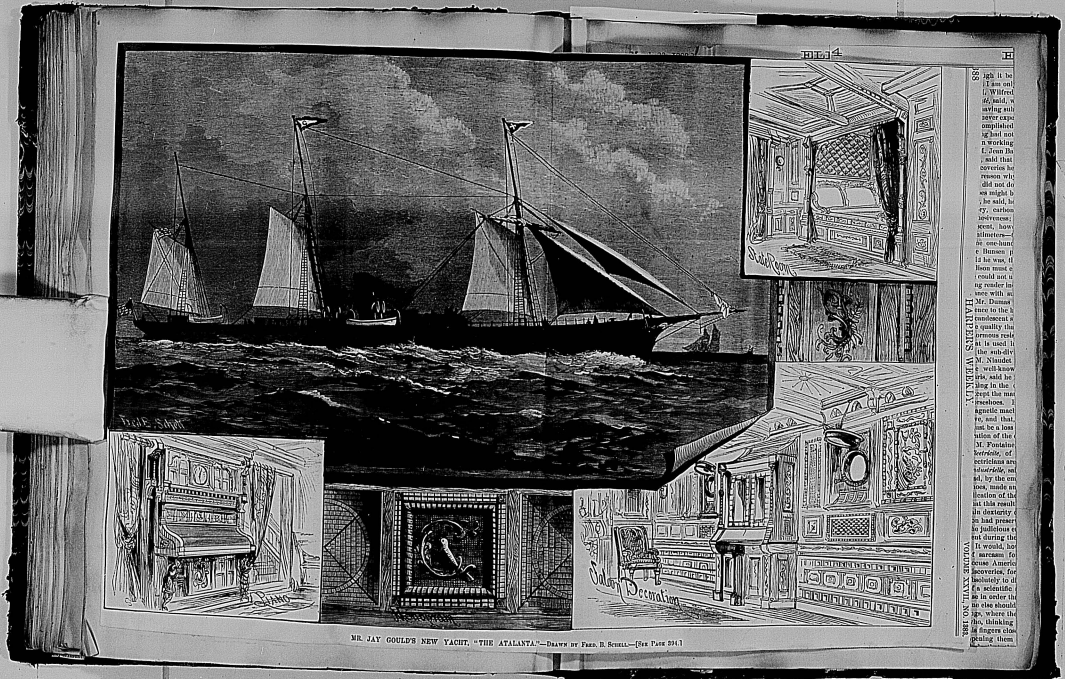
Forward of this is a recess on the right of the passage-way, a long bath-room, or lavatory, fitted up with every luxury. In the collision bulkhead, forward of this are the quarters of the head steward and the six cabin servants, which are reached by a separate companionway from the upper deck.

The Atalanta is to be commanded by Captain STACKPOOLE, formerly of the White Star service, and lately commander of the steam yacht *Minnie*, of the American Line, between Philadelphia and Liverpool. Under him will be two mates, four quartermasters, two boatswains, eighteen seamen, chief engineer, two assistant engineers, three oilers, six firemen, three coal-passers, one steward, three cooks, and six servants, or fifty-two men in all. She is propelled by a compound, horizontal, direct-acting, surface-condensing engine of one diameter brass-power, provided with two cylinders, one thirty inches in diameter, and the other sixty inches. A small engine driven by steam-cylinders of seven inches, which supplies electricity by means of which every passenger may have a light at his state-room desk, and every corridor and final his room with light, to create a motion and measure a current. Every portion of the yacht is lighted with the Edison incandescent lights, and every portion is in direct communication with the engine-room, so that in case of fire or sickness she can be summoned by electricity. By means of a steam ventilating fan the cabins of the American Steam-yacht Co., which is a white Bellows cross on a blue field bordered with red. The cost of the Atalanta has been more than a quarter of a million of dollars.

AUGUST 16, 1883.

THE ARTISAN: NASHVILLE.

The Brush Electric Association of this city, which comprises the southern and Western states for the Brush Electric Light Co., has purchased a recent light gave an exhibition of the incandescent system in the rooms in the Umnite Building, Thursday evening. This is one of the systems of electric lighting which was not represented at the late Railway Exposition held in Chicago. The system has many things to commend it to either large or small consumers. It is considered admirable in their ability to make the light portable by changing a battery that can be moved or placed anywhere. This system, it appears, is just the one for use in a village inside as the cells of stored electricity can be exchanged at each end of a city. It is worthy of an investigation by railway managers.—*St Louis Railway Register.*



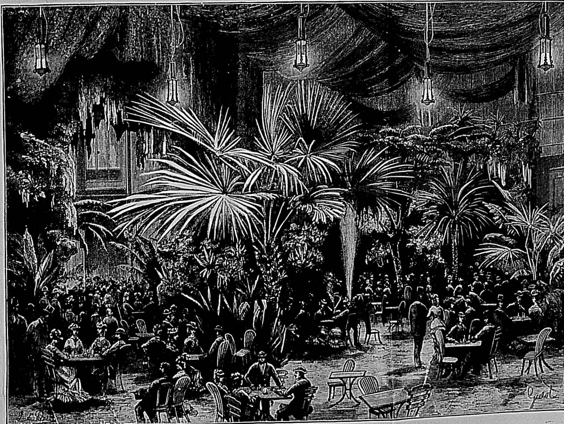
MR. JAY GOULD'S NEW YACHT, "THE ATALANTA."—Drawn by Fred. B. Schell.—[See Page 394.]

The Electric Light at the Eden Theatre, Brussels.

(*Translated from La Lumière Electrique.*)

The progress constantly being accomplished in the construction of apparatus intended for electric lighting renders possible the application of the new method of illumination to all the varied forms of modern industry.

It is very interesting to follow with an attentive eye the movement now going on in the Patent Offices, both in France and abroad, and to notice that not a day passes without some invention, connected with electricity, being registered. Electric lamps hold, as to number, the first place in the list of electric inventions, and while certain types display originality in conception, yet the general movement is in the same well-worn rut, and many so-called inventions brought before the



THE WINTER GARDEN OF THE EDEN THEATRE, BRUSSELS, LIGHTED BY THE SIEMENS ELECTRIC LIGHT.

public with a great flourish of advertisement, are often only modifications, more or less valuable, of apparatus already in use, or applications of principles already well-known. However that may be, one is nowadays embarrassed in making a choice between the numerous new systems of electric lighting; and the numerous efforts at improvement in this field, recorded in our columns from day to day, proves how much this interesting question occupies the attention of inventors.

In awaiting a practical system of distribution to be successful in all our commercial and industrial centers, a result which cannot long be delayed after the conclusive experiments made on the lines of the *Chemin de Fer du Nord* for the transport of force to a distance on ordinary telegraph lines by the method of M. Marcel Deprez, there have been made in a great number of cities isolated installations which have demonstrated that electricity must sooner or later replace all other systems of lighting hitherto known, both for public highways and domestic uses. Everyone will recall the experiments in electric lighting made in the beautiful Avenue de L'Opéra, which was then newly opened, at the time of the exhibition in 1878. The experiment was entirely probationary, but was continued during several years, and has only recently ceased by reason of a failure of the understanding between the *Societe Jablochkoff* and the Municipal Council.

The same demonstration has long since been made for large establishments, and in the latter case it is proved that the new illuminant while possessing extraordinary advantages from a hygienic point of view, as well as for the quantity and beauty of the light, realizes also great saving in expense. Buildings like the *Louvre*, which was the first one to enter into the way of progress, are one after another adopting the new methods. We have besides in a preceding article, given an account of installations actually made in certain of the great stores of Paris.

It is principally for theatres and establishments of all descriptions that the electric light ought to be preferred to all other means of illumination, for it presents for these purposes advantages of the first importance. During the ordinary course of the representations the ventilation of the auditorium leaves much to be desired; notwithstanding all the precautions adopted the heat and vitiated air serve to make a trial of endurance of a performance where a numerous audience is present, besides the safety of the spectators is always menaced, and we have only too many examples of the terrible catastrophes produced by gas, not to wish for its replacement by a safer agent, as rapidly as possible.

Among the large installations made in Paris among establishments of this character, every one knows the Hippodrome, beautifully lighted with numerous electric candles, of which the regular working during several years has never caused a disappointment. During the year 1882 an experiment was tried in lighting the *Theatre des Varietes* with the system of simple incandescence; but it seems to us that for a theatre these small lights are insufficient, and can only produce an adequate decorative effect when supplemented by the arc lights.

We are, besides, happy to note all the essays which are being made in this direction everywhere, and that they will be found in great number in foreign cities. Brussels, among others, has not been willing in this respect, to lose its nickname of *Little Paris;* in fact, it is well known that the capital of Belgium possesses already many natural points of comparison. The boulevards, the diminutive park of the Tuileries, the squares, the luxury of its stores, and in the environs of the city the *Alee Vert*, which may be compared to the Champs-Elysees, and, finally, the *Bois de la Chambre* and its lake, recalling the *Bois de Boulogne*, are among the points of resemblance. The extensive demolitions which have been made for the opening of the boulevards Anspach and *du Hainaut* vie with, although on a smaller scale, the audacities of the Haussman administration. But it is not only in the local arrangements that Brussels can vie with Paris; all forms of progress realized with us are soon adopted by our neighbors, when they do not precede us, as has been often the case in the domain of theatrical representations, both dramatic and lyric.

Much has been said lately about the opening of a magnificent establishment built at Paris, near to the new opera house, in the *Rue Boudreau*, and which is only a repetition on a grand scale of a similar establishment inaugurated a long time ago in Brussels, *Rue de la Croix-de-Fer*, under the name of the Eden Theatre. In the picturesque design on this page an effort has been made to reproduce from a photograph one of the winter gardens which surround the principal hall of the Eden Theatre in Brussels. The decoration of the sides is extremely successful. Immense stalactites simulate in the background grottos under which jets of water gracefully gush out, whilst exotic trees and plants with the most varied foliage adorn the lower portion; above this mass of verdure the electric light from the Siemens lamps projects its brilliant rays, and the effect produced by reflections infinitely multiplied is truly marvelous.

C. C. SOULAGES.

The *London Lancet* thinks that the electric light must soon become the common illuminant. This staid authority would scarcely reach a conclusion were the electric light a real source of danger to the eyesight.

Electric Rivals.

NEW JERSEY PHYSICS—A FEW FOREIGN OPINIONS—THE FRENCH CLAIMANT—COST OF GAS AND ELECTRICITY—GAS AND COAL AS FUEL—POSSIBLE ADVANTAGES OF THE FORMER—SATISFYING THE SKEPTICS.

[Written expressly for the ELECTRICAL REVIEW.]

Whether or not Edison has done more than others toward finding a solution for the electric light problem, he deserves, at least, the credit of inciting his brother electricians to renewed effort. Learned Professors had been working silently in their laboratories for years, practically to no purpose, when this young man—unschooled, fresh from an operator's desk—announced that he had found that which they sought. We will not here look into the truth or falsity of the alle-

HARPER'S WEEKLY.

THE ELECTRIC LIGHT IN HOUSES.

JUNE 24, 1882.

Some years ago the famous Baron Rothschild made a trip in the country, at the time the subject of the invention was unknown, but it is now proposed to have the electric light on behalf of an electric lighting company, to discover how the soft white light of the heavenly star will compare with whether, for instance, the light was supplied from gaseous to the proper color when it is lighted by gas, whether the current could be so equalized that firmness at any point and supply the whole of all points with an equal light, and whether the current could be subdivided so that, as the Baron in his interesting and extensive account of his tour does not know, the same motive, it may be presumed that his solution was a failure, At any rate nothing came of it, and it was reserved for Mr. Edison to evolve without a hearty excessive a method of producing artificially that soft white light which has furnished a theme for so many poets, so that the poets of the future will soon be able to get up a little private room, such for himself, and in spacetopic, even since the heavens without are covered, the silver rays at they come dancing over a basin of water though it is to be devoutly hoped that the same law of peace will not increase with the number of electric lights.

Mr. Edison's invention naturally met with much opposition, and though the opposition has diminished considerably, there are still many who refuse to put faith in the system. They fear that the electric light, like the sword, is revealing, will prove "false and inconstant." The first lot of darkness, who did not believe that Mr. Edison could subdivide the current into small lights, were allowed some time ago by the actual subdivision, and soon the inventor proposes to illustrate to the practicability of his system by illuminating the streets and houses in about a dozen mile of city—that is, about a square. Wall, Nassau, and Nassau streets, and the East River. The island the system has already been tested. Mr. Edison runs a current from what is known as the Pearl-street Station underneath the buildings, supply-ing buildings, Dr. Paxton's Temple, and part of the Post-office, and the result is the Edison Electric Light Company are lighted by Mr. Edison's system.

Yet it is natural that the inventor should meet with considerable opposition. The introduction of gas was at first bitterly opposed; and now that gas is generally in use, in torn spots the introduction of the electric light. How strong that opposition is, may be judged from the enormous power at its back. It is computed that about ten thousand millions of dollars are invested in gas all the world over. Of this amount about three hundred and eighty-five millions are invested in the United States, and about one hundred and five millions in England.

In selecting the down-town district for the first experiment on a large scale in this country, Mr. Edison had in view the fact that the greater the consumption of gas in this district, there is a good deal of steam motor power employed, which the Edison Electric Lighting Company propose to supplies by electric motor power from the same current which supplies the light. A second preliminary success of this district was the following statistics: There are in the district 18,000 gas jets, burning from five and six in the evening; 12 steam-engines, aggregating 3388-horse power; 212 boilers and 20 elevators, and 85 sewing-machines. Besides, the census elicited the interesting fact that the horse-power is used in the lighter manufactories in the evening. Eighty horses were, ever trouble in the big stories of buildings. Some of these horses are kept there all the time they are taken up until they die.

The central station of the down-town district is located at Nos. 255 and 257 Pearl Street. Much work was required before the buildings were ready for the plant. This consists of six dynamos, and the engine-room in the basement of the building is delicately four boilers, with an aggregate capacity of 1000-horse-power, Babcock fittings, two large steam-whistles, steam conveyors for coal and ashes, a fire-proof basement, and the engineering and boiler apparatus. The placing of these requires vaults under the sidewalk, and a trustworthy iron frame-work resting on a strong bed of masonry and cement-work. Each of the six engines has a normal capacity of 125-horse-power, and a maximum capacity of 200-horse-power, making a total maximum capacity of 1200-horse-power. A dynamo is placed in the basement of each building, three tons, so that the weight of the six is 180 tons. The weight of the frame-work and the dynamo apparatus will be about 300,000 pounds, which will be distributed as an average only about 200 pounds per square foot of structure. The boilers, with a total of 1400 horse-power, will consume 100 tons of coal and 4,200,000 gallons of water per annum, or practically a daily consumption of about five tons of coal and 11,500 gallons of water.

A full description of the dynamos belongs to strictly scientific periodicals, and would fail to interest the general reader. Of the machines we can but an expert. They consist in the main of field-magnets energize, between the poles of which an armature or inducing coil is revolved by the use of belting. From the armature the electric current flows through the conductors in the pipes laid in the streets at water flows through a main, and similarly it flows from whatever point the electric current may be required. The supplying or extinguishing of any number of lights in the circuit. A supplementary indicator is shown in the burning of a number of "full lights" in the regulating room.

The laying of the pipes and incidentals proved an interesting and popular feature of the work. The writer remembers how much curiosity was excited early in October last by the queer-looking iron rod boxes that were being piled up on the sidewalks of Gold, Spruce, and William streets. Walking down Spruce Street one afternoon a number of people gathered at the corner of Spruce and William streets having run into a hole. The hole a few feet below the surface was an ample size, and was supplied with man-wrapper. But there was no one to explain the reason of the caliber of the hole or of the box. Soon some curious along and began filling up the hole, but still no information to give. Long before Spruce Street, though, the writer saw that the pipes were being put in on Gold Street. As he approached the spot he now knew similar to that in the hole in Spruce Street piled up. Extra hands on the roadway on either side was dug up a few feet below the surface. A man was talking about in the ditch with a tape measure, and several others were unloading the iron pipes, fitted with the thick pieces of metal projected. When an iron box was lifted into the ditch the writer saw that it was divided into three parts. The middle one contained the pipes which were to be laid in the street, and the two outer pieces of a chair of the city boarded by Sanna, Wall, and Spruce streets, and also East River, and that Mr. Edison, one of the engineers of the company, could explain the purpose.

"Those pipes are ordinary gas pipes which insure their strength," said the engineer, "and the iron box is to protect the pipes lying on the sidewalk—expressed from the cellar to the building entrance. Five kinds of boxes are employed, each in size, and used. They are about a foot long, the inches wide, and one deep. They are respectively junction boxes, coupling boxes, corner boxes, service boxes, and a combination of the coupling and service boxes. The simplest of the boxes is the junction box, in which the connection between two pipes is made. The coupling boxes are set into the sides of curbing, the pieces of metal projecting from either side being connected by the coupling. In the service boxes are connections with the house pipes filled up with a molten insulating fluid, which is poured in through a hole in the top of the box, and closed. The combination coupling and service box is used in the case of a corner house, and requires a third, through which the wires are "served" to the house.

The safety box is an ingenious contrivance to protect the wires from the heat caused by accidental crossing of the wires. The principle on which it works is that when the wires cross they do so accident, the damage caused by the crossing heat is confined to the safety box. In the safety box the fuses of copper wire are interrupted by lead. Although the commencement with the crossing of wires, the heat runs along to the lead and melts it. Then the circuit is broken, and no damage occurred. These boxes are on the corner of every street, in the houses from the sidewalk, and on inspection of these shows whether or not the wires along the line are illuminated. Similarly the junction boxes the lines cross at the corners.

The lamps in the private drive terminate are the Edison incandescent Lamps. Each consists of a glass globe about the size of a large pear, with no to height, exhausted of air, into which is mounted the filament of carbonized bamboo fibre or thus a horse-hair. This filament becomes incandescent when the electric current passes through it, and emits a soft white light. The lamp is fitted into a socket, which is mechanically attached to a chandelier or bracket of a design or to suit the taste of the house. The lamp is simply screwed into the socket, needs no further attention, and, as has been shown, breaks. That is a few seconds it is unscrewed and replaced by a new lamp. The cost of a lamp, besides, is about 80 cents. The cost of the electric light is divided, worked out the question in two different ways. In the former firm, subject to the Boulevard three-cylinder engine, and the coupling it direct to the axis of the dynamos, the supplementary engine-power which may be required. Messrs. Siemens Brothers, on the other hand, considered that in an electric installation, which must necessarily consist of some small, but plenty of itself, was better without the addition of an engine driving direct, and which therefore Mr. Bewsnth, their representative in Manchester, devised a new form of rope transmission, which has been extensively and successful in practice, having been applied in twenty-three instances, among which may be mentioned the steamships City of Rome, City of Paris, Alaska, Arizona, Aumala, Umbria, and Servia. In connection with the space, as the machines and the motors can be arranged very near together and give no trouble in working. It has the further advantage of permitting the use of ordinary engines, either of the vertical or horizontal type, which require no special skill to manage them, and of speeds which do not give rise to tremor or vibration.

A grand electric light-house, having an elevation of 60 meters, is about to be erected at Point de Grave, near St. Antoine-sur-Mer, and will be one of the chief lights on the mouth of the Seine.

At Cannes, on the 4th of April, on the occasion of the International Regatta, there was a grand display of illuminations and electric lights. From 8 to 10 o'clock at night, the boat-sheds of the Mediterranean Nautical Club, the Navarre, the Trident, the Napoleon—the Navarre, the Hendre, and Ocean, the Rallumeurs, the Nautique, the Revenge—and the Lauches Hirondelle, Cygnet, and Hyeres, lit up with their powerful electric lights the City of Cannes, the adjacent islands and the neighboring hills. Immense searchlights, red lights and Mangin projectors were used.

International Electrical Exhibition—Vienna, 1883.

In the course of last month the applications have so much increased that it will not be to follow by continuing our sketch the chronological arrival of the announcements, in order to set on the importance of the Vienna Electrical Exhibition for the progress of electrotechnik in the right light.

We begin with the application of S. Schuckert, at Nurnberg, who, besides a great number of dynamo electric machines for electric lighting and transmitting power, with a great many incandescent lamps and arc lights, will exhibit a telephone machine for coal mines, driven by electricity; the locomotive lamps of the Austrian electro-technical girl, Hermann Sedlaczek, dynamometers, etc. Alexander Kovacs, from St. Petersburg, promises to send a set of his instruments for the department of galvanoplastic, and G. L. Hagen, from the Hague, dynamo-electric machines, instruments for electro-technic measurements, electric lamps and lights, and an electric motor-carriage power, novelties which have hitherto been seen in no exhibition. A. Volsinkel, from Moscow, announces, besides a series of instruments for electric measurements, a dynamo-electric machine for producing differential lamps on a new system, telephone stations, and a new kind of switching and distributing electrical apparatus. The machines to fire mines by electricity, by A. Borsholdt, at Hamburg, will be exhibited in working order. Chimes to fire a mine, manufactured by the Royal Artillery Technical Committee, as well as the Infantry Committee, as well as the Infantry Committee, as well as the Infantry

ELECTRIC LIGHTING MISCELLANEA.

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The Maxim-Weston Electric Company are in sad straits. The shareholders have passed a vote of censure upon the Directors, by not accepting the accounts; and, as a result, an adjourned general meeting has been held, wherein the Board tendered their resignations *en masse*. The next step to be taken will therefore be to elect new Directors, and the meeting has been adjourned for this purpose. All the subscribed capital has gone in various ways chiefly for patent licences), and more is wanted; but the shareholders will not give it, and the friends of the old managers, while still be the end of the difficulty cannot be foretold; but it is almost amusing to read that the former Chairman (Admiral Inglefield) tried to calm the angry proprietary by showing them the gold medal that he had received at the Crystal Palace on the previous Wednesday week for the Company's exhibit of last year. Unfortunately for him, the shareholders would not regard this pretty bit of metal as an equivalent for all the thousands of sovereigns that have disappeared under the Board's management, never to return. It is at least to be regretted that every shareholder could not receive a medal for himself by way of memento of his lost property.

amperes at the outset, falling gradually to 0·3 amperes, or six-tenths of 0·45 amperes. But a current of this intensity requires theoretically the consumption of 11·94 grms. of zinc hourly per element. It is always possible that the actual result may fall short of theory, but here we have a discrepancy exceeding 100 per cent., and it is therefore to be desired that Mr. Trouvé would carefully repeat his experiments, so as to obtain more probably figures. Nevertheless, it may be lost to modify the conclusion which he has believed, it possible to draw in his former remedy."

Bells Unpower Machines.

Editor Electrical Review:

A good invention will survive all adverse comments thereon, and, were it not for several extraordinary misrepresentations in reference to my unipolar dynamo electric machine, I would have allowed all criticism to pass unnoticed.

Objections have been made to the use of the name "unipolar," but not a single sensible reason has been given, why it should not be used. My fundamental invention consists in the employment of a conductor coupled at one end with one pole of a magnet, but I find it an advantage to utilize both poles of a magnet and therefore employ two armatures, one with each pole. The two poles can be on opposite sides of the same disk or drum armatures.

It seems to me that it is far more appropriate to apply the said name to my machine than to that of Siemens and Haiske, in which two copper conductors are coupled at the ends in connection with two magnets, each cylinder revolving between two poles (one of each magnet) of opposite polarity.

I am often results, and cure nothing for names, and if any one can suggest a more appropriate name for my machine I will be pleased to adopt it.

None of my machines have been placed on the market in this country, and only a limited number of machines of the first pattern have been made in Canada. Having the expectation of exploiting, who appreciate the importance of a first-class and complete system of electric lighting and motive power, there has been no necessity for placing an incomplete system on the market in this country.

The criticism of the *Electrical World* on my machine is simply misrepresentation and theoretical blunder, as experience will demonstrate. That the expert of the said paper is a mere theorist and book electrician, is quite evident from his comments on electric lighting, which contain nothing new, being nothing more than a rehash from other writings, and in which I can say from experience will stand any inventor or electrical student, if closely followed. I owe no success to the fact that I have ignored the old theories, in reference to the action of the sing armature and lines of force.

Adverse criticisms upon my machine have, naturally, been expected, for the reason that nearly every electrical writer has become so thoroughly imbued with the old theories, in reference to the action of the ring armature, that it is difficult for them to quickly comprehend a new discovery that is diametrically erroneously been governed by one of Faraday's experiments (1832, par. 1867, in which he employed a rotating copper disk between the two poles of a magnet, and found that when the it rotated over one pole than the other that the effects obtained were by no means so powerful as when it rotated equidistant between the two poles. (Faraday's Experimental Researches, 3197.)

In one of my own experiments, similar to that of Faraday, I found that just the opposite effect was produced in a ring armature, and also that the best effect was produced when one pole was altogether discarded, thereby demonstrating that there is a great difference between the copper disc used by Faraday and the armature of the present day.

Furthermore, I am prepared to disconstrate the importance of my unipolar discovery by making a compositive test with my bipolar or multipolar electric generator in the market.

The New York *Electrician* in referring to my machine says:

"The arrangement shown also involves mechanical difficulties which must prove very serious. It will be observed that by presenting only one pole of the field magnet to each armature, the armature is powerfully attracted toward the pole, and the whole strain of this attraction is brought to bear immediately upon the armature shaft."

The fact that not the least detrimental effect has been experienced with the armature shafts of any of the machines which have been in constant use in Canada for over two years, is sufficient evidence that the above opinion is of no account.

The following misstatement by the same journal:—"Some of the machines with the ordinary bipolar field and a single armature, which are now in common use, show a net efficiency of over 90 per cent."—also needs correction.

The most net efficiency (the proportion of power accountant for in the lamps or external circuit) of the four best high tension machines (Burgin, Gramme, Siemens and Weston) at the late Paris Exhibition is 42.8 per cent.

The net efficiency of my unipolar machines of the first pattern, as tested in England, is 39 per cent., being the highest of all high-tension machines, while my latest improved machines have given results as high as 50 per cent. It is said that Edison claims a net efficiency of 80 per cent. for his dynamo machines, but it must, however, be borne in mind that it is only used for incandescent lighting, and that his copper conductors are coupled in series in a low-tension machine than in one adapted for arc lighting.

The armature of the machine now in London is only 8" in diameter, and consequently will run at a high speed. The revolutions of an armature can be lessened to any desired number by increasing the diameter thereof.

The periphery speed and not the revolution of an armature is the important factor.

Mr. Rankin Kennedy in a communication to the *London Electrical Review* of the 7th ult. says:

"That it can hardly be claimed as a discovery of any kind, as it is well known that one pole of a magnet can generate currents in a rotating Gramme bobbin."

Other writings have also been discovered to claim that I have made no discovery by citing experiments made by Faraday in which he employed a copper disc rotated nearer one pole than another, and also to the experiments in which he employed a copper disc in one pole of a rotating permanent magnet. In both instances very weak currents were, however, generated.

It is quite evident that Mr. Kennedy and other writers have misconstrued the import of the fact that the best results are obtained in a ring armature when it is subjected to only one pole of a magnet.

The electric generator devised by Mr. Kennedy with its employing a ring armature with four pole-pieces as shown in the *London Electrical Review*, of March 17, 1883, fully confirms his ignorance of the said fact, as it is the most unscientific machine that I have invented.

Mr. Kennedy and also the expert of the *Operator and Mail* further show their complete ignorance of the subject, the former by suggesting an electrical wave, in connection with two like poles, which he terms the true unipolar principle, as an answer to my claiming as an anticipation of my invention the carbon regulating mechanism of the arc lamp devised by M. Tchikoleff, a Russian, in 1876, which consists of a ring armature employed as a source of electricity, with four pole-pieces of like polarity, the magnets of which being in two parallel circuits.

It is quite evident that if the said lamp regulating mechanism had suggested the advantages of employing an armature with but one pole, that all inventors would not have been working in ignorance of the said advantages since 1876 by constructing bipolar and multipolar generators.

I cited the experiment of an armature with two like poles about four years ago and discarded the arrangement on account of the unsatisfactory results given.

I will add that in the opinion of present patent experts who have thoroughly examined the matter this alone is novelty in my invention, and that the bread claim of an armature with one pole of a magnet allowed me by the Patent Office.

C. E. BALL.

New York, May 14, 1883.

Triumphant Over All Obstacles.

THE ELECTRIC LIGHT FORCES ITS WAY INTO THE STAID CONNECTICUT CAPITAL.—THE PART THE PRESENT AND THE FUTURE.

HARTFORD, Conn., May 8, 1883.

The unexpected boom that has been given to electric lighting in this city within the last few weeks is attributable to three causes: A long delay since a company was first organized, and through the press and otherwise made very big promises which amounted to naught; a growing feeling of mortification that Connecticut's sole capital should be behind her sister cities of smaller size and less resources in exhibiting herself of this great illuminant, and a general dissatisfaction with the gas furnished by the local company for both public and private lighting purposes. As regards the latter reason the Mayor voiced the public sentiment when in his last message in which he declared that the lighting of the streets of the city has not been satisfactory in any respect.

At any rate, we have got the electric light now, and it has come to stay. It is not simply an experiment even here, for its practical value is fully established, and our streets are now the ceiling for the lamps faster than the company can put them in.

The American Electric and Illuminating Company of Boston have just completed their contract for the 200 lights ordered, and have now contracted for a plant of 100 more to be put in by the latter part of August, or earlier, if possible. Eight years ago the same company put up their first light, and the extraordinary advance they have made since is in spite of the strongest opposition. But perhaps a brief retrospect here would be in order.

The present company was chartered in 1881, just after they got their interior wires laid in more of them until 1882, when they came up again asking for more privileges. Inquiries as to their standing were made, the substance, that they were in no particular hurry, but were waiting for some more capital to be put in. Connecticut like, they were willing to let other cities do the experimenting, and they would reap the benefits of that experience.

It was the opinion of some of the stockholders, too, that simply an arc system would never pay here, and that it was best to wait until some other incandescent light should be devised; but it was coming, oh yes, it was coming; but patient as a few others" Micawbers while the gas company people were laughing in their sleeves. But last fall matters of a different complexion began to take definite shape. Then the stockholders woke up. A meeting was called, considerable stock was taken, and on the following officers elected: Mr. A. G. Dunham, President; Mr. H. H. Starkweather, Vice-President; Mr. Howard M. Clark, Treasurer; Mr. S. G. Dunham, Secretary; Mr. G. L. Hubbell, Superintendent, and before the people were fully aware of it a building for this purpose was up.

The American Company were so thoroughly convinced that the investment was a good paying one that they took out in stock most of the expense of putting in the first plant, and are well represented in the management of the company.

The plant is in every way fully up to the manner in which our people usually do things; consisting of four dynamos with a capacity to feed fifty lamps each, run by two beautiful 50 horse power Armington & Sims engines made expressly for this purpose.

The company made a bold strike in the first place by putting in twenty lamps at the Union depot, where everybody would be most likely to see the light and judge of its merits. Of course the gas company fought this home-shot tooth and nail. They even offered to light the depot for nothing if the electric lamps were kept out. But up they went, and the public came, saw and were conquered. The company have succeeded even beyond their expectation. The leading merchants generally demand the light. The prices here are lower, I believe, than in other cities—it costs a single lamp per night, say 60 cents for two or more; and this is done at a fair profit.

The principal obstacle so far has been in keeping the wires. The street commissioners don't want to give permission to put up poles in the streets. Thus far the wires have been carried over private houses by arrangements with individuals, but the consent of most of them was hard to get, and then only on condition that the wires should remain but temporarily. But the company have established a precedent to assume the responsibility of lighting the streets, which, if accepted, will of course carry with it permission to put up poles. There will be in place 400 gas lamps with 100 electric lamps, and to illuminate the outlying streets with improved naphtha lamps. This will do for a starter, and moreover they agree to furnish lights every night in the year, and every week in the year for $9,000 less annually than the gas company are receiving, for there is a strong public sentiment back of it. Singularly enough no part comes from an unusually wealthy and aristocratic quarter—the Hill—and for a purely selfish reason. The young people out there are particularly devoted to lawn-tennis and croquet parties, largely gotten up by the Trinity College students, and moonlight excursions are arranged. To hold these early in the afternoon is very inbeen in spite of the strongest opposition. But perhaps a brief retrospect here would be in order.

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[May 8, 1883.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

ELECTRIC LIGHTING MISCELLANEA.

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[SEPTEMBER 7, 1883.

NEW YORK HERALD.

THE LOUISVILLE EXPOSITION

What It Has Accomplished and What Its Influence Will Be.

A TALK WITH PRESIDENT DU PONT

The Coal Mines and the Art Collection—The Coal Beds by the Lean of Northern Pastures.

Mr. B. Du Pont, President of the Southern Exposition, at Louisville, is in the city, his particular mission being to secure reduced rates to Louisville during the remainder of the Exposition. Yesterday he put the case before Commissioner Clark, and the representatives of the various trunk lines. An agreement was soon whereby half rates during to Louisville will be sold on certain days.

A Herald reporter asked Mr. Du Pont how the managers were pleased with the prospects of the Exposition.

"The managers have every right to be satisfied with the situation," he said, "We expected an large attendance in August; it was to be the month of vacation, but the opening was made a week remarkable to it, and it has been well done. The exhibits are all in place, and the attendance, especially during the past two weeks, has been large. In the course of a week or ten days a number of additional persons visited the grounds. In September and October we expect a large increase."

"What are the distinctive features of your Exposition?"

THE DISPLAY OF SOUTHERN RESOURCES.

"It is an exposition of the resources of the Southern states, and the display of raw products from the field—of grain and grass, of wood and coal and minerals—is unequalled in the country. Our agricultural machinery is second to none, and the mechanical exhibits are very good. Besides all, the city itself invites to the fact that business opportunities are to be found here, and the fact that the Exposition is a success is evidence that the people are alive and willing to supply it. It is the statements of the exhibitors that the Exposition is a success, and it is more interesting to visitors than that of any other in Philadelphia."

"Are you better enabled to light the buildings by electricity?"

"The buildings are very extensive, including, with the corridors, about seven acres under a park, making in all forty-five acres to be lighted. In the Philadelphia Exposition the buildings were not connected, and the lighting was done with the electric arc. The effect is wonderful, and to the art gallery it is particularly fine, but it is not adapted to the use of the Louisville Exposition, for the reason that in the United States gas light, in addition to all this, several times more illuminating power than in Philadelphia, and on the grounds, and no one would be willing to pay for electric lights when gas-lighting is to be had everywhere."

THE ART LOAN COLLECTION.

"The pictures are a magnificent display."

"It is difficult to estimate in pecuniary terms the grand show by this loan collection, for which we owe to Mr. Clark, of New York, and Mr. Corcoran, of Washington, and other gentlemen. Nothing greater can say on Saturday afternoon when the great collection is packed, except the pleasure to get into the building. It is a constant succession of pleasure. The collection is a most valuable one, and the exhibition of it is a most valuable feature of the Exposition; at the kindness of our friends in the East we owe it to the fact that the Exposition is the second occasion of any will be held in the country, and on this account, as well as because of the value of the collection, it is very fine."

"Are you satisfied with the coal beds, which, it was said, when we were in a country and mine, and were found, anything else of interest, Mr. Du Pont?"

"Yes, in every particular, will be the chief benefits derived from this Exposition?"

"The benefits will be answers to the expectations of the managers. The coal beds and the capabilities of the country are known, and beyond all doubt. It is the idea when the people of the North and South will meet socially rather than on business, and the result will be a better feeling between both sections. Louisville is the border land. It is half-way between the North and South, and the people of both sections meet here. The Exposition will be a success for such a reunion, where the people of each section can meet on common ground. The Southern districts was selected for the Exposition, and Louisville as centrally the figuring of the South, and the people of the North and West will come here in the same spirit that they would go to Philadelphia were years ago may be induced to visit Louisville, and the people of the South will go to Philadelphia seven

AUGUST 1, 1883.

NEW YORK DAILY TRIBUNE.

THE SOUTHERN EXPOSITION.

THE OPENING TO TAKE PLACE TO-DAY.

DESCRIPTION OF THE BUILDINGS—ARRIVAL OF THE PRESIDENT.

[BY TELEGRAPH TO THE TRIBUNE.]

LOUISVILLE, Ky., July 31.—Yes, the Southern Exposition will be one of the largest affairs of the kind that have ever been held," said General Manager Wright yesterday. "Our main building has only been extended in order for the principal building for the great London World's Fairs and by the main building of the Centennial Exposition. It is a great deal larger than the main buildings for the Paris and Vienna Expositions. Without counting the space occupied by its annexes, it covers over thirteen acres."

The Exposition building is a handsome structure, light and airy in architecture, and admirably adapted for displaying exhibits of the best advantage. The building is quadrangular in form, and incloses four court-yards, each of which has a large central fountain bordered by tropical plants, and broad tan-bark walks winding through a bright carpet of grass. At night the building will be lighted by 4,000 Edison incandescent electric lights, connected by more than forty miles of copper wire. The park and court-yards will be lighted by the Jenny arc light.

A whole army of busy workers have been scattered through the building, and gayly decorated booths have been erected in all directions. Exhibits of all kinds have been ordered in position. The immense engines for driving the machinery that fills more than one-third of the ground floor have been set up and tested. The great organ is completed, and a rehearsal of the Louisville chorus, consisting of five hundred voices, has been held. During the Exposition, organ recitals will be given by Messrs. Morrison, of New-York; Whiting, of Cincinnati, and Dottier, of Baltimore. Per the first fifty days of the Exposition, Capoul's Seventh Regiment Band will give daily concerts, and for the last fifty days, Gilmore's band will furnish instrumental music.

THE GROUNDS AND THE BUILDINGS.

The grounds of the park in which the Exposition is to be held, comprise eighteen acres, in which there is to be found a fine collection of forest trees. There are a hundred and fifty varieties of trees, flower beds with hundreds of varieties of blooming plants, fountains, summer-houses, mock-castles and rustic monuments. An electric railway makes the circuit of the grounds.

The agricultural department has a particularly interesting exhibition. On grounds south of the main building a small "farm" has been laid out, in which are growing the various species of farm and garden products cultivated in this climate, besides many from other parts. There are large fields devoted to cotton, tobacco, sorghum, flax and sugar-cane.

The art gallery is a handsome fire-proof building in the form of a cross, situated at some distance from the other buildings, in a pretty grove of trees. The walls are of brick covered with cement; the roof is of iron and glass and the floor is of cement. The building is substantially built and will be one of the coolest places in the Exposition grounds. The art display will be exceedingly fine. Among the contributors to the loan exhibition of paintings are August Belmont, George L. Rives, H. V. Newcomb, D. O. Mills, James H. Keene, ex-Governor Cornell, John Hay, W. H. Stevens, John Ogden, J. Pierpont Morgan, and R. G. Dun, of New-York; James L. Claghorn, of Philadelphia, with local contributors (General Sherman will lend seven rare old Gobelin tapestries, General Grant, his large collection of curios and souvenirs; Samuel J. Tilden, the statue of Pluto, from his house in Gramercy Park; Mrs. Potter Palmer, of Chicago, a large collection of bric-a-brac, and many others will contribute pictures, statuary and other works of art. The American Art Union collection of pictures—comprising 153 examples—will occupy an entire wing of the art gallery. The portion of the exhibition will be under the management of Charles M. Kurtz.

ACCOMMODATIONS FOR VISITORS.

Visitors to the Exposition will probably find little lack of accommodation at the numerous hotels here, which promise that their rates will not be increased during the Exposition days. Those who wish to remain in the city for solid time, however, and who would prefer furnished rooms or boarding-houses to hotels, will have poor opportunity for choice accommodation, except at extortionate rates. Rooms that could be rented all winter at from $6 to $8 per week, ordinarily, are now held at from $2 to $3 a day. Many families will vacate their dwellings in the city while the Exposition is in progress, in order to rent the rooms are owned. Of these there are a large number. Few of them are lighted with gas because gas is too expensive, and there is generally a stipulation that the tenant shall not use it. Water is also scarce, and hard rooms are scattered in half of the single-story houses, and water often can only be obtained from hydrants in the back yards, which are shared in common. The rents, as a rule, are exorbitant, and their charges are high, but honestly say that, with an occasional exception, the only rooms about ever to a tempted years, and they intend to make the most of it. Most of them seem to think that the rents will be paid, be obtained after the Exposition is fairly opened.

THE EXHIBITS NOT ALL READY.

All last night and Sunday more than 2,000 men worked without ceasing in the Great Southern Exposition, and exhibit after exhibit sprang into place, beauty and completeness. The displays are not all ready; but the blame is upon exhibitors and not upon the management, which has done all it promised and more, opening the building for the reception of exhibits a week sooner than was originally intended. The goods of many have been in transit, consignment, arriving, and within ten days the display in the Exposition will represent every variety of industry in the South and every prominent manufacturing interest. No laborer will be employed on Sunday hereafter. All national, State, city, military and civic guns will be fired, and the main building, are numerous bands and other features of interest will not be allowed by the management.

The exposition is bound to be a success. The people of the South, reduced as Atlanta is years ago, appreciate to its full value the opportunity, afforded them, and every Northern State is represented by displays of great or less magnitude, while the people promise to come in great throngs to meet their more prosperous brothers of the North.

At 11 o'clock this evening President Arthur and his party attended a reception to Terry Belmont, Governor Blackburn, Governor Carter, Governor Foraker and Presidential party at the Galt House. Visitors attended, among others General and Mrs. Sherman, Mrs. Logan, Mrs. Sheridan, President G. D. Shepherd, of the Louisville and Nashville Railroad; General Harvard and H. H. Green, of Boston. The attendance was large and the entertainment brilliant.

ELECTRICAL REVIEW

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE, TELEGRAPH AND SCIENTIFIC PROGRESS.

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WEEKLY.

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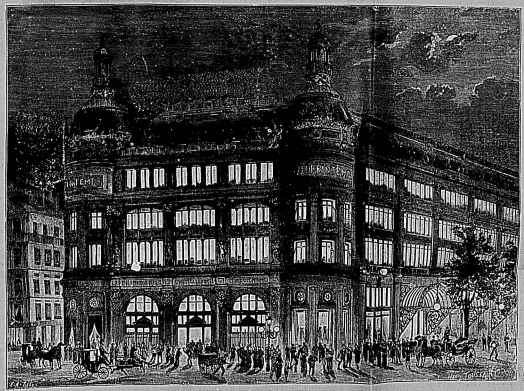
The Electric Light in the Grands Magasins du Printemps.

(Translated for the ELECTRICAL REVIEW *from "La Lumiere Electrique.")*

Thanks to the rapidity displayed in the reconstruction of the great dry goods store called the *Magasins du Printemps*, this vast establishment is now in full activity and the terrible catastrophe of March 9th, 1881, has permitted the replacing of the buildings which occupied nearly one-third of the block on the boulevards on the side of the building on the Rue de Provence, where the gallery was being raised, which terminates in the pavilion at the angle of the Rue Caumartin. These gallery, as well as the pavilion, which is symmetrical with those of the principal front, and will correspond with that which is to be constructed at the fourth angle—between Haussmann and Rue Caumartin—were begun in February last and finished four months afterward.

Our engraving gives a general view of the building, and represents it with all the elevations shown in our engraving, and which terminates the angle of the great quadrilateral of the Boulevard Haussmann and the Rue Caumartin, that can only be begun after several stories, now occupied by merchants with unexpired leases, can be taken possession of, either by expiration of the leases or by accepting the heavy indemnities demanded of the founder.

When this latter portion shall be completed, all the service will be organized on an immense scale, and that, with which we are specially occupied—the electric light—will present a general installation certainly unique in the entire world. We can judge of what the effect will be when it is finished by the one which we already have been accustomed under the numerous difficulties connected in the hasty construction of such a magasin. In fact, up to the present time, the steam engines and dynamo machines have been installed wherever room could be found in the rear of the unfinished basement. Of course, the arrangements are only temporary, but nevertheless, the quantity of light furnished is very considerable, since there are in use 10,000 Jablochkoff candles and 112 Mo-



THE ELECTRIC LIGHT IN THE GRAND MAGASINS DU PRINTEMPS.

bounded by the Rue du Havre, the Boulevard Haussmann, the Rue de Provence and the Rue Caumartin, by a magnificent palace consecrated entirely to Her Majesty, *The Fiakers*.

In July, 1881, the foundations of the principal front, on the Rue du Havre, were commenced, and this portion of the building was far enough advanced in October, 1882, to allow the storing of merchandise. We published in the number of March 25, 1882, of this journal a description of the state of progress of the work at that time, and a perspective view showing the electric light in its fullest activity. The effect produced by this gigantic glass edifice is truly extraordinary, and the whole neighborhood appears as in broad daylight, notwithstanding the effect of this powerful electric illumination. The engraving shows the front on the Boulevard Haussmann, as it will appear when completed. It is not, however, finished, for since the month of April, 1883, the portion which is on a level with the awnings is still occupied by the workmen, and is open to the sky. It will not be until 1884 that the galleries, as well as the grand nave, can be opened. As to the latter portion, which is now shown in our engraving, and which terminates the angle of the great quadrilateral of the Boulevard Haussmann and the Rue Caumartin, that can only be begun after several stories, now occupied by merchants with unexpired leases, can be taken possession of, either by expiration of the leases or by accepting the heavy indemnities demanded of the founder.

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dynamos with alternating currents, each one furnishing twenty lights, a combination certainly unexcelled. At the apex of the Mansion lights; on the other side four new alternating-current machines for twenty lights each and Gramme continuous current machines to actuate the numerous incandescent lights.

The supply of steam for the greater part of these motors is furnished by horizontal Belleville boilers; and in the final installation when completed there will be eight of large size and six smaller, which will supply four Creusot engines, developing a total force of 800 horse

APRIL 5, 1883.

THE MONTREAL HERALD, AND DAILY COMMERCIAL GAZETTE.

THE EDISON LIGHT.

At the present time, when a recent leading event has been the inauguration of the Edison Light at the Canada Cotton Company's works at Cornwall, a few words on the subject may not be out of place. Mr. Edison, it may be remarked, if not absolutely a Canadian, claims relationship with the Province of Ontario, where his parents were born, his mother being of Scotch and his father of Holland-Dutch origin. Moreover, there is good reason why we should take some interest in the Edison Light enterprise, since the charter of the Company, which is operating in Canada, specifies that every portion of the lights must be manufactured in the Dominion, and, in consequence, every part of the lamps exhibited on Tuesday was manufactured in Hamilton, Ontario; and, according to the inventor himself, they were as fine specimens of his lights as he had ever seen—a proof that there is little, if anything, which it is impossible for Canadians to do. The Cornwall lights are the first of this patent and upon this scale which have been operated in Canada, and that their inauguration test should have been so satisfactory cannot fail to be gratifying. We learn that already there have been a hundred and twenty applications made in Canada, principally for large circuits, embracing extensive and influential establishments. It is not long since that parties in New York, who professed to be among the knowing ones, admitted their inability to understand why more rapid progress was not being made by Mr. Edison, the Brush and other companies seeming to have gained the advantage over him. However, since then he appears to have amply made up for lost time, both in America and in Europe. In New York there are already 700,000 lights in operation, between 1200 and 1300 factories and mills having adopted the system, while in Europe, including the Russian navy yards at Dantzic, there are a very large number of lights employed. On board ship they have been found to answer every purpose, among the latest satisfactory tests having been on board H. M. S. "Thunderer," where the concussions incidental to gun firing have no visible effect. According to Mr. Edison's own statements the intention when he began his experiments in 1878 was to supersede gas as an illuminator by means of electricity and in this he claims he shall succeed, inasmuch as he expects to be able to produce the equivalent of 1,000 feet of gas for eighty cents, although he would not care at present to supply the light at such a low price. He anticipates that although his electric light is already the cheapest and most perfect illuminator yet discovered, experiments on which he is now engaged will go still farther to reduce the cost. The inventor avers that his light as contra-distinguished from that of some of his rivals is perfectly harmless to life and property, since the wire he employs, if the heat become too intense, will burn, and destroy the current immediately, extinguishing the light. Further his lights are on low pressure, not exceeding "110" volts, while the arc lights frequently rise to over 2,000. His sixteen candle lamps he considers to give light equal to that supplied by the consumption of eight cubic feet of gas per hour. Nevertheless he does not appear to think that gas companies will materially suffer by the perfecting and operation of his invention, as he believes that eventually gas will be found to be the cheapest fuel and illuminating power. His lamps are understood to cost only about a dollar, their average life being 800 hours, although some of them attain as much as 3,000 hours. An advantage of the electric light is that it will burn anywhere, immersion in water failing to affect it in the slightest degree. The inventor deems it preferable and more economical to operate his lights in sections of a square mile. Mr. Edison seems to think that in Canada there is an immense field for the use of the electric light, particularly in sections which are too limited to make it profitable for gas companies to operate. Unquestionably there is a future for electricity, whether as an illuminator or in other respects of which we none of us have more than a faint conception; and, therefore, the greater is the interest that attaches to every discovery connected with it. Electricity as a vehicle of sound communication, electricity as an illuminator, electricity as a medical adjuvant and electricity as a motive power, are subjects with which we already have some acquaintance, but we are inclined to think that we are but on the threshold of what will be discovered and perfected just at the time when that knowledge can become a power and serve its purposes. We do not say that Mr. Edison is going to accomplish all this. He is one of many who have experimented with a greater or less amount of success. Nevertheless, whoever shall be the means of bringing this agent under the greatest amount of control, and shall obtain from it the largest amount of service, is the one who will be regarded as the greatest benefactor.

FEBRUARY 12, 1883.

THE DAILY NEWS,

ELECTRIC LIGHTING AT HAMPSTEAD.—There is every probability that Hampstead will be the first parish in the metropolitan area (outside the City boundary) to have its streets lighted by means of electricity. At the last meeting of the representative vestry of that parish, the Rev. S. B. Burnaby, M.A., vicar, presiding, the vestry almost unanimously approved of the action of its electrical committee in instructing the solicitor to request the Board of Trade wholly to reject the scheme of the Metropolitan (Brush) Electric Light and Power Company, on the ground of the "unreasonable and oppressive character of its provisions," but with regard to the scheme of Messrs. Ferranti, Thompson, and Ince, which was "neither unreasonable nor oppressive," only to offer such "opposition" as was necessary to ensure the insertion of protective clauses for the parish. The committee had visited the works of Messrs. Ferranti and Co., and also a private house at Highgate, which was lighted by electricity by that company, and the result of their investigations appeared to be most satisfactory. It was considered a great advantage that Hampstead was the only parish which Messrs. Ferranti sought power to light, and it was stated that they would supply a thirty candle light for the price the vestry now paid the gas company for a sixteen candle light.—Major-General Young objected to Hampstead being the first metropolitan parish to make the experiment, but the vestry did not sympathise with this objection. It was further stated that the capital which Messrs. Ferranti proposed to expend in lighting the area of the parish they had selected was 78,000*l.*, whereas that of the Brush Company, which sought powers over the whole parish without being obliged to do anything, was only 1,869*l.*

ELECTRICAL REVIEW

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Charles E. Buell's System of Combined Telegraph and Electric Clock Circuits.

As early as 1841 and 1847, attempts were made to operate and control electric clocks at remote points from a standard controlling clock by means of an electric circuit.

New forms of electric clocks have multiplied since then, but no radical improvement, no effective working of clock systems developed.

The systems offered required the construction and maintenance of electric circuits, especially for time systems, and the clocks were so connected with these circuits as to require heavy batteries, and to be liable to become out of order by extraneous disturbances of the circuits, so that the expense and uncertainty of operating these systems defeated the attempts to introduce electric time systems, which would otherwise be in public favor.

We show in figures 1 and 2 of the accompanying engravings, how a system of time transmission can be combined upon the same circuit with a signalling or message telegraph system and avoid the expense of special wires and batteries, and the uncertainties and obstacles heretofore attending the attempts to transmit time over electric circuits where special lines and batteries were required and where a disturbance of the circuit deranged the system.

Referring to Fig. 1, there is shown a main line wire in which are included the relay electric magnets, *F*, *F*, and transmitting keys, *K*, *K*, for receiving and transmitting messages by a make and break of the circuit in the ordinary manner of Morse telegraphing.

The line so equipped is normally charged by the main battery *B*, the circuit being in part over the armature lever of the electro-magnet *A*.

There are also included in the main circuit the relay electro-magnets, *E*, *E*, which are adjusted to respond only to an increase of the force charging the circuit, and not to be made operative when the circuit is charged by the main battery *B*, alone, so that telegraphing upon the circuit does not cause the armatures of the relays, *E*, *E*, to be attracted.

An auxiliary battery *C*, is so connected to the main line that the depression of the armature lever of the electro-magnet *A* will interpose the auxiliary battery *C*. in the main line, together with the main battery *B*, so increasing the force charging the circuit as to cause the armatures of the relays, *E*, *E*, to be attracted, and when the armatures of these relays are attracted they close the local circuits, shown connected therewith, and make operative an electro-magnet that is adapted to set the hand on each clock to XII, if it should be within a minute of that time.

The electro-magnet *A* is controlled by the regulator clock, which is adapted to close the local circuit that includes said magnet, every hour, or every twelve hours, as may be preferred, and to hold it closed long enough to send out an impulse from the battery *C*, to set all the clocks along the line.

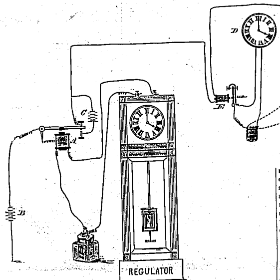
Clocks are used that are wound by hand or automatically wound, and are adjusted to a fair degree of accuracy in the ordinary manner of adjusting clocks, and thus set to correct time over a line used for other purposes if they should have gained or lost within the twelve hours.

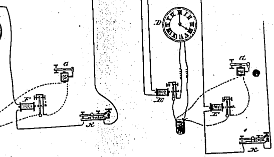
The clocks being controlled by the local battery employed to work the sounders, *G*, *G*, and being arranged to be controlled only at a period of time when the hour-hand of each is within one minute of XII, they are not liable to any of the extraneous troubles that have been heretofore met in attempts to work clocks over electric circuits, and as they do not depend upon a strength of current over the main line to perform the work of moving the hands of the clocks, but simply a strength of current to attract the armatures of the relays, *E*, *E*, they can be made operative over the longest as well as shorter circuits, and cheap clocks can be used with a certainty never before attained by very expensive clocks.

Fig. 2 represents a railway station with its telegraph office, and with a clock placed in view of the platform and of passing trains, both the clock and the telegraph apparatus being made operative over the same line that extends along the railway. The combined system of electric clocks and telegraph is the invention of Mr. Charles E. Buell, of New Haven, Conn., who has recently devised a system in which the clocks are kept in motion by local batteries, or batteries which consist of plates of metal buried in the earth, or from secondary batteries at each station that are charged by the waste current flowing over the main line, so that the clocks require no attention or winding up, and the clocks thus kept going are set at predetermined intervals to standard time over the line used for telegraphic purposes, if they have become too fast or too slow.

As the clocks would keep going, with a fair degree of accuracy, if the line wire should be broken for several days, and as the transmission of time signals is robbed of the expenses that have been necessary in other systems, this form of electric clock system must meet with public favor in this 19th century, when the entire civilized world is being run on schedule time, and are looking for absolutely correct time without constantly recurring expense and irksome care.

Every telephone and district telegraph line should be utilized to set clocks, which if done at 6 o'clock every morning or at midnight could not interfere with their other uses, and would admit of the most profuse distribution of correct timepieces with comparatively no expense over present uncertain methods.





CHARLES E. BUELL'S SYSTEM OF ELECTRIC TIME CIRCUITS.

Random Flashes from New England.

III.

THE JABLOCHKOFF CANDLES AT PRANG'S—THE BRUSH-SWAN ENTERPRISE—MINOR NOTES.

The Jablochkoff candle can be seen at but one place in New England. The New York organization has a branch office adjoining that of the N. E. Weston at 18 Post-Office square, Boston. Some time ago they sold to L. Prang & Co., the famous chromo firm, a six-light plant for special service in their factory in Roxbury. This isolated system deserves more than a passing notice. It is installed beside several Weston lamps, and the contrast between its steady deep-red glow and the bluish flash of the Weston is very marked. The current is furnished by a Siemens alternating generator, of the form which had grown out of the principle first illustrated in 1879, excited by one of his smaller machines. The dynamos are located in the engine-room, and take their power from the motors used for the general work of the factory, requiring 1,260 revolutions per minute.

Five insulated copper rings are placed at one end of the armature shaft, each of four of them connecting with the end of a section comprising four of the sixteen coils of the armature, the other four ends being joined at the fifth ring. Externally the four direct rings are connected by thick narrow copper springs or brushes, with the circuits to which the lamps are attached. Two of these circuits carry two lamps each, the others one, and the ends of all unite in one return wire to the brush of the fifth commutating ring. The brushes, being mounted on a movable standard, may be used as cut-outs, sending currents only through such lines as are kept in contact with the commutator. A hand switch on each lamp shifts the current from one of the six candles to another, as about once in every hour and twenty minutes a pair of carbons are consumed. Thus while

THE CHICAGO EVENING JOURNAL, MARCH 1, 1883.

THE ELECTRIC LIGHT.

The Aldermen Preventing Their Constituents from Enjoying Its Benefits.

Description of the Edison Incandescent Light, and of the Apparatus.

No Danger from Its Use—Its Advantages Over Gas—The Comparative Cost, Etc.

While Chicago is ahead of other cities, or up with the times, in most affairs, in the matter of electric lights it has been outstripped by small villages. This is not, however, because the advantages of the use of electricity have not been seen and appreciated, nor because our people are in this instance wanting in their usual enterprise, but the blame for the backwardness in the use of this invention is due almost wholly to the tactics of the City Council. Enterprising men have foreseen the future use of electricity in place of gas, and have formed reliable companies and put capital into the business, but they are dependent upon the Council for the privilege of laying conductors in the street before they can make any general introduction of the lights. The Aldermen, for

SOME OCCULT REASON,

have either refused to give franchises or have not acted upon the ordinances which have been presented to them, and people have been greatly inconvenienced thereby. For there are many persons, especially in the business center, who have been anxious to introduce the light into their buildings, but are unable to do so until some company has been given the privilege of laying conductors in the street. The majority of persons cannot afford to put in boilers and engines and all the apparatus necessary for the lights, merely to furnish illumination for their own buildings. Still, while the many are waiting for a company that shall be able to generate the electricity for them, there are quite a number of firms and individuals who have given up waiting for the Council, and have put electric lights into their premises independent of any company, or else, in co-operation with a few neighbors. Among these are J. W. Doane, Marshall Field, Edson Keith and O. R. Keith, who have the lights in their private residences on Prairie avenue; N. K. Fairbank, in his residence on Michigan avenue; the Calumet Club, the Academy of Music, the *Daily News*, the Palmer House, Rand, McNally & Co., Marshall Field & Co., National Life Insurance Building, McCormick Machine Company, Norton Bros.' and Clinton Briggs' flour mills, and the American Express Company. They are also being placed in Haverly's Theater. Mr. Haverly investigated the subject while in Europe, and decided on introducing the light for the reasons that it made a pleasanter light for his patrons, and was safer, so far as danger from fire was concerned.

It was also a matter of economy. It seems now to be pretty well established that, in the case of those having a surplus of power, this light can be attached to their machinery, and a large saving over the present prices of gas effected.

These lights are not such as are seen in the streets and in some public buildings—so bright that they dazzle one to look at or be near them. The latter are what are known as the arc lights; the light is of great intensity and concentrated; it is constantly changing color and is very trying to the eyes. The lights used in the places above-mentioned are only of the brightness of ordinary gas jets of the best quality; they are soft and steady, being what is known as

THE INCANDESCENT LAMP

(the invention of Edison). An ordinary five-foot gas-burner is theoretically equal to about twelve-candle power. The Edison burners in use in the places named are the normal size for dwellings, offices and workshops, and are equal to sixteen-candle power, or a seven-foot burner of the very best quality of gas. While this electric light is somewhat brighter than gas, and of a yellow and soft color, it has other advantages which gas does not possess. It is free from odor, does not give off any perceptible heat, and (as it is inclosed in a vacuum bulb) it is not affected by draughts of air, and can set fire to nothing. The flame can be held in any position, so that, with the aid of shades, the whole effect of the light can be turned and concentrated where desired. It can't escape and suffocate one. A lamp may be fastened at the end of a wire of any length, so that it can be carried about a room and used anywhere, in fresh air or the most poisonous, or in liquids. It will burn as well under water as out of it. The lamp does not explode, and even if the glass is broken the carbon merely instantly burns like a thread in the fire, and goes harmlessly out. Besides being unequaled for domestic and general illumination, the light is especially adapted to the workshop, because the light can be inverted and held where it will cast its entire light on the work, and it is so mellow that it will not hurt the eyes. When to all there is added the fact that the Edison light is even safer than the old-fashioned candle, the advantages of the lamp may be appreciated. With all these advantages it has that of economy. The actual running expense of sixty lamps of sixteen candle-power is 10 cents an hour, while that of sixty gas jets of seven-foot burners is 84 cents.

THE APPARATUS

used in generating and regulating the light looks complicated, but is really exceedingly simple. In fact, most of it has only to be let alone, and, once in place, it will take care of itself. The practical working of the lamps can, as stated, be seen in many places in the city, but a reporter who was interested in the subject obtained permission to go through the office of the Western Edison Light Company at 51 Wabash avenue, where the whole system is in constant working order. An Armington & Simmes engine furnishes the requisite motive power. The little engine is especially adapted for very high speed, and runs at the rate of 321 revolutions a minute, and keeps this up day after day for fifteen consecutive hours. It transmits power to what is called the dynamo, an apparatus which generates the electricity for the lamps. It consists of a powerful electro-magnet, between the poles of which an inducting coil revolves at the rate of 900 times a minute, and generates electricity for 250 lamps. As the reporter walked by the suspicious-looking machine he hugged his clothes close to him for fear the electric current might touch him, but his guide showed that his fears were uncalled for. He touched the positive and negative poles, and allowed the current to pass through his body. The reporter was also induced to try the experiment, and was surprised, not at the shock, but at the want of a shock. When breaking the circuit by withdrawing the hand, the faintest nervous twitch was noticeable, and that was all. It was then explained that this

LOW TENSION OF THE CURRENT

was the great merit of the Edison system. The currents used for the arc lights, such as are seen in the streets, would kill a person, and are strong enough to set fire to wood-work several inches away, if the wire is not properly insulated. The current for the incandescent lamp, on the other hand, only measures 110 volts, or, speaking less technically, is equal to one-third of an ordinary telegraph current, and to one-fortieth of that used for the arc light. This low tension of the current removes one of the gravest of popular objections to the electric light; for many have an idea that it is fatally dangerous to be near a current of electricity that is used for illuminating purposes; while here is a light that is supplied by electricity so mild that it can scarcely be detected with the bare hand. There are other grounds of popular fear which have also been guarded against. Following the wire from the dynamo one sees it pass to a small apparatus called

THE REGULATOR.

This has a red and a blue light, and an alarm bell. When the current gets too weak the red light is lit up and the alarm bell rings till the current is adjusted, and if the current becomes unnecessarily strong the alarm bell rings and the blue light is seen. Now, by some accident, there may be a contact between the wires of the Western Edison Light Company, and a wire of some other party—suppose of some hotel that has the dazzling arc light—and it would naturally be supposed that the intense current of the latter would at once pass over the wires in the Edison office, and do great damage to property and to life. But such an accident has been provided against by

THE "CUT-OUT."

A "safety catch," another one of the inventions of Edison. It consists of a small piece of wire fusible at a low temperature, which is placed in every circuit, and in the lamp itself. If the wires become heated from any cause this safety catch at once melts off and opens the circuit, thus averting all possible damage from fire. The circuit can be again closed by taking out the burnt safety plug and putting in a new one, the work of a moment. This "cut-out" prevents fires from arising either by wires crossing, or coming in contact, or by the jumping of the current from one wire to another.

THE LAMP

which gives the light consists of a pear-shaped glass globe about 4½ inches in height, exhausted of air, into which is sealed a filament of carbonized bamboo slightly thicker than a horse-hair. This filament becoming incandescent by the passage of the current of electricity through it, emits a beautiful, soft white light, absolutely steady and constant, and equaling in intensity, or exceeding, if desired, the illuminating power of a gas jet of the best quality. The lamp is screwed into a socket which is permanently attached to a gas or other chandelier or bracket, and contains a key whereby the light in the lamp may be turned on or off. The [illegible] screwed into the socket needs [illegible] attention or care until the car[illegible] the old lamp is un[illegible] the socket, and a new one [illegible] work of a few seconds. [illegible] in the number of hours [illegible] burn, but their average [illegible] candle power exceeds 600 [illegible] burning. Each light is independent of the others, and [illegible] be arranged and controlled [illegible] pairs, or in groups of any [illegible] many forms, [illegible] uses.

The Development of Electric Lighting.

BY J. E. H. GORDON, B. A.

DISCUSSION.

Mr. George Offor, manager of the South-Eastern Brush Electric Light and Power Company, while thanking Mr. Gordon for the valuable information he had given, said he should like to make a few observations on this interesting subject, being practically engaged as manager of electric lighting companies, and, therefore somewhat familiar with it. The real difficulty they had to contend with was not any indisposition on the part of the public to adopt the new mode of illumination, because they were now to a large extent familiar with it, and as to the question of price, they were already aware of the fact that it could, with a fair amount of lighting, be supplied at about the cost of gas. The difficulty experienced had been this, that they had not possessed the power to supply. They were now obtaining provisional orders under the Electric Lighting Act, but they had not got them yet; they had no power to take up the streets, and put down mains, to supply the public in the same easy way that they were supplied with gas. Twelve months ago there was a great champion of one particular system, and no doubt he had a great deal to do with the development of the industry within the last year or two, but he changed his views, and took up with a machine of the same character as had been described that night; and the public began to think if this champion has changed his views we had better pause before we put down plant which would require thousands of pounds. With regard to the system described to-night, it seemed in many respects defective. What was required in electric lighting, for domestic purposes, was a steady light which could be regulated without the aid of two men, however intelligent they may be, to watch whether the lights were being turned on, or turned off, and then to turn a wheel to regulate the speeds, to prevent too much or too little current going into the lamps. They wanted an automatic arrangement for keeping the lamps steady, and a constant supply, whether an engine broke down or not. Now, in the development of electric lighting, both these objects had been obtained. He had been running regulators at Colchester for some months, where he had turned off the lamps put on to a frame one by one, until he had only a single lamp burning, and that had been regulated entirely automatically, so that whether there were only one lamp or one hundred it would make no difference. This might be seen at Colchester at any time, where they were lighting a number of hotels and shops in the High street, and the business was increasing, because there they had the power of putting down mains, and supplying the public in the same way as they were supplied with gas. Then, were they sure, under the system of Mr. Gordon, to get a constant supply without any check by the breaking down of machines. It was true that, by the expenditure of a certain amount of capital, you might have a reserve machine, but a reserve machine of such a gigantic size meant a large amount of capital, and even that reserve machine could not be put into action at once if one of the others broke down, and if the bearings of both machines in connection broke down, the reserve would only take the place of one, and in any case there would be a certain delay. That difficulty was got over by the only way, in his humble judgment, which was suitable for domestic lighting, namely, by means of a storage battery. In that way, if a machine broke down, you had a supply of electricity to draw upon, and consequently, you might have the light day and night without keeping the station constantly going. Mr. Gordon had pointed out the advantage of the large machines, that you could dispense with the belt, but he was probably aware that there were steam-engines in connection with dynamos which ran direct without any belt. He might mention Hodson's rotary engine, which was running a dynamo without any bands, and there were many important engines with dynamos fixed to them, which ran in the same way. Again, something should be said in favor of small installations. When electric lighting involved such large figures and such very large machines, he was not at all surprised to hear that local authorities suggested that a trial on so large a scale should be made at the risk, in the first instance, of those who believed in it. He believed the great bulk of the business they were likely to do for some time would consist of small installations, beginning with 100, 200 or 300 lamps and increasing gradually. How did gas companies supply a town? By means of large gas holders from which they drew all that was required, and that was what his company promised to do; viz., by a storage system establish in different parts of the town and from that, drawing off, as from gasometers, the supply of current required by the public.

Mr. Gordon had pointed out that, under his system, the lighting station should not be at any great distance from the supply, but that was not necessary under the system of the companies he managed. Their stations might be many miles away, the only inconvenience being the length of wire required to connect the stations with the storage batteries; but, by the use of a high-tension machine the current could be conveyed a long distance at a very moderate expense, so that they did not need to bring the lighting stations into the more expensive parts of the town, or to create a nuisance there, however unimportant. He had had the dynamo running for many months and had received no complaints even from the neighbors. He had also had offices lit for the last eight months by means of the storage system. He believed there was a great future for electric lighting, because they were now obtaining powers under the act.

The companies he represented had already agreed with local authorities and the board of trade for provisional orders for fourteen towns, and as soon as the necessary act of Parliament was passed, the arrangements would be carried out. He knew from observations and inquiry that the public were quite ready to take the new illuminant as soon as they were able to supply it in the same simple effective way that gas was supplied.

Mr. C. G. Gumpel said he must agree with Mr. Gordon that the greatest difficulty electric lighting had had to contend with was stock jobbery. What had caused the indifference shown to electric lighting was not the want of powers which Parliament had withheld, but chiefly the absolute loss which had been brought about by speculators. When they heard of the large sums which had been given to electric companies by the public, he would remind them that those sums were not paid to inventors, but were paid to promoters—to men who were the intermediaries between the practical men and the investor. He thought the history of this speculation ought to be written as a warning to future undertakings. We lived in a very different age to that of 80 years ago, when gas first made its appearance, and did now in five years what was then done in thirty. The first speaker had referred to an automatic regulator, and there was no question that they required it. At the present time there was no practical regulator in the market. Professors still spoke about dynamos which kept a constant potential at their terminals, and one suggested one plan and one another, but those acquainted with electrical literature would know how many different plans had been adapted. When the doctors themselves did not agree, what could be done? Mr. Gordon never said a truer word than when he referred to the necessity of making the plant of such a size that lighting could practically be introduced.

It must be remembered that in introducing electricity they had to compete with gas, where one large gas-works supplied a whole town, and the question was to give the plant such a form as to take from a single engine enough power to supply the light required. They did not want small installations, for which it would be easy to devise small machines, and when they were recommended he imagined the wish was father to the thought. They wanted larger installations, because you could get them cheaper, as had been shown in the figures. Every electrician knew that. It was the same with gas. Mr Gordon had solved the one great question of making a machine large enough to supply a town of medium size, and whenever the history of electric lighting was written, his name would stand forward as one who had shown the way.

With regard to the storage battery, Mr. Offor was connected with the company which supported cumulative batteries, and hence it was necessary that he should advocate them; but Prof. Lodge, in that room a few days ago, speaking of the nature of storage batteries, said they were all very nice as long as you used them. You might charge them and discharge them, and they would act as long as you did so, but you must not let them stand. If you let them stand for any length of time, you required a very strong current to break through that thick coating of sulphate of lead which was formed on them, making an insulator which you could not penetrate. Suppose you had a battery in a house, and went out of town for a few weeks, and let it stand; when you came back and turned on the lights the battery would not charge, and you might wait until doomsday, but you would not get a current into it or out of it. He believed there were points connected with batteries which would make it a long time before their manufacture took a practical form. He had worked at the subject for five months, and had met with many drawbacks in their working.

Mr. Rawson said the figures which had been given were most valuable, and when they appeared in print must strike the public, especially in many places, particularly abroad, where gas cost 20s. a thousand cubic feet; it would lead people to inquire and see if there was not something in electric lighting. He wound remark that it was not the price of the current, but the price of the light, which was important, and the question was what you could get out of the lamps. If with a certain current you could double the illuminating power, you at once reduced the cost 50 per cent. Up to the present time incandescent lamps had not been worked at so much as the other parts of the plant, and there was no doubt they would be greatly improved, so that with a certain current a lamp of a greater power would be obtained and the price of the lamp reduced. They would then be able to run lamps with much higher candle-power. An ordinary lamp would now give twenty candle-power, with seventy volts-amperes, and last 2,000 hours; but if the price of the lamp could be reduced you could afford to work it for only 1,000 hours, and could get so much more light. The price of gas would, no doubt, come down; and the products which now fetched a good deal of money, if gas were less used, would become higher, and, therefore, electric lighting would have still further competition to meet.

Mr. Gordon, in reply, said he had listened with a great deal of interest to the remarks which had been made, and it was very useful to hear the views of other persons acquainted with the subject. With regard to the question of Stock Exchange operations, he did not think that was the place to discuss it. All he could say was, he did not agree with Mr. Offor, and nothing he had said had caused him to alter his opinion. He must leave it to the audience to say whether wild and reckless speculation, not in electric lighting, but in paper shares representing electric lighting, was likely to cause the public to adopt it as a safe and steady investment. With regard to the controversy between high and low speed dynamos, it had been going on for a long time, and was not finished yet, and it would probably take some years of work before the question was thoroughly decided. He was speaking chiefly not of what was used in small installations, but what was wanted on a large scale to compete with gas. With regard to driving direct from high-speed engines, he had seen nearly all such engines which were made, and there were plenty which would work very nicely, but he never saw a high-speed steam engine which worked 500 revolutions—and the "Hodson" worked 1,500—that would be guaranteed for a year. He stood near one the other day for a few minutes, working at about 1,200 or 1,500 revolutions, and the noise was extraordinary; the whole place shook and rattled, and you felt, although it might last six months, or perhaps one year or two, the item on depreciation of plant of that kind would be something like ten times what he had put down. He believed he had been the only electrical engineer in England who had persistently said that storage batteries were worthless on a large scale. Storage was not analogous to pumping gas into gas reservoirs. You could not store electricity; you stored energy, and the analogy to storing energy was winding up a spring or pumping up water to a high cistern. Suppose you had a steam engine which worked a quantity of machinery in a large factory, what would be thought if some one came to you and said if your engine broke down the shop must stop, so you must have storage; and told you to take off the belt, use the engine to pump water into a high reservoir, and let the water run down again, and turn a turbine and drive a shaft, and then you would be sure not to break down; they would not think much of the practical nature of such advice; and if he added you must pump it into a cistern which leaks very badly, they would think still worse of him. Storage certainly has its uses, particularly in small plant. If you had a little plant in a country house, where the steam-engine which did the pumping did a little electric lighting, and the wages of the engine driver would double or treble the expense, and you wanted the gardener to attend to it, who went home at 6 o'clock, then have storage; because if you lost half or two-thirds it did not matter, it would be cheaper than paying an engine-driver. But when you had plant of the size to compete with gas, you could afford to have men up all night. A question had been asked what would be the state of a storage battery after 2,000 hours. He had never heard of one which had worked 2,000 hours. With regard to capital expenditure, a point was made that a spare machine meant expenditure, and, therefore, storage batteries ought to be used instead, but the best storage batteries now in the market, capable of storing up current for 5,000 lamps, would cost more than a spare machine, he should think probably two or three times as much. As to regulation, he might say that all through the paper he had spoken, not of what they hoped would succeed, but what was actually practical. He had every hope that they would yet have automatic regulators and he had experiments now going on, but he did not feel justified in speaking of this as an accomplished fact until they had succeeded. If anybody would bring them a first-rate automatic regulator, they would be glad, if they found it useful, to adopt it, and pay royalty on it; the market was open to anybody at present. He was not aware of any regulator which worked perfectly with a large machine, so he had thought it better to discuss the matter, assuming the more expensive method, if hand regulation was to be adopted. With a small machine, automatic regulation was very useful and important, but with big machinery it was not always the wisest thing. In their experience at Greenwich, of coiling submarine cables into tanks, it was found better that it should be done by hand. They had tried a number of different patents for automatic coiling machines, but had not adopted any of them. If you wanted to reel cotton, you must regulate the flow by machinery, because you could not afford a man to each reel; but with a cable of the value of £50,000, a man more or less did not matter very much, and very often the expediency came in which made them decide to use hand regulation in preference. Still they had no prejudice, and were perfectly ready to employ automatic regulation if it were perfectly certain, and did not require a man to watch it. The question of incandescent lamps was very important and interesting, and he had all manner of hopes about the future, but he did

THE EVENING BULLETIN, PROVIDENCE, R. I., NOVEMBER 28, 1883.

(From the Electrical Review, New York.)

Questionable Methods of Opposing Electric Light Competition in Providence, R. I.

We have from time to time commented on the energy with which the American Electric and Illuminating Company has prosecuted its business of putting Thomson-Houston electric lighting plants into various New England cities, and commended its vigorous methods of dealing with competitors. We have noted the opposition with which it has been met in establishing a plant in Providence, and have informed ourselves as to the facts in the case.

It seems that this Company some months since, leased a building in Providence suitable for an electric light station, equipped it with steel boilers of two hundred horse-power, four Armington & Sims engines of fifty horse power each, and the necessary dynamos, lamps, and other electrical appliances for a full two hundred light plant, expending in actual cash over sixty thousand dollars in the work, every dollar of which has been paid. Having shown its good faith in this substantial way, it applied to the City Council for authority to run its wires over a designated route in the city. Its petition was referred to a joint special committee of both branches of the City Council, and on Wednesday of last week, Nov. 21, that committee gave a public hearing, at which the petitioning company and any who desired to oppose the granting of their request were notified to appear. The American Electric and Illuminating Company was represented by Col. Spooner, member of Congress from the Providence district, who urged the granting of the petition, and offered a large number of letters, and the evidence of prominent gentlemen present, as to the character of the light, the responsibility of the company and its straightforward and business-like method of conducting its affairs.

Col. Douglas appeared for the only remonstrant, the Rhode Island Electric Light Company, which has a Weston plant in operation in the city of Providence. He said nothing against the merit of the Thomson-Houston light. He offered nothing against the station which, as we know from disinterested persons, in whose judgment we have implicit confidence, is a model of construction and arrangement. He could not raise any question as to possible obligations for damages falling upon the city, because the petitioning company offered to give any desired bond, with sureties satisfactory to the City Council, holding the city harmless in the event of any damage arising from the [illegible]uction of their light. Finding no opportunity for attack in any of these directions, he attacked the personal character of President Goff [illegible] other officers of the American Electric and [Illu]minating Company, on charges long ago ex[illegible] and disproven, concerning their connection [wit]h the American Electric Light Company of [Mas]sachusetts, a corporation long defunct. The [illegible]s in this case have been rehearsed in these [col]umns. Concisely stated, they are that Mr. [Goff], by false representations made to him, was [ind]uced to become Vice President of this defunct [corp]oration, that he was connected with it just [f]ive weeks, that at the end of that time he dis[cov]ered that he and his associates had been duped, [that] he exposed those who had deceived him, and [that], to the last dollar, he expended his private [prop]erty, amounting to about $40,000 in buying [the] stock from people who were led to invest in [it be]cause of his connection with the Company. [F]urther, as evidence that it was he who was [real]ly the victim, we long ago published a letter to [Mr.] Goff from Mr. Rowland R. Hazard, President [of t]he Gramme Association, which investigated [the] matter thoroughly. In justice to Mr. Goff we [rep]roduce it here:

OFFICE OF THE GRAMME ELECTRIC CO.,
115 Broadway, N. Y., May 9, 1882.

[E]DWARD H. GOFF, Boston:

Dear Sir—I acknowledge receipt of your favor of May 3d on the following day, and beg now to thank you for the very full and satisfactory report which you make of the proceedings of your late associates, which fully confirmed our latest advices and opinions. We have taken the liberty of transmitting copies of your letter to the several constituent companies, and shall take every opportunity in the future, as we have in the past, to expose the business methods of which you are one of the numerous victims. We are looking after several of the companies organized by the same managers, and hope that you may find some responsible person to hold for the pretences which induced your expenditure and service.

Yours very truly,
ROWLAND R. HAZARD, *President.*

It was noted as a singular coincidence that on the morning after the hearing in Providence, there appeared in the *Boston Journal* a special dispatch from Providence, purporting to give a report of the hearing which was garbled and distorted by omitting nearly all the evidence introduced in favor of the petitioning company, but carefully giving all the false statements made by the counsel for the opposing company in Providence, and so worded as to give the impression to the casual reader that the petitioning company was one and the same with the American Electric Light Company of Massachusetts, a corporation long defunct. And it was further noted that some one was at the pains and expense to send hundreds of copies of this issue of the Boston *Journal*, with the false telegram *marked*, to prominent people in all the cities in New England in which the American Electric and Illuminating Company has or is establishing plants, with the evident purpose and intent to injure it in the eyes of its patrons and friends.

It was to be expected that the competing company would oppose the introduction of the Thomson Houston lights to compete with its own. Had it confined its efforts to honorable methods, and had the opposition been confined to the city of Providence, where the contest was in progress, there would be no word of criticism from us. But its course of attack was unworthy and dishonorable, because founded on statements long disproved, and its case was weak because based on personal calumny. And the sending of a garbled dispatch and its wide-spread circulation in selected cities, *marked* and addressed *personally* to gentlemen identified with the companies using the Thomson-Houston light, leaves *somebody* in a position so contemptible that it is beneath criticism.

Utica Daily Press.

SATURDAY MORNING, APRIL 7.

The Edison Light.

If Utica is not lighted by electric light, it will be no fault of the companies. We have one company located here now and another one coming.

Mr. Chas. A. Benton, representing the Edison Electric Light Company, is in the city. He told a reporter yesterday that he had come to Utica to look the ground over with the intention of forming a company having the requisite capital to operate the light; the shares being $100 each. Mr. Benton will introduce his light in Utica and give our citizens satisfactory evidence of the superiority of his light.

Mr. Benton says of his system that the electricity is generated by dynamos driven by engines of the required power. There are two systems of electric lights: the arc and the incandescent. The Edison light is of the latter sort and has many advantages over all others. People who use it can pay according to the terms of a contract, or can be charged for the amount of light they use, that to be determined by a meter. The possibility of measuring the consumption is a feature incident to this system only. The Edison Company put in a plant and run it 30 days, insuring that it will perform the work as represented. The lamp used is pear shaped in form, about six inches long, has no mechanism and gives a steady light. Inside the globe, which is a vacuum, is a U-shaped horse hair filament of bamboo fibre, thoroughly carbonized, fastened to a small copper wire by bending into clamp-like form about the enlarged ends. The light is produced by the current passing from the bottom plate around to the second plate. There are two sizes—8 and 16 candle power. For street lighting purposes the 16 candle lights are placed in bunches of five. This light is admirably adapted for house and store lighting purposes, inasmuch as it can be turned off and on easier than a gas jet. The current is absolutely harmless. Enclosed as they are in a vacuum, no noxious odor or perceptible heat can escape or be generated. The light is brilliant, yet of such mildness and steadiness as to be most agreeable to the eye. The Edison Company propose to substantiate all they claim, and in case Utica has a company, they will undertake to make a perfect installation of it and hand it over to the company in perfect running order. Outside of New York city, where they are extensively used, Port Jervis and Albany have been the first to take up the matter of these lights. They are confident that they can more than give satisfaction.

FEBRUARY 17, 1883.
THE TORONTO MAIL.

THE ELECTRIC SPARK.

An Exhibition of the Incandescent Lighting which is to be Introduced into Toronto.

A despatch from Hamilton with regard to the new system of electric lighting, which will shortly be in use at THE MAIL building, says:—

Last evening, at the invitation of Mr. Thos. Swinyard, an exhibition of incandescent lighting was given in Killey's Mona iron works in Hamilton, under the supervision of Mr. H. M. Byllesby, one of the engineers of the Edison Electric Light Company of New York, and Mr. Baron, foreman. The particular object of the exhibition was to test a dynamo machine which is intended for the illumination of the premises of THE MAIL Printing Company, consequently the arrangements were of a temporary character except in the office, which was fitted up, with several elaborate electric light fixtures, among which was a handsome portable lamp somewhat similar to those at present used for gas purposes, but decidedly more neat and graceful in appearance. There was also a swinging wall bracket and one or two other fixtures such as are employed in fitting up the offices which are lighted by the Edison system in New York city. The appearance of the dynamo, which does not at all resemble those employed by arc light companies, was the subject of general remark. The most prominent difference between the Edison and other light machines is in the size, Mr. Edison's being much larger than any other. The object of this increased capacity is to obtain economy in working, Mr. Edison believing that a small extra expenditure in the first cost is more to the ultimate advantage of the purchaser than cheap prices and continuous outlay for repairs, which is always the case with machines in the construction of which a smaller quantity of metal is used. Altogether the dynamo presented the appearance of a well-built,

SUBSTANTIAL, AND FINELY FINISHED

piece of work. The lamps exhibited were manufactured by the Edison lamp factory, temporarily located at Montreal. Each lamp consists of a small pear-shaped glass bulb—from which the air has been completely exhausted—containing a fine loop of carbonized bamboo, which, being connected to the wires of the circuit, becomes brilliantly incandescent, and produces the soft mellow light peculiar to this system. One feature which was particularly noticeable was the fact that the current being of a low tension the conducting wires could be grasped in the naked hands—as was done by several of those present—without any inconvenience. Many of the leading manufacturers from Paris, Dundas, and Hamilton were present, and expressed themselves as very agreeably surprised and pleased with the light. Another large plant intended for the lighting of the Montreal Cotton Company's mills at Valleyfield is now in course of construction.

ELECTRICAL REVIEW

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(From *La Lumière Electrique.*)

Munich Exhibition.

APPLICATIONS OF ELECTRICITY TO THE LIGHTING OF SCHOOLS OF DESIGN, MUSEUMS AND ARTISTIC COLLECTIONS.

The old capital of Bavaria, so celebrated for her schools of painting and sculpture, and immense artistical riches, in her first

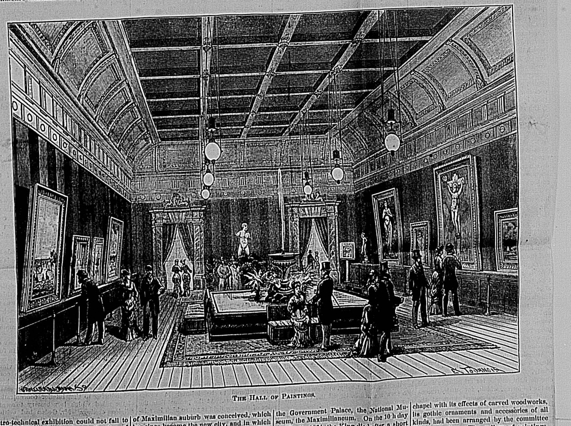
ing passed several years of his youth in Italy, brought back with him a very well marked taste for arts; from the very beginning of his reign he took care to give his capital an aspect of grandeur and elegance which already commanded the admiration of all the strangers. The sovereigns of the last century, and King Louis particularly, also continued with ardor the construction of cathedrals, palaces and museums, and already under Joseph Maximilian IV. the plan

world, and have attracted into that centre so well fitted to entertain the sacred fire of art, a multitude of workers, a few of whom have acquired great celebrity.

Under the successor of Louis I., who was his eldest son, Maximilian II., they began the erection of the vast Grain Exchange and the Crystal Palace, intended for exhibitions, the Railway Depot, the Winter Garden, the Physiological Institute, Maximilian street, one of the most beautiful streets of Munich,

pieces of the masters at much more convenient times and without being restricted, as it has been until now, by the duration, so variable, of the daylight.

Consequently, from the first beginning of the installation of the diverse parts of the Crystal Palace for the opening of electricity exhibition several rooms had been reserved to show the applications of the electric light to artistical productions. One gallery of paintings, one model of school of design, one



THE HALL OF PAINTINGS.

electro-technical exhibition could not fail to reserve a large place for the application of the new lighting processes in the sundry manifestations of art.

It is generally known that Munich, from its very foundation by Henry-the-Lion in 1158, saw arising one after another diverse monuments which seem to have been constructed for an immense city, though its population does not amount at present to over two hundred thousand inhabitants all told, including the population of its suburbs. It is mainly about the seventeenth century, during the reign of Maximilian I., that its artistical reputation began; that prince hav-

of Maximilian suburb was conceived, which has since become the new city, and in which nearly all the grand modern buildings are gathered. From 1825 to 1848, under the reign of King Louis, the most of those edifices were constructed; we can admire under different points of view the new Palace, the Church of St. Louis, the Basilic, the Glyptotheca, the Pinacotheca, the Odeon, the Library, the University, the Factory of painting on glass, the Ruhmes-halle, the Siegesthor, the Isarthor, the Feldherrn-halle, the House of Education for Noble Young Ladies, &c., nearly all these monuments contain collections which are unique in the

the Government Palace, the National Museum, the Maximilianeum. On the 10th day of March, 1864, the King died after a short sickness, and left his throne to his son, Louis II., who has continued the noble traditions of his ancestors.

The antecedents of the city of Munich and the love of art which she continues to honor with such earnestness, were a sure guaranty of the efforts which would be made during the exhibition of 1882, to show all the advantages which can be drawn from electric light intelligently applied, either to light in the evening the schools of design, or for the courses of painting, or else to study master-

chapel with its effects of carved woodworks, its gothic ornaments and accessories of all kinds, had been arranged by the committee of organization. The gallery of paintings, of which we give, Figure A herein, a general view, was indebted to Mr. Gedon for the favorable disposition it presented; red tapestries covered all the panels of the large hall, and formed a very well appointed ground to give relief to the wide golden borders of the paintings, and above all to the painted works they were surrounding.

There were for the communications with the neighboring rooms three rich doors in simile-marble of grand and severe archi-

THE DISTRIBUTION OF ELECTRICITY.

An important advance in electrical science, as regards the distribution of the electric current, has been effected by Messrs. Gaulard and Gibbs in the secondary generators invented by them; the working of which we recently inspected at the Aquarium Electrical Exhibition. In designing this apparatus, the inventors have outlined the path hitherto traversed by electricians, and have taken a wide and decided departure from ordinary practice. Their predecessors in the field have usually followed Faraday in the manner in which they have simplified and extended. Messrs. Gaulard and Gibbs, however, have gone back for a starting point beyond Faraday to Ampère. Faraday's experiments were based upon the action of agents, or of magnetized iron, before bobbins of insulated copper wire, while Ampère's experiments, which have been practically abandoned of late years, were based on the influence of currents upon bobbins of insulated copper wire. Following up this principle, the Gaulard and Gibbs secondary generators, one after another, on the same circuit, are traversed by the same copper wire, through which circulates an alternating current of small quantity produced by a dynamo, which may be placed at any distance from the secondary generators—even miles away. The current thus produced is not only capable of absolute distribution and transmission in great distances, but is available when so distributed and transmitted for the production (at either or) are or an incandescent light, or motive power. Turning to the apparatus itself, we may observe that it consists, in the first place, of a dynamo-electric machine producing, so alternating current. This current is conducted to the secondary generator, which, in external appearance, resembles four columns about 3ft. high and 8in. in diameter, placed a few inches apart on a masonry stand or table, measuring 3ft. 6in. by 2ft., a similar table being placed on the top of the columns, and carrying a couple of handles and the necessary electrical connections. Each of these columns is composed of a hollow wooden cylinder, upon which is wound, in parallel spirals, placed in layers, a cable formed of a central thick insulated wire having six other fine compound wires also insulated, wound around it. Each of the outside or compound wires is composed of 12 insulated copper wires. The cylinders, or columns, as we have called them, are so connected as to allow the electric current generated or induced on the compound wires by the influence of the movement of the alternating current which traverses the thick central wire, to develop different potentials at will, i.e., the different qualities of current required respectively for incandescent lamps, arc lamps, and motive power. The primary current is made to traverse either the whole or any portion of the number of cylinders by turning a small handle, and by this means the quantities of electric energy can be varied at will by the user to suit his requirements. Another handle or switch is provided by means of which the quantity of current generated can be increased or diminished, and the light obtained thus perfectly regulated. It is a very important point in the system or electrical distribution of which we are treating that a metallic-circuit closed circuit is used to convey the primary current. The circuit is closed because it is never opened for supplying lamps directly, as in all other systems. As danger to life is high tension current can only arise when a circuit is open, it follows that with a metallic-circuit closed circuit no limit need be fixed to the electro-motive source of the current, which, on such a circuit is practically harmless. It is only the currents in lines on the secondary side of the generators that are dangerous to life, and these are, as such as waterfalls, currents and other motors conveyed to great distances without danger, and their power distributed exactly as required.

At a recent private examination of the invention there were two of the secondary generators we have been describing. One of them was supplying a current to 40 Jablochkoff candles, or electric candles, while the other was serving a Jablochkoff arc lamp, five Swan incandescent lamps, and was likewise running a small electro-motor for transmitting power. The latter is the Jablochkoff rellipitic motor, which consists mainly of two coils, the one being fixed and arranged in a vertical plane, and the other being movable and fixed in a horizontal plane, and so arranged as to be capable of resemble that of the ellipse or the cycloid, and hence the name of the motor. The fixed coil is wound on a foundation of copper, and the movable coil on a frame of iron, which, in operation, is transformed into an electro-magnet. With regard to the nominal power of Messrs. Gaulard and Gibbs' secondary generators we may observe that each of those under notice is said to be capable of developing about four horse power, eight incandescent lamps being considered as equal to one horse power. This power can be increased to any required extent, at will, by adding to the number of coil, most of which it will be observed, are in parallel arc. The power is practically applying, and in this respect it is proposed to establish central stations where dynamo machines, driven by water power wherever possible, would be placed. A current would be laid over the district to be supplied, and for each house where the electric current was to be used a transformer would be placed, consisting of a series of 4 cylinders placed a secondary generator. By means of a commutator the current could be put on or taken off the circuit without interfering with the passage of the current. The lamps during working are in connection and the current would be registered by an apparatus in the prime station, which would be a pendulum actuated by the passing current, and this pendulum would turn the hands upon when the charge for the current supplied would be made. It is right to say that the Jablochkoff candles are not yet perfected, far more so than when used from the dynamo last. This stimulates from the circumstance that the electric current obtained on the secondary wires of the secondary generator depends only on the quantity of the primary current, hence the variations of the electric machine do not influence the secondary current. Some of the lamps we saw that night were very fine, and we have brought in question the reduction and distribution of a current sufficient for three old purposes we have indicated above—and that a very important one—namely in practical and then, if indeed, they have not actually solved it their incredible discovery.

FEBRUARY 7, 1883.
DAILY NEWS,

THE LIGHTING OF THE HOUSE OF COMMONS.—The Electric Lighting Incandescent Lamps Bill, as we understand, is to be introduced into the House of Commons, so far as the Committee and passage are concerned, this session. The lamp will not, however, be used for lighting the House of Commons this session, as it is intended to reserve all the requirements of the members and the country of the House. In many of the corridors and rooms of the House, and leading to the conference room, the fan has been, and the library, the gas light has been found rather ineffective, as much so that where flights of stone steps had to be descended, there was a certain danger of stumbling to those who were not familiar with the position of the long series of stone steps by which access is made to the reporters' gallery has been, under the circumstances, considerably lighted. All these defects will, it is expected, be materially remedied by the introduction of the Edison incandescent lamp.

ELECTRICAL REVIEW

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Incandescent Lighting at the Munich Exposition.

(Translated for the REVIEW *from La Lumière Electrique.)*

The Munich Exposition presented a marked difference from the Paris Electrical Exposition, considered from a point of view regarding the application of incandescent lamps. At the latter, the effort made to give the chandeliers and lamp-supports an ornamental character should be pleasing to the eye seemed general, and this applied equally well to arc as to incandescent lamps.

The greater part of the arc lamps were enclosed within elegant lanterns, and the chandeliers with Siemens lamps, which ornamented the rotunda in the exhibition, as also the one with Werdermann lamps in the theatre, and the numerous and varied arrangements for which the latter lamps were well adapted will be remembered. As regards incandescent lamps, the solid mountings of Edison and his out-glass chandeliers may be said to have vied with the elegant blown glass chandeliers of Swan.

At the Munich, however, very little by way of ornamentation was done for arc lamps, all efforts being apparently, directed to incandescent lamps as if it had been assumed that the latter were suitable for domestic uses and that they were the only ones in need of ornamentation.

It appeared also, as regards arc lamps, that the only object sought was to exhibit systems without doing anything in the way of lamp decorations, and we have, therefore, but little to note in this connection except the Compton lamps,—a view of which was given in a previous number—the Schuckert lamp exhibited by Zeltler and Bohm; of Munich, and a drop light chandelier for Schuckert lamps similar to those used by Mr. Jaspar, and exhibited by Mr. Ausmuch, Feuerbermaier and Company.

For incandescent lamps, however, it was quite otherwise, ornamental arrangements being exceedingly numerous and it will readily be seen why this should be so. It is quite a difficult matter to give an artistic aspect to an arc lamp, or to group several of them in such a way as to form an elegant chandelier, while incandescent lamps, owing to their small dimensions, are admirably adapted for the most varied combinations. Incandescent lamps, moreover, can readily be fitted to the supports already in use for gas or candles, and the facility which they possess for burning in any position, renders their installation still more easy. It was thus that the engineers were enabled to arrange in the restaurant garden a most original and picturesque lighting with Swan lamps, these being suspended among the leaves of trees and climbing plants. Being also attached by means of their conducting wires without any show of artifices, and possessing, besides, a certain flexibility, on account of this mode of mounting, they participated in the movements of the leaves, and the garden, as in the story of the "Thousand and One Nights," seemed fairly lighted by the luminous fruit of magical trees.

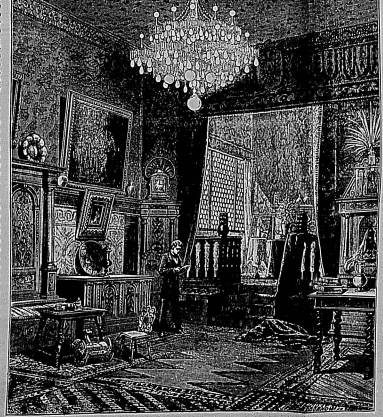

FIG. 1.—SALOON FOR ART TREASURES LIGHTED BY A CHANDELIER OF INCANDESCENT LAMPS.

But this was only an ingenious arrangement showing further the facility with which incandescent lamps can be employed. To return to the apparatus, properly speaking, we will first have to consider the supports and devices for single lamps, and these were found at Munich just as they were at the Exposition of 1881.

Although the subject of considerable attention since that period, they have not changed but remain the same as then; we shall, therefore, not have to reconsider this part of the subject, but will occupy ourselves especially with the more complicated arrangements of electrical chandeliers, in the construction of which the designer's imagination has been given wide scope.

And right here let us be permitted to digress a little with regard to these chandeliers, to protest against the word electrolier, which is beginning to be introduced in electrical language. It comes to us from the English, imitating our word chandelier, they have called every apparatus intended for holding lamps electrolier without perceiving that the latter is introduced in the termination belongs to the root of the word in chandelier, and that to be consistent with this mode of procedure we should call polevtier, polevtier; saurelier, etc. This mongrel word made its appearance about a year ago in the English electrical journals, and since then we have, not without astonishment, seen it repeated in French Journals. Let us take from our neighbors, such as they are, such words as have no equivalent with us, but let us permit them to keep those terms which, though French in appearance, are forged by them contrary to all rule.

Electrical chandeliers were exceedingly numerous in the Munich Crystal Palace. The exposition having been connected with a decorative art exhibition, numerous manufacturers undertook to show that they could do quite as much for electricity as for gas and other methods of lighting; and the result was a multiplicity of different models.

Some of these were nothing more than gas chandeliers slightly modified to suit the circumstances, while others were specially designed for electric lamps; but what particularly struck the beholder was that nearly

THE MORNING NEWS, TUESDAY, APRIL 10, 1883.

HAWELY'S ELECTRIC LIGHT.

Edison's Incandescent System Tested—Minute Description of the Apparatus.

A successful private exhibition of the Edison incandescent light, just introduced into Harrisburg, Pa., took place, was given yesterday afternoon, under the direction of Mr. P. D. Johnston, engineer for the Western Edison Light company, Mr. Edson Sturges, president of the Western Telephone companies; and Mr. Jacobs, general manager of the Wisconsin Edison company, and representatives of the dramatic and newspaper professions were present. The praise of the gentlemen familiar with electrical matters was lavish. The actors present were particularly pleased with the steadiness of light, for the reason that the light given from the lamps was clear, and the unpleasant sputter of the arc light was abbreviated. The effect of the light on the stage and in the vestibules and auditorium, was delightful.

The electric power is supplied by one Lawrence engine of nineteen horse power, driving two sources of electricity known as the "A" and "B" machines, giving 250 lightsaccd, and one "C" dynamo, giving sixty lights. Of the former, one is used to supply the lights for the stage, the other for the auditorium, and the latter for the halls and vestibule. The total number of lights in the theater is 507. In the basement are the dynamo machines, which are used to regulate the candle-power of the separate lamps and give the engineer control over the entire system of lights used, enabling him to maintain the normal candle-power. Connected with the dynamo machines are the wires which carry the current to the stage, from thence being distributed to the boxes, halls of the house. In connection with the wires in the boxes is an indicator, which shows at once the candle-power of the lamp in use. Should the candle-power become excessive it used to show to the engineer instantly where the trouble was, and operating at once to adjust the proper lamp to the indicator. In a bell and two lamps, one in the box office, the other in the dressing room, which are used to regulate the candle-power; above the latter, the call bell for the stage is placed, enabling the call boy to ring violently, notifying the engineer that the current is too low, whereupon he will step over or more and the lamps below assent, the latter lamp is brought into circuit, and the proper high voltage secured, the power is then normal the lamps are cut out and the half over gently turned on.

The "rigs" or "borders" used on the stage are several from the rigging loft, in the same manner as gas fixtures are hung, and are composed of slender metal tubes, in which are placed the wires, scarcely larger than a knitting needle, in this manner the fitting can be moved at pleasure at will. There are five borders, two in front of the proscenium, one in the center of the footlights, numbering fifty, are placed in the same position as the gas lights. The bunch of colored lights, used for illuminating special parts of our scene, are controlled by a switch, and can be moved to any part of it, no matter where the rigging.

The ventilating apparatus for the stage and auditorium light is a fan, placed in the basement, 8 feet wide, 3 within a space two feet deep, four feet wide, and four feet high, are in use. The fan is driven by a four inch belt, and the apparatus can be used for the auditorium, one compartment for the stage, and the other for the ventilation of the dressing rooms, and if we, the engineer, should be unable to control the system of stage lights is furnished as required, and the engineer has the perfect regulating apparatus at his command. The lights in the house can be turned from its most brilliant condition, or will fade out slow or put entirely out at once, and as the light passes from bright to dim, the color shadings are obtained.

The auditorium lights are covered by delicately tinted ground glass shades. Placed in the ceiling, which is arched and ivory panels are studded with silvered knobs, from which, in delicate tones of pink and green, light is given, creating a fine effect. The central chandelier, hung from the dome, has been made especially for the house, at a cost of $500. A temporary chandelier has been hung from the floor, being placed temporarily for the exhibition. The chandelier is of steel and black. It is a beautiful affair, consisting of twelve lamps in varied colors, producing a blush of rose, and gives a beautiful effect to the scene.

The visitors to the exhibition were favored with a complete exposition of the workings of the system, and the engineer, Mr. Jacobs, was kept very busy. Should any accident occur to the system the system of wires has been so arranged that it does not interfere at all with the gas, which can be utilized at any moment. Only two men are required to run the machinery, as employed the electric lights of the Globe theater of Boston, and Daly's Academy of Music, Chicago—but they are as complete as the system at Hawely's.

ELECTRIC LIGHT.

ITS INTRODUCTION AT HAWELY'S OPERA HOUSE.

At half-past 2 o'clock yesterday afternoon an exhibition of the new Edison electric light was given in Hawely's Theater. For some months past the Western Edison Light Company has been perfecting the latest and prettiest of the first exhibition was given to-day. Mr. Hawely, Mr. Johnston, Mr. Jacobs, Mr. Sturges, Mr. Johnston. There were present: Mr. Hawely, Manager John G. Daff, and members of his company, Treasurer Hall, Mr. Hawely, and members of the press. There are in the theatre 67 lights in all, operated by twenty-one lamps—one for the footlights, two for the scenes, one for the stage, and twenty-four for the chandeliers, above the parquet, with 16 candle power each, and twenty-four, also 16 candle power, in the fifteen globes. There are also 16 lights in the vestibule. There are four sets of border lights, each set containing fifty globes, and each globe has sixteen candle power. There are five sets of border lights in the flies, each containing fifty globes, and each globe has sixteen candle power. The chandelier in the center of the parquet has 100 globes, each containing sixteen candle power. There are also 100 globes distributed in the parquet circle, and 100 in the gallery and entrance hall; one hundred and twenty-four lights in the dressing-rooms and stage are also of sixteen candle power.

The footlights in front is the new regular, built expressly for the stage, with 50 candle power, which illuminate the scenes with its many colored globes. The scenes used throughout the house, in the first night's performance of "Pinafore," were manufactured for the purpose of showing the lights. By means of these the lights in any part of the house can be turned on, raised, or entirely extinguished. The lights in the dressing rooms are independent and can be turned on or off at will. The electric lights are to be used in the dressing-rooms, and if we, the engineer, should be unable to control the system of stage lights is furnished as required, and the engineer has the perfect regulating apparatus at his command. The lights in the house can be turned from its most brilliant condition, or will fade out slow or put entirely out at once, and as the light passes from bright to dim, the color shadings are obtained.

Heart and Hand at Hawely's Theatre.

A very large audience witnessed the performance of Lecocq's opera of "Heart and Hand" at Hawely's Theatre last night. It is certainly better put upon the stage than any piece seen in this city for some time. The representations is well worth seeing, and is sure to be thoroughly enjoyed. Miss Lee-Cook, however, is suffering from a severe cold, and her voice is not in the best condition for singing. Nothing marred the performance, however, and the audience was kept in a constant state of laughter. The scenery was unusually fine, the stage was illuminated throughout by the electric light, and the great solidarities of many and varied colors of the sunbeam when the light was turned on, and the effect was perfectly steady, and under such much more brilliant than gas, more contrast. There was no heat from the lights, and its introduction is an important step in advance. The arrangements for this theatre. The scenery and costumes are also illuminated by the electric light, and in the second act the effect of the colored glows was so pleasing as to win another round of applause. Soon, a garlands of sun was used, and when, and even the audience were disposed with toward the close of the performance.

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Electric Light Applied to Special Purposes.

Outside of the ordinary illuminating purposes, electric light furnishes the means of attaining certain effects which could not be attained by the ordinary sources of light.

For instance, the projection of a powerful jet of light on a given point which is to be brightly illuminated at a distance could not

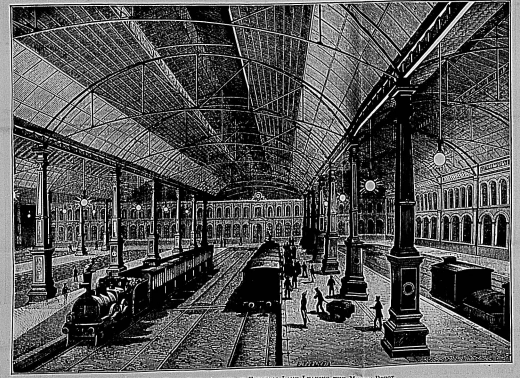

FIG. 101.—TRAIN LIGHTED WITH AN ELECTRIC LAMP LEAVING THE MUNICH DEPOT.

have been easily resolved with oil or petroleum.

Such result, with those means of lighting cannot be merely obtained except by the use of heavy and cumbrous apparatuses only applicable to stationary focuses, such as lighthouses.

For movable projectors electric light alone can be used.

It will not be necessary for our present purpose to refer to the similar appearances of that kind which are used in naval and military applications.

They were represented at Munich only by a very simple modeles of rather large size, which was used within the interior of the Crystal Palace, to produce certain effects of intense illumination.

A much more important machine containing new features was the illuminating carriage of Messrs. G. Schuckert and Meichlaler & Co. For a great number of cases it is very useful to have the power of bringing to a given point all the materials necessary to electric lighting engineered in such a manner that the lighting apparatus may be set up within a very short time.

The support of that lamp, or illuminating tower, is composed of four sets of such Nurnbergish Bleam, combined and worked together, as shown by Figure 97.

That apparatus is folded down on the car rings for transportation.

The folding and unfolding (erecting and raising) is obtained by winching or removing his base by moving to and fro and along the four grooves on the top of the truck the four resting points which form the base of the folding. Such moving is obtained by means of a screw worked by a gear and crank.

The lamp is suspended in the upper part of the tower by means of cords passing over pulleys. When the winching is folded the lamp sets down in a cylindric support or pocket placed in the center of the carriage, to keep it fast in its place during transportation.

The carriage further bears four vertical screws, which can be used to wedge up the machinery very firmly.

The apparatus was exhibited outside of the Crystal Palace, not far from the entrance of the Exhibition, and during several evenings is was worked before the public in order to demonstrate the regularity of the work and the facity of the lamp.

It has also been demonstrated that the raising of the lighting tower does not require more than five minutes.

In order to more fully try the apparatus under that point of view, on the 18th day of October it was transported to one of the squares of the city; wherein it was installed, and twenty minutes after the arrival of the two carriages the engine was under way, the tower raised, and the lighting in full operation.

In spite of the heavy rain, the light given the apparatus was sufficient to read a newspaper at a distance of fifty yards.

ELECTRIC LIGHTING.

TO THE EDITOR OF THE TIMES.

SIR,—You have recently given prominence to an elaborate exposition by a "correspondent" at what is known here as "Mr. Moulton's Provisional Order." Since then you have published a letter from a firm of solicitors on behalf of their clients the "Metropolitan Brush Electric Lighting Company," and from another firm of solicitors representing one of the district boards of works in London.

Although it is not altogether convenient that the professional advisers of contending parties should be publishing through The Times their views on behalf of their respective clients, yet the present subject is one of even more than metropolitan interest, and you will perhaps permit one legally employed professionally in these matters to place before you his views on portions of the recent correspondence.

Confining my observations to metropolitan local authorities, it is notorious that having long smarted under the tyranny of the gas companies they were prepared to welcome and encourage the introduction of electric light, partly on its own merits, and partly as tending to stimulate the gas companies or mitigate their charges. When the Act of last Session was under consideration a few individuals interested in electric light having the avowed support of the Board of Trade succeeded practically in modelling the form of the Act, the local authorities not (in my opinion) having conducted their case to the best advantage. On provisions of the Act (the consequences of which were not probably foreseen by Parliament) empowering any company from making an application to the Board of Trade for a provisional order this Session unless they had entered notice upon the local authority of the district which they sought to supply within one month after the passing of the Act. I believe that period expired before the Act was printed, and the knowledge of the provision was, therefore, confined to those enterprising individuals (representing few in number) who took part in the Parliamentary proceedings on behalf of the electric lighting companies. I find that in more cases than one, notices were distributed broadcast during that month to various local authorities by certain persons, who thus monopolised the entire benefit of the Act for this present Session; and in some cases notices were sent in anticipation on behalf of districts who were yet to come into existence, and the ground was thus occupied. It is important, therefore, in order to understand the true position to remember that there can be no applications for provisional orders this Session except by the initiated few who understood the contents of the Act of last year before it was issued.

When the provisional orders for this Session were drawn and the intentions of the applicants were disclosed or canvassed by the ingenious draftsman prepared by Mr. Moulton. This form has been adopted by the Edison Company, the Swan Company, and the Brush Company, all apparently "in the same swim."

In one order metropolitan case a less transparently delusive form has been adopted and there are not, on the face of it, the same objections; but there is enough in Mr. Moulton's order to justify the local authorities in objecting altogether to its application to their districts. The strongest objections seem to be the following:—

One of the most important matters for consideration is the price to be paid by the consumer for the commodity supplied. In the case of the electric lighting companies confine themselves to providing electrical lines and apparatus for those who desire to use them the price will depend upon the ordinary laws of supply and demand and be governed by competition, and the real or nominal capital of any of the companies in no way concerns the public; but directly the companies seek statutory powers it becomes essential to investigate these matters.

The Metropolitan Brush Company, for instance, are applicants for about 25 different orders affecting the metropolis. Judging from the recent discussions between the shareholders and directors and from what information can be generally obtained, the available resources of that company are at best entirely insufficient to enable them to fulfil the obligations which they undertake, or indeed to provide in all the various districts which they invade even one experimental installation. The nominal capital of the company is one million. The orders contain no provisions for defining or fixing the amount, and it is capable of indefinite expansion by the mere action of the company itself. That somewhere among the existing electric lighting companies there exists already a great inflation of capital, due to the random purchase of patent rights of inconvenience, which may or may not be valuable, and to the process of gambling which has been conducted before the public eye, is strongly suspected by local authorities; and it is now proposed that whole districts in London should be charged in perpetuity in order to pay dividend on this capital.

It is impossible to see on what amount of nominal capital the consumers would have to provide dividend, nor is there any security that this capital shall bear even a reasonable proportion to the cost of the work.

Time does not admit of my discussing this form of order in detail, but it may be broadly stated that it is a specious document, conferring in effect upon the undertakers a very large amount of obligation, accompanied by the greatest facilities for escaping from those obligations, and enabling them to sell in one or more lots the privileges which it will confer. Such a power is so obviously objectionable, that it has been so generally condemned by Parliament in analogous cases, that its insertion appears somewhat indiscreet on the part of the electric lighting companies. The clauses may be explained or withdrawn by the undertakers, modified or refused by the Board of Trade or Parliament, but they have provoked a reasonable suspicion among the local authorities which will be allayed with difficulty.

At the present moment the London local authorities have sufficient power to contract with any body of persons for public lighting, and with very little difficulty they could arrange for private lighting also. They are free to contract to whatever company or system can from time to time provide lighting most efficiently and economically, and there can be no possible reason why, in the present state of electrical knowledge, the best interests of the public should be handed over in perpetuity to anyone particular person or company happening to have got a start this present Session, as is the intention of all others. The applicants this Session are all the representatives of some patent rights or other, and if they should obtain the powers they seek the result will be either that in some cases they can be bought off, or that the consumers will be unduly charged in order to pay a dividend, not only on the capital necessary for the installation, but on that which has been created by the translation of existing rights into paper shares.

If these are the objections which the solicitors of the Metropolitan Brush Company regard as "frivolous," I do not agree with them. They are not by any means the only ones.

May we Londoners not say to the various applicants, "If your patents are of legal validity and practical use and have been acquired by purchase on fair terms, no single person is entitled to you without your having statutory powers, but if their value be doubtful and your expectations upon them extravagant, you must not expect to set those powers right by forcing us to provide you a return on your last expenditure."

A leading director of these companies says to me, "Why make this fuss about our capital and expenditure in patents? You go to Lloyds and Bennett for a bit without investigating their rent, salaries, and income, and do not seek to see the books. Instead of 25s. because they regard those items as too large."

I answer, "True; but if Lloyds and Bennett and two or three others should go for a huge speculation—buy, as my battery, all the existing leases and rights to make use of the recognised patterns, and then ask statutory powers to supply the bats of the metropolis for some 21 years, might we not try to guard ourselves against being during that period let by Pitt, a piece instead of Pic, (without bats and balls!)?"

Then it is urged that these orders will not confer "exclusive" powers. The same was said years ago, when gas and water companies first sought statutory powers, and it is theoretically true of their powers. But the present Draft Orders seek powers just as practically exclusive as those of the gas and water companies, no one can any electric light company, subjected to statutory conditions of supply, be fairly expected to risk its capital on other terms.

Although several of the principal local authorities in London have been represented by speaking—and following—my advice, I forbear to indicate my clients or publish my name.

Yours faithfully,

Parliament-street, M. L. C.

THE TIMES, SATURDAY, FEBRUARY 3, 1883.

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Summary of the Munich Electrical Exhibition.

(*Translated for the* REVIEW *from* La Lumière Electrique.)

We have delayed giving until now any detailed account of the Munich Electrical Exhibition, not desiring to begin until we could obtain all the documents relative to this new manifestation of electrical progress and such data as might be necessary to enable us to make the description as complete as possible.

If the exposition has not proved of as great importance as the one at Paris, it has at least presented many interesting features. Its remarkable organization for electrical measurement and the exhibit of machines and lamps wholly of German make, and but little known in France, have given special interest to the exhibition and added to the importance which it has already acquired in the scientific world with the memorable experiments of M. Marcel Deprez.

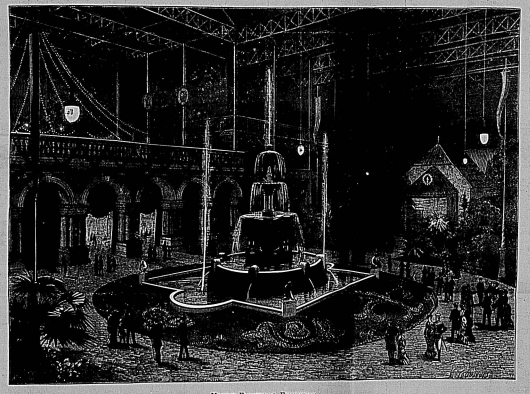
The principal object of the Munich Exposition was to study the practicability of electro-technical application, to make the necessary measurements for a just appreciation of the value of these applications and, at the same time to judge critically of electric lighting from an artistic standpoint.

From the latter point of view a more appropriate place could not be found, for, aside from Paris, where all nationalities seem to meet and devote their talent, the Munich school occupies a foremost rank both as regards the number and talent of its painters and sculptors.

At the Industrial Palace during the Paris Electrical Exposition in 1881 artistic applications of the new methods of illumination were quite limited.

The saloon for paintings, lighted with the Pateil lamp, certainly produced a very happy effect, and the arrangement of the theatre and the apartments of the President of the Republic showed that marvels might be accomplished in the way of luxurious lighting, but, up to this time any lighting of museums and monuments had not been accomplished, while at Munich attempts of the kind were made with considerable success. All who visited the Bavarian capital at this period will recall the excellent effects produced by the Schubert lamps on the Praxenhöfstrasse and at the same time, the electrical arrangements in certain streets. They will also recall the tasteful decorations of the various saloons filled with objects of art, and in which the light from elegant chandeliers illuminated in such a magnificent manner the superb products of Bavarian art.

It will therefore be seen what an amount of interest the inhabitants of Munich ought to take in the study of electrical machines and motors, and above all, in the study of the transportation of force; and it will readily be understood why the Committee on Organization on learning of the statements advanced by M. Marcel Deprez relative to the transport of at a distance, urged that gentleman to give experimental proof of the same, and freely placed at his disposal every means for the com-



MUNICH ELECTRICAL EXHIBITION.

From another point of view the application proper of electro-technics, the place was most favorable; for, if in some cases, where with steam as a motive force, are susceptible of rendering important service, they must be still more serviceable when natural and less expensive forces can be made available.

Now, Munich is traversed by the Isar, whose magnificent falls are capable of producing thousands of horse-power. The natural force thus created is moreover not confined to a single point, for arms of the river traverse thickly in various places, so that the utilized force has there already received a natural distributional beginning.

pete demonstration of his lately experiment.

Notwithstanding these favorable conditions, however, electrical industries were, until recently, but little known at Munich; but when Prof. von Bezold, of the Polytechnic Union, and Engineer Oscar von Miller, of the Society of Architects and Engineers, described before large meetings the marvels of the Paris Exposition, there was no longer among the members of the society but a single desire—that of taking up the study of these new inventions, which were being made so rapidly that the electrician himself could scarcely follow them, and determining for themselves by means of practical experiments their scientific and commercial importance

THE TIMES, TUESDAY, FEBRUARY 6, 1883.

ELECTRIC LIGHTING.

TO THE EDITOR OF THE TIMES.

SIR,—While studiously avoiding the discussion of the details of the Provisional Orders which are now *sub judice*, it seems desirable that we should submit for the consideration of your readers who are taking so keen an interest in the correspondence, the following general remarks from the undertakers' point of view :—

1. The Provisional Orders were issued without aid or guidance from the Board of Trade or other public or private source, without precedent of any kind a new piece of legislation, had to be compiled, comprising difficult scientific and practical as well as legal considerations. The task was undertaken with a *bona fide* desire to grapple with the difficulties, and an endeavour fairly to meet the just requirements of the public, and at the same time to afford adequate protection to the undertakers. It was known that the scheme proposed would be subjected to keen criticism, and be corrected wherein it was imperfect ; but it was not expected that we should derive the advantage of a full public discussion of our proposals. In the result, we have no doubt the Orders will benefit by many of the suggestions made in *The Times*, and it will, we think, be found that the undertakers are indisposed to disregard any reasonable objections ; and, as the last, severity for the most ideal commercial working of the new undertakings, it will be their wish to work hand-in-hand with, and to meet the views of the local authorities, as far as is compatible with a due regard to the novelty of the undertaking, and the yet unproved practicability as regards incandescent lighting, in the absence of the complete perfection of a system of storage, of supplying private consumers on an unlimited scale. That on the profits will depend upon the number of consumers so undue pressure need be applied to force the undertakers to what their first interests will dictate.

2. Your correspondents for the most part represent their own isolated views, and may be excused for not looking at the matter as a whole. It has been our duty to study the subject carefully, both from a legal and commercial standpoint, and we have had to listen to the views of scientific men, of learned counsel, of engineers, of commercial men, and to adjust our views with due regard to many considerations ; and although we believe there is a great future for the electric light, we are impressed with the thousand-and-one difficulties that have yet to be surmounted. Thus the Orders are considered by Parliament the work will have only commenced ; but during the progress of the Orders, the opinion of capitalists will be formed as to the paying prospects of the ventures, investors will be apt to exaggerate the risks, and in view of the present depression in electric lighting shares they will be sceptical as to the profits. Therefore we say, let the public who want the electric light not reckon without their host, but rely upon the enormous amount of capital required being forthcoming unless there is encouragement in given and reasonable protection afforded, and a tangible prospect of profit given. This is plain speaking, but it is better to end the discussion of minor matters not to lose sight of the great factor—capital.

3. Why have the local authorities with but few exceptions not availed of their preferential rights to become undertakers themselves ? In the autumn there was a general disposition to do so, but other counsels prevailed. The report of the Birmingham Corporation Committee pointed out with unanswerable effect the dangers ahead, and showed that for local authorities to enter upon the business in its experimental stage, when experienced undertakers were ready to meet the requirements of the public, would be unwise. The debt being thus upon our clients and others stepped in, and it is to be hoped that the broadest of reasons which prevented the authorities applying may be extended to the private undertakers, and that undue influence may not be attached to the opinions of those counsellors who, now that the companies are applying, would have the authorities comfort as inapplicable to others what applied to themselves, and affect to-day to underrate the risks which yesterday they thought prohibitive, and magnify the prospects of profit they thought unfeasible. Far from the companies wishing to keep the authorities out it was their wish at once to see them become undertakers, knowing that recourse must be had to experienced companies to execute the powers ; but the indirect effect of the opposition to nothing not to cause any misgivings as to the security of the companies rushing in where corporations feared to tread, and thereby with a courage worthy of encouragement, the companies came forward ; and whether they are successful in advancing their own interests and those of the public will be determined by the shape of the Orders.

4. The Orders have been drawn in form to proper account the interest now assumed (from a small scale) as one of the first importance to give weight to the opinions expressed by the numerous critics of the Orders when obtained ; but we do not let any verbal critic suppose that by the phrase, "a reasonable time," a reasonable commodity is made the rhetorical remark as a protest against such a method of legislation, which we should be kept as a higher level. Say it, be it remembered that the best chance of the public securing at an early date the benefits of electric light is through the medium of companies, with the spur of profit to capital, and having an experienced staff, and the chance of carrying out the provisions of the Act, which, by the way, says that no special form of lamp shall be prescribed ; but that the undertakers shall, subject to the companies meeting the conditions, be free, are willing to submit to such reasonable tests as may be considered necessary, the systems are sound and satisfactory, and that "slighted policy of the public" loses the opportunity now presented to secure the early fruits of those attractions of an electric supply, the limit of which cannot be defined !

5. Then, as to the question of monopoly, even the contests before the Electric Light Committee of last Session, as to the period after the expiration of which the undertakers might be compelled to sell to the local authority, and that it was ultimately settled at 21 years, proves that the companies admitted that this was reasonable, and that the period within which the undertakers could keep after securing their undertakings (subject to many limitations that portion of their profits not refunded in the event of purchase. The fears on which the Orders are based are, we think, groundless ; we have the local authority with but partial exceptions, and the Electric Lighting and Power Company (Limited), which, almost alone, represents the Metropolitan Electric Supply Association. Indeed, with which it has been considered, are interested in supplying the public, and in securing to the public capital necessary for the undertakings, and will either prove : as the extent that they are possessed of the requisite capital for the undertakings, or by the powers they will submit that such powers shall remain in abeyance until the Orders have been tested for a term of years as to the success of isolated undertakings, not doubt that any powers should for an undue length of time remain in their hands unexercised.

We are, Sir, your faithful,

WALTER H. ELLIS and CO.

25, Queen Victoria-street, E.C., Feb. 3.

TO THE EDITOR OF THE TIMES.

SIR,—Will you permit me to state that the manager of the Metropolitan (Brush) Electric Light and Power Company (Limited) has expressed his intention to write to *The Times* to-day ? I may perhaps be pardoned for not quite agreeing in understanding the degree of relationship existing between the various members of the "Brush" family of companies.

May I, in my turn, criticise the opening statement of his letter, that he "forbears as hitherto to anticipate in *The Times* the discussion of his draft Order, which is reserved for a another place ?" He must not put on me the responsibility for this anticipation ; as, but for the publication of letters from his company's solicitors, you would not have been troubled with my letter of the 3d instant. They introduced through *The Times* on the 24th of January last the "views" of the London local authorities, who (apparently alone) had not objected to their Order ; and in my former letter, published on the 31st, they broadly characterised the objections of other London local authorities as "comparatively trivial as far as trouble."

Apart from any question between the companies and the local authorities it may be of interest to state that there are 34 applications for Provisional Orders (the Saxton affecting the metropolis—One, by the Edison Company, covering a large central district ; 23 by the Brush Company, covering substantially all London and some suburbs ; three by the Pilsen Joel Company, covering the City of London, St. Pancras, Holborn, and St. Giles's four by the Swan Company, covering the Rosemary square, South Kensington, Strand, and Victoria districts ; and one by the Varley of the parish of St. Pancras ; but with the sole exception of the last-named Order all the applications emanate not from persons desirous of being supplied with light, but from persons desirous of obtaining the right to supply them.

I would like to add, in justice to these new electric light companies, and their able advisers (whatever may be the result of the present applications), that their efforts to grapple with a very difficult problem and to enlighten us upon a subject upon which we are much in the dark, even though not wholly disinterested, will do a great public service and be widely appreciated.

Yours faithfully,

Parliament-street, Feb. 5. H. L. C.

ELECTRICAL REVIEW

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE, TELEGRAPH AND SCIENTIFIC PROGRESS.

(Formerly Review of Telegraph and Telephone.)

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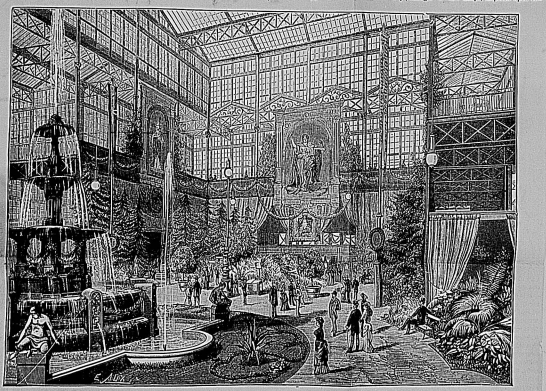
Interesting Features of the Munich Exhibition.

Last year, when the Exhibition of Electricity opened at the Munich Crystal Palace, it will be remembered, a great many electricians, in France as well as abroad, did not believe that it would ever attain anything like the importance it was destined to have. Indeed, in spite of the celebrated experiments which Mr. Jaspard Dupret had begun, and the result of which was expected by everybody, it could not *a priori* be believed possible that since the Paris Exhibition the progress and in electrical science would have been of a general study could be resumed with much profit.

The matchless arc lamps, and incandescent lights exhibited, down to a very few exceptions, were already known. Serious trials of them had been had, and it was difficult to foresee what new experiments could be made.

Consequently the Munich Exhibition looked then as if it were destined to be only a pale copy of its predecessors, when, in reality, it was announced by its very title some as a supplement of what had been done before. Usually of the electrical transportation of power at a great distance, it was not expected that any new invention would come to light ; the purpose was merely to study in a serious manner the sundry industrial applications of electricity, and that in every way and form. It was not expected that on the apparatus, ancient and recent, exact figures, such as to constitute a precise base for future researches. The end proposed was reached, and success crowned the efforts of a diffuse light, similar to that of the day, the brightness of which was hardly surpassed in the reality. The number of lamps might have been doubled, and, without hurting the eyes, the general effect would have been greatly improved thereby.

Having said this much, let us cross the Palace in its whole width ; let us not stop to consider the brilliant palace to which we will return presently ; and, passing under artificially decorated arcades, let us enter the garden of the exhibition. There the decoration did change. Swan's lamps, disposed upon two



THE MUNICH EXHIBITION GARDENS.

rows of slender iron semaphores festooned with loops, garlands, illuminated in a very agreeable manner the small central pond, brackets and chandeliers projecting the same light, and showed the entrance of original grottoes, in which the customers were seated, while arc lamps, from the top of the lofts of the building, spread a bright light on the points on which chandeliers light would have left some obscurity. In the background was the great hall covered with canvas, which constituted in reality the restaurant itself. In its whole width it was lighted with incan-

THE TIMES, TUESDAY, FEBRUARY 13, 1883.

THE INTERNATIONAL ELECTRICAL AND GAS EXHIBITION.

However much it may have been intended in the first instance to conform to the title of the present display of artificial light at the Crystal Palace and to make it an electrical and gas exhibition, in the result it would appear that the title should have been reversed, inasmuch as there is a comparatively poor display of electric light, but a very profuse show of that produced by gas. Such a transposition would more correctly indicate the relative importance of the exhibits as judged by their extent and prominence, and this idea seems to have occurred to the compiler of the catalogue, who, while preserving the order of the title of the exhibition on the title-page, has placed the gas section first in the book itself. The reason why the display of electric lighting is being made is said to be due to the circumstance that the leading electrical companies are not ready, and that the need to further advertise themselves at present has not only induced a scarcity of exhibitors in this section, but even the installations of the few who are represented were, in several instances, at the time of our visit on Saturday incomplete. Not only are the gas rivals actively pressing forward early in great strength and in nightly filling up with more of the Palace with a splendid flood of light. The electricians are in search of the north nave, many of which are apparently recently begun to make some show. In fact the, exhibition has at length assumed a condition of approximate completeness, which renders notice in order.

Keeping to the time the title of the exhibition, we will turn first to the gas section, one of the last examples of which is at present to be seen on the Alhambra court, which is situate at the far end of the transept. The beauties of these halls are fully brought out by the Vitruvium-Lee arc lamps, four of which are suspended in the centre of each, while another is placed in the hall of the Abencerrages, commonly known as the dome, which is very effectively lighted by them. It also illuminated by a number of these lamps, which are of the original Wermdorm type, consisting of a carbon rod and platinum terminal disc, are placed in the remaining three courts of the Alhambra court and in the Tropical department. Another of these lamps standards have already been mentioned in previous notices. The Werdermann-Lee lamp is a new, upon the Wermdorm and Sarting carbon rods of different diameters, the thickness of the upper positive carbon being 22 millimetres and that of the lower negative carbon 20 millimetres. The positive carbon is fixed into a metal carbon holder, the arc, as the current passes through it, being kept steady by means of a solenoid, through which the current passes, and at the same time that it strikes the arc the holder is gripped between three rollers, which are driven by clockwork. As the length of arc increases, the resistance to the current increases also, and a portion of the current then passes through a second solenoid wound with fine wire and being thus a shunt to the main circuit is the one of this solenoid is a lever arc dashpot working against the outer edge of the topmost of the three rollers. The solenoid is magnetized by the diversion of the current it presses this lever against the edge of the roller and forces the latter to slip under it, and so to release a of a proper length. When it has reached a position of this kind, which may be regulated to a thing by means of a weight, the lever becomes detached from the spring which carries the current to the solenoid and it over-balanced and depressed by an upper spring attached to it, which brings it into rollers and allows the current to pass again to the solenoid, which, as they are of definite resistance, are adjusted so as to take according to the requirements of the lamp, that is to say, to keep a steady light. The lower carbon being so much the shorter of the upper one, the arc is kept within a range of one inch in length, and as the lamp is capable of burning for 24 hours continuously, the light produced is comparatively small, but brilliant, and the cost of supplying apparatus just described is not liable to get out of order is apparent from the fact that some of the lamps in the Alhambra court were started when the others were extinguished on the 15th of December last, and are still working. Of the Siemens-Hefner-Alteneck lamps, of which there are a number in the Alhambra court, we have already spoken. The current is supplied by an "A" Gramme machines similar to those which are driven by a 25-horse power engine. Another, a number of power being retained for other machines yet to come. Of the Crompton and Rookin of the Vulcan works, upon the construction of electric lighting, his first demonstration upon the occasion of the Prince of Wales on the 6th of November, 1879 we have here lamp, and one of small intensity, is that of Mr. Crompton's own design, four of which are to be seen in the Tropical department, three of which are to be seen in from others in several important particulars. In most circuit with its enclosure to separate the carbons, or solenoid, is used and also a shunt electro-magnet or solenoid to regulate the arc in each lamp when several lamps are

Lever lamp is that it dispenses altogether with one of these magnets—that known as the shunt is regulated solely by the shunt magnet or solenoid. Superiority is claimed for this system on the grounds of economy in the utilization of resistance, and regularity in the feed of the carbons, economical as regards the current, since it does away with the constant maintenance of the main magnet or solenoid. There a great number of these lamps can be worked in single circuit by the use of a shunt box, a type of the cell-lamp. Instead of bringing the carbon points to come into contact with each other before the current is sent through the lamp, as is usually the case, the process is reversed in the Lever lamp, and the carbons are separated with each other by means of a wire acting as a lever with a fine platinum collar encircling the carbon-holder and thus establishing the circuit. Into the arc, formed of iron, having two arms working through it with large flat heads for the purpose of keeping the metal down to the lever, and underneath this bar of iron, the carbons are the poles of the shunt electro-magnet. The Lever lamp, as we have said, gives a good, steady light, are supplied with current from a Siemens machine driven by a Davey Paxman semi-portable engine of 20-horse power nominal. The Swan Electric Light, Power, and Storage Company, are illuminating one section of the Alhambra court, and those of four of the Duplex arc lamps, the current for which is driven by the engine used for driving the Swan incandescent lamps. Other sections of the Alhambra court are illuminated by about 80 of the Duplex Company's incandescent lamps, also supplied by power cash. These lamps are supplied with the current from a Martin generator, assisted by a small Siemens dynamo, and are driven by a 10-horse portable engine by Messrs. Tasker, Sykes, and Co. This engine and the machines together with the Crompton machines previously referred to are all placed in the large machinery annex at the north end of the tropical department.

Continuing our course southwards along the north nave, we next come to the Gilbert-Ayrton-Hopkinson arc lamps, by eight large incandescent lamps, which are placed in the nave and two in adjoining courts. The object of the court is to be lighted by the Gilbert Company with their new incandescent lamps placed on the same circuit as the arc lamps, the current for supplies with a current from a Gilbert dynamo machine, the peculiarity of which is that it produces a current of constant intensity, but of varying a great factor of safety. The connecting wires from the dynamo machine to the lamps are of small size, and it is shown that they may be handled with impunity, there being no danger to be apprehended from them.

Continuing in a small room in the centre of the nave, where the safety of the system in this respect is demonstrated, we next come to the Siemens arc lamps in the north nave, in what is known as the transept, are driven by a 10-horse power combined engine and dynamo by Messrs. Hammond, Hack, and Jefferies. In this nave there is the generating machinery of the British Electric Light Company, which consists of a large Gramme dynamo of a type with one as we earlier. These are driven by a Davey Paxman 20-horse power engine of 30-horse power nominal. The current is at present supplied to six Brockie arc lamps of the new arrangement, but these are to be added to by others in course of time to complete the installation. The lamps are in the centre of the nave near the centre transept.

Between the transept and the nave are placed the Edison lamps, which are exhibited by Messrs. Steele and Hiemens. These lamps are supplied with a current by the Siemens machines, while a fourth supplies about a hundred Swan incandescent lamps, which are tastefully arranged on Messrs. Steele's stands, which are tastefully large. Only 25 of these incandescent lamps are at present at the same time, as a new machine is only capable of production of the current required for that number. The Edison lamps, however, ranged in four groups, and the current can be switched off and on to any one of the four at pleasure. The machines which produce the current are placed in the west section, and are driven through intermediate countershafting by the 30-horse power engine of 50-horse power, which was originally put up to drive the machinery of the Woollen Exhibition. This engine is also driving a dynamo machine, which supplies the current to the six Blanchard Fyfe Main Company's incandescent lamps, which are placed in an elegantly organized chamber in the Renaissance style at the centre transept. This chamber is the one formerly occupied by the Prince of Bavaria, and was shown last year at the Exhibition of Art Industry at Nuremberg, where its artistic fittings obtained for its designer the highest award of distinction. The arc of electric lighting terminates at the commencement of the transept with the three of Messrs. Gerard and Co.'s arc lamps. Three of these lamps are lighting the entrance to the Fine Art Court, the Lord Mayor's Gallery, while another is to be found in the west corridor, whose the dynamo supplying these lamps is placed, and which is driven by the Gallowray engine.

The floor of the north nave is occupied by the stands of the Brush Company, a variety of electrical apparatus and accessories, the Electrical Trading Company exhibit samples of Mr. Bernhard Hurst and Co.'s electric con-

ductors, which are a wide departure from ordinary practice. The conductor is formed of a copper wire, or of several, thoroughly, wrapped with several thicknesses of cotton, and then saturated with something a mixture of paraffin and solution, which forms the insulating material. The protected wires are then twisted into a cable by an ingenious and special process, which results in compressing an ingot of lead by means of hydraulic appliances, and the lead is forced through it over the wire which has been coated with the cotton and the insulating material. This system of manufacture is claimed by the contributor to establish a high insulation without decay, and they are favourably reported upon in other connections. The Electric Installation Company exhibit some telegraphic and electrical machinery, which possess a remarkably fast electrical speed, as shown by the figures, and which could be used with advantage for their purposes as insulating ground permanent way for electric conductors, which consist of a plate of earthenware, with a groove, and the naked wires are laid in them and fixed with cement. Another exhibit is that of Messrs. Siemens Brothers, who have a large space in precise three of the north nave. Here will be found the various systems for the transmission of telegraph and telephone messages, which are to be seen overhead in most towns and the underground system of Messrs. Siemens. Grand and detailed exhibit a very useful description of the various systems for the transmission of telegraph and electric lamp standards. There are a number of stands at which electrical and telegraphic instruments of various kinds are exhibited, as well as the details relating to these two departments of applied science. Last exhibit in the north nave of electricity is will represented, but at the time of our visit there was nothing of novelty calling for notice, by which we have described. We must reserve for a subsequent article the gas exhibits in the south nave for a subsequent notice.

Electrical Review
July 19, 1884.

Louisville Exposition Light.

The Machinery Committee of the Southern Exposition met yesterday afternoon (July 9) at the building and signed the contract with the Edison Company for Isolated Lighting, of New York. The contract is the largest that was ever made for lighting a building with electric lights.

The company agrees to light the building and the annexes with 4,400 Edison lights of 16 candle power each, in other words, the plant that will be used will furnish more light than any other plant ever did. It will even be larger than the combined plant used at the great electric light exhibition at London last year.

Some idea of the undertaking may be gained when it is announced that the wire to be used would reach 40 miles in length if stretched out in a straight line. The wire is all of copper, and much of it is very thick. Its weight will be 48,000 pounds. The number of dynamos machines will be fifteen, worth about $2,000 each. To run them will require four of the Armington & Sims engines used by the Edison Company.

The cost of the entire plant will be about $100,000, and it will require about 100 men, working constantly from now until the end of the month to string the wires and put all the electrical machinery in order. The plant will be sufficient to supply a large with 40,000 lamps, as not more than a fifth of the lamps in a room are ever lighted at the same time. Here all will be burning at once. The plant will be equivalent to a gas plant manufacturing 25,000 cubic feet per hour. These figures give some idea of the enormous supply of light that will be required and furnished; but no one can really comprehend how much light will be necessary until the grand opening is entered and beyond then it may be understood what the necessities are.

While the 4,400 lamps are thought on a careful estimate by experts sent out by the lighting company to be more than sufficient to light the building brilliantly, there is no doubt that many exhibitors will want to make a specially brilliant display over their exhibits, and the electric light can easily be furnished from the mains already laid. Edison himself will be here to superintend the completion of the work and the lighting of it. The advantage of the incandescent electric lights in such a building as the exposition building cannot be overestimated. If generates no heat, nor does it absorb any of the oxygen of the air. Were the building lighted by gas the consumption of oxygen would probably equal the amount that a crowd of 25,000 people would use up. The display of electric lights will certainly be beautiful, and those who see it will have the satisfaction of knowing that they have seen the largest display ever made.

The Electric Light Company will make special exhibits of electric motors and of submarine lamps, which are very wonderful and interesting.

Other incandescent light companies will make exhibits of their lights here.

The courts and parks of the exposition will be lit with the Jenney arc light of Fort Wayne, Ind. The company will furnish 75 arc lights of 2,000 candle power each.

Menlo Park Scrapbook, Cat. 1017

No. 11G. "Electric Light"

This is the seventh of nine scrapbooks containing clippings about electric lighting. It covers the years 1880-1884. There is also one clipping for 1877. The book contains approximately 140 unnumbered pages.

Electric Lighting

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THE METROPOLITAN, OCTOBER 14, 1882.

The Electric Light in Clerkenwell.—All public bodies having the care of important thoroughfares are somewhat perplexed at the present time as to the best and cheapest method of lighting. Electricity and gas are contesting side by side, and the former can scarcely be said to have sufficiently advanced to ignore the claims of the latter to public support. Indeed, a question which in the minds of many is only at present partially decided is, whether by the same expenditure upon gas, equal results may not be obtained as from electricity. The Lighting Committee of the Vestry of Clerkenwell has, under the leadership of its chairman, Captain G. A. Potter, been endeavouring to solve the problem, and obtained the permission of the Vestry to try both gas and electricity under conditions which, it is hoped, will indicate with tolerable accuracy the relative merits for two modes of lighting. The committee decided to employ for the purposes of these tests an incandescent electric lamp of greater power than those used by Edison on the Viaduct, and an incandescent gas light which appears to be an old friend in an improved form. So far as the question of electric lighting was concerned the views of the Lighting Committee were met by the Weston Maxim Company, who offered to supply engine, machines, lamps, &c., and to light for a period of twelve months the line of thoroughfare known as the Pennonville-road, from the "Angel" to King's-cross, *for £250*. The lamps were to be incandescent, producing a light equal to 50 candles, and two of each were to be placed on each of the existing lamp-posts. This offer the committee accepted, and further more stipulated that the taking up of the roads for laying the cable, &c., should be done by the Vestry's paviors. The necessary preparations were so far completed that a preliminary trial of the lighting was made in the evening of the 6th inst. The result was most satisfactory, for no part of the road appeared to be in darkness, neither was a lot of power wasted on the adjoining houses, such as one may witness when powerful arc lamps have been used in ordinary thoroughfares. The light was steady and not at all unpleasant to the eye, while it power was fully demonstrated when the current was shut off and the ordinary gas lamps again lighted. The experiment will cost the parish nearly three times the price of gas, but the lighting afforded is nearly ten times as great. The works in connection with the incandescent gas light are not yet completed, and we, therefore, defer full details for the present. The matter, however, stands thus:—In the early part of the summer Messrs. Hegan and Co., of Moorgate-street, who have acted as the agents of the patentees, placed themselves in communication with the Vestry and an exhibition of the light was subsequently given at the Vestry Hall. Messrs. Hegan thereupon submitted a request that the Vestry would grant permission for a certain section of the parish to be lighted by their system, the whole of the expense, including the breaking-up and re-making road and footways, to be borne by themselves. The Vestry was satisfied with the lights exhibited that they gave consent for the trial to be made, and referred the whole subject to the Lighting Committee to arrange. The committee agreed that as Messrs. Hegan had works on Clerkenwell-green, their pipes should start from that point and be continued up St John-street-road to the Angel. Furthermore that all road work should be carried out by the Vestry's paviors, Messrs. Hegan depositing £100 as security for such expense. The patentees were also bound down to remove all their plant at the expiration of the experiment, providing the Vestry were dissatisfied with their system. These terms were accepted and embodied in an agreement, but owing to the patentees wishing to form a company, or some such like cause, the work has not yet been carried out. We hear, however, that the gas company has bought the patent and intends to fulfil the contract made between the Vestry and Messrs. Hegan. Briefly speaking, the system consists of gas and air being driven through separate pipes and uniting in a patent platinum burner, whereby both flame and smoke are avoided, and a soft, but withal powerful, light obtained. The cost will naturally slightly exceed that of the ordinary gas lamps, but the result, it is asserted, will more than compensate for the additional outlay.

St. George's Vestry and the Electric Light.—On Monday night, a committee of the whole Vestry was held in the Board-room, Borough-road, to take into consideration the Electric Lighting Bill, 1882, and to take such steps in relation to the same as might be deemed advisable. A special meeting of the Vestry was held afterwards, to receive the report of the committee. The rector, the Rev. Harman Casali, presided; and there were also present—Messrs. R. D. Hilton, Emary, Gillett, Bacon, Yates, Sinden, Heather, Wm. Taylor, Dowse, Mitchell, Bartley, Beaver, Meredith, White, and Dr. Smith.—Mr. Yates moved the adoption of the following recommendation of the committee:—"That in the opinion of this Vestry it is not desirable at present to apply for a provisional order or license for the electric lighting of this parish."—Mr. Sinden seconded, and the motion was unanimously agreed to.—Another recommendation of the committee was—"That unless the Electric Lighting or other companies applying for provisional orders, or licenses (under such clauses as provided by this Vestry, the Vestry Clerk be empowered to instruct Messrs. Simons and Co., Parliamentary agents, to oppose the schemes."—On the motion of Mr. Bacon, this was also agreed to, and the Vestry adjourned.—It will be seen in another column that steps are being taken for a conference of delegates from all South London parishes on the subject.

The Swan Light at the Paris Opera House.—A very successful installation has just been completed with Swan lamps and Faure accumulators in the Paris Opera House. The lamps were first shown to the public on Friday, September 29. They have been placed in several parts of the building, but more prominently in the foyer, the extremely elaborate decorations of which have been entirely spoilt by the ruthless effects of the electric light the foyer with gas, ten chandeliers, with 48 lights of 20 candles were used—equivalent to about 9,600-candle power. Two of these chandeliers have been fitted with 48 Swan lamps each. There were run up to about 40-candle power, making a total of 2,840 candles for the two chandeliers—almost exactly equal to the eight remaining gas-lit chandeliers. The effect in the neighbourhood of the electric light was extremely marked, and the representatives of the Opera House who witnessed the trial expressed themselves extremely pleased with the result. We may add that all the main cables were covered with lead, and every lamp was protected with fuse circuits to avoid any possible chance of fire.

A Warning Lamp.—An ingenious adaptation of the electric signalling system has been effected in connection with a lamp which is made to give notice of either a burglarious entrance into or a fire upon premises where it is employed. The apparatus consists of a small battery with wires leading to attachments on doors and windows, and other wires communicating with the lamp which may be placed either inside or outside the premises as preferred. If a door or window being moved, after the apparatus has been set for the night and the lamp lighted, a red glass disc is released by the aid of a small electro magnet placed within the lamp, and a red or danger signal is thus given, the light having previously been white. For fire purposes a special thermometer is used, and when the raised temperature causes the mercury to rise, metallic contact is made, and the lamp at once shows the danger signal. The lamp is being shown at No. 23, Lidgate-hill.

NOVEMBER 3, 1882.

THE INDIANAPOLIS JOURNAL.

THE ELECTRIC LIGHT

In Successful Use in Many Places in the City of New York.

W. A. Croffut's Letter.

[In eight columns now since I said anything in these letters about electric lighting, that time tremendous progress has been made, and it is not worth while for any letter-writer to ignore it. Of the achievements of the United States company it is unnecessary to speak, for its blazing arcs illuminate the streets and burn in the cupolas of the towers, but in a few days there were a dozen companies in full operation to furnish any city with the incandescent light—this it is, in light interiors with small shifting bulbs like gas lights—but at this moment Edison's company is the only one actively in the field. It not only occupies the field, but it comes near filling it. Mr. Edison has done all he ever promised to do and his promises usually are paramount, but he has not done it so quickly as he anticipated.

The 1st district of this city is lighted—lighted apparently to the satisfaction of all, besides. Eighty-one buildings are now using the electric light exclusively, and more are being added every day. Only one engine is being used at present, and 16 dollvers all the time. Four more were purchased, and more. The last one was to be delivered on the 3 per cent., but the force from the engine-room now is only 1-000th of 1 per cent. Mr. Johnson tells me—which implies pretty nearly perfection. The light actually furnished is about nine lamps to the horse-power. The six engines in the Pearl-street station were bought not to run uniformly, and are being supplied with all services. Next week, Monday, will be the 4 lighted together, and 400 buildings will be supplied. Then 4 more, and those already on the circuit. The next district to be lighted will be the heaviest in the city—that of which Madison square is the center.

The Times is lighted on the circuit of the first district. I went into the counting-room and found the room last night in beautiful order. They spoke warmly in its praise. "The best artificial light I ever wrote by," said the managing.

The Herald and Telegram establishment is lighted wholly by the same light. I walked over there after completing the above canvass, and saw the editor, Mr. Cannon; and the business manager, the foreman and several of the editorial writers and reporters. They all, now, said the foreman, "as if we could never be satisfied with any other light." The room was clear, steady light, and the temperature of the composing-room, usually too high, is very much reduced. We shall never go back to gas. As to the cost, I don't know. If it is more than gas, I think our men would be willing to pay the differ; more but they say it is cheaper than gas. The office is about 100 feet square, and everywhere the bulbs are hung down from the thickest parts, each surrounded with a large tin shade.

The testimony of the business manager is the same effect, but he added, "It is not only better than gas, but cheaper. Being one of the first district, the Herald is lighted from an isolated plant that is, we furnish our own electricity. We have two engines, one local engineer, engineer, and two firemen. The interest on investment and all, amounts to about $7,000 a year. Our gas bills for several years have been $12,000 a year."

The Edison Isolated Company, besides the Herald building, has already lighted about 100 buildings, mostly manufactories throughout the country. These include the Chicago Daily Inter-Ocean, Cincinnati Commercial, Public Ledger, Ohio State Journal, Brooklyn Eagle, Cincinnati Commercial, Public Ledger, Philadelphia, and Boston Herald.

The largest plant is that of the new steamer Pilgrim of the Fall River line, the largest steamboat in the world.

Said Ralph Meeker of the Herald to-day, "It is as much better than gas as gas is better than tallow candles."

JANUARY 5, 1883.

THE TIMES.

MR. EDISON.

[FROM A CORRESPONDENT.]

The development of Edison's system of electric lighting, of which so much was heard in London during the early part of 1882, has since then almost exclusively engaged the attention of the inventor. It is well known that the Edison system comprises the manufacture, distribution, and measurement of electricity by means of a motor, and the sale of light and power to consumers on their own premises. In New York, the central station in Pearl-street was opened on the 4th of September last, since which date there has been no intermission in the production of the current, either day or night. The pressure on the 30 miles of mains is constant and equal, and the additions to the system average something like 80 lamps per diem. The remarkable simplicity of administration cannot fail to impress even the ignorant visitor. The regulation of the system is carried on by means of an automatic device, by which when the lamps on the system are below their proper candle-power a green lamp is switched into circuit, and when the candle-power is excessive, the fact is indicated by the display of a red lamp. The lamps are perfectly steady, and are maintained at a somewhat greater candle-power than the majority of incandescent lamps in England.

The success of this practical trial of the system is now beyond question. Not only are the inhabitants of the district daily demanding the supply of the light, but stations up town in New York, as also in Boston, Chicago, and Denver, are already in contemplation.

Not less successful is the Edison Isolated Company's organization for the supply of light to mills and factories, &c., by means of plant on the premises. The company declared an annual dividend at the rate of 10 per cent. during the month of November, and in so doing eclipsed the distinction of being the first electric light company to pay a dividend on the results of electric lighting pure and simple, excluding profits on manufacture or sales of concessions.

The Edison Lamp Company, whose factory is at Newark, in New Jersey, possesses an establishment which is remarkable even in the land of ingenious processes. The Edison lamp passes through more than 200 stages during manufacture, many of which are automatically performed by the agency of electricity. Mr. Edison's mind is stamped on many of these processes, the exquisite simplicity of which elicits admiration from the engineer. Edison turn out 10,000 lamps per day, and according to Mr. Upton, Mr. Edison's manager in the undertaking, the resources of the factory are sufficiently capable of accommodating the demand.

At the Edison Machine Works, at Goerk-street, New York, the dynamos, large and small, are manufactured. Since January of the present year more than a thousand shipment to London; four were despatched for Milan, where a central station on the Edison system is being organized by Professor Pacinotti.

The factory of Bergmann and Co. is exclusively devoted to the manufacture of switches, fittings, sockets, regulators, and other details of the complete Edison electric light system. Here also the application of electricity as a motive power and lighting agent was manifested in an impressive manner. Mr. Edward H. Johnson, whose name is well known in London, together with Mr. Edison is continually at work improving the minutiæ of the system, it was shown a simple screw, the sole survivor of 42 separate and discarded models, which had failed to satisfy Mr. Edison's standard of efficiency. Details of the system are accurately and constantly subjected to the fierce light of criticism, and continually being brought up to the requirements of the inventor. As an example of American manufacture and administrative power, the following is one instance:—An order for light the Boston Bijou Theatre with 650 lights was completed within 11 days after receipt of the order. The theatre was wired, the boilers and engines were placed in position, the current turned on, and the special regulating system necessary for switching the lights on the various circuits on the stage or auditorium not only devised and manufactured in New York, but also in position. The writer was present at the opening of the theatre when different acts and scenes successively produced and all the necessary scenic effects obtained by the aid of the Edison light alone. The theatre was better lighted than the Savoy in London, and the regulation of the lamps seemed to be under more immediate control. The feasibility of accomplishing this work in so short a time arose greatly from the absence of such complications as the legislative restrictions as in England impede the progress of electric lighting there.

During past years Mr. Edison has suffered from fulminations, premature, inventions of his inventions, and for some time, therefore, he has remained silent, reserve present information as to the progress of his inventions. Some months have elapsed since the Edison system was first shown to the English public at the Crystal Palace, and, as is well known, it is operating in various places. Since then Mr. Edison has, however, not been idle. He has made remarkable discoveries, the effect of which is greatly to increase the efficiency and reduce the cost of the light. These discoveries include a considerable improvement in the dynamo and the invention of a more economical lamp of very high resistance. It is interesting to know that in England and the capacity of the machines does not involve the disuse of any of its parts. Nothing is made obsolete. A simple and inexpensive addition increases, to use popular language, the electrical horse-power, and the use of the improved lamp more light is obtained from a given quantity of electricity than is now the case.

Patents for these and other improvements have already been applied for, both in England and the States, and the English company will shortly give a public demonstration of the new inventions. Mr. Edison's knowledge of the conditions of the electric light question in England is complete. To his mind the price of gas in England is the one factor in the problem which requires solution. It is this problem to which he has applied himself with so much success.

THE PRESENT POSITION OF ELECTRIC LIGHTING.

[FROM A CORRESPONDENT.]

It is now a matter of surprise to many that the progress of electric lighting has been so slow. The superficial observer of two years ago was impressed with the idea that perfection had been reached, and henceforth there would be a rapid supersession of gas by the new light. It will be well to discuss briefly one or two of the causes which have led the non-scientific public astray in their conclusions as to the capabilities of the electric light. The greatest enemy to electric lighting has been speculation. It amuses even those who for years have been students of finance to see how admirably the financial affairs of certain, large companies have been managed. Those companies have been treated, with an enormous capital, to manufacture and install apparatus, which to those who understand such matters, was seen to be applicable, for a very moderate extent. A new form of obtaining revenue was found in the selling of concessions—a method, again, of limited application and doubtful expediency when the future as well as the present is considered. Usually a manufacturer is willing to pay commission to agents, but here the order of things was reversed, and agents paid large sums to manufacturers in order to become agents. Such a course might with advantage be pursued in the case of absolute monopoly, but in the face of the keenest competition it is absolutely fatal. The apparatus manufactured, saddled not only with the ordinary manufacturing profits, but also with the interest of the capital sunk by the concessionaire in purchasing the concession. We need not point out that this term "concession here," when analysed, indicates something totally different from the term "concession as generally applied to gigantic engineering works in the shape of railways and canals in new and sparsely populated countries. The electric light concessionaire has been principally concerned with a system of lighting termed arc lighting, that is, lighting by means of arc lamps. Such a system is not applicable to ordinary dwelling or bed rooms, but, undoubtedly, more economical than any other system; but few people care about a light equivalent to two or three thousand candles during dining, drawing, or bed rooms; then, again, these lights are not altogether unexceptionable in point of beauty. They have an objectionable glare of blinding when you particularly seek quietness, and of casting a flickering and flickering light when you ask for perfect steadiness. Till the result of the long series of experiments carried out by Edison and Swan in England, and the almost contemporaneous experiments of Edison in America pointed out that a small lamp to give light of similar intensity to that of gas was practicable, the concessionaires for lighting seemed to be independent upon the degrees of perfection which could be given to arc lamps. Directly, however, the results of these experiments were published, and incandescent lamps were seen and tested, those who understood the matter saw that these lamps were suited to take the place of gas, and that the future of electric lighting was closely connected with the incandescent as opposed to the arc system. Thus, the enormous speculation in arc systems was incomprehensible, and by forcing into notoriety a system which has small value, great harm was done inasmuch as a system that is incomparably its superior, viz., We would not be understood. The arc system has a place, but

of usefulness, but when compared with that of the incandescent system the field is indeed limited.

A second preventive to rapid progress was due to legislation. Existing laws operated against the introduction of the new light, and it was not till the last Session that a Bill was passed to increase facilities and remove obstructions. There has not yet elapsed sufficient time to allow the legal conditions imposed by this Act to be carried into effect. The necessary notices have been duly given, and drafts' provisional Orders, adapted in accordance with the requirements of the Act, to about one hundred and fifty cases, so that early next Session several of the better-matured schemes will, no doubt, be granted. We have reason to know, so far as having carefully considered the draft, will enable one to know, that the drafting of the order has been done in a very able manner, and an attempt has been made to establish a model order, the chances of which duly consider the welfare of the companies, their duties and privileges, while at the same time guarding the public against imposition and loss.

We are glad to notice that a few of the local authorities are applying for orders. It cannot be too often or too strongly impressed upon the various authorities that before committing themselves to any company they should take an opinion from those competent to give one. Unfortunately the number of men whose opinion on such a subject is worth having is few, and great care should be taken in the selection of consulting engineer.

It may be surprising again to learn that, even had facilities existed for the introduction of the electric light as far as regards legislation, it would till quite recently have been impossible to carry out any work on a large scale. The dynamo machines required to produce the electric current were practically, models, and entirely useless for lighting on an extended scale; Mr. Edison, indeed, constructed machines to supply currents to a thousand or fifteen hundred of his lamps, but we think the general opinion is that the sixteen candle lamps as seen at Holborn are of too low a candle-power, preference being given to the whiter light of the twenty candle-power Swan lamps. This question of candle-power has little to do with the value of the Edison or any other lamp, because it requires only a modification in the manufactors to increase or decrease the candle-power. Mr. Edison can give lamps of twenty, forty, or a hundred candle-power, and no doubt will do so if public opinion favours the higher intensity. Mr. Crompton's machine, if report is trustworthy, is far surpassed by that of Mr. J. E. H. Gordon, which has been constructed at the Telegraph Construction and Maintenance Company's works at Greenwich. This machine is compact, strong, said to be economical, and will supply a current for six thousand Swan lamps of twenty candle-power. The design of this machine admits of much larger machines being constructed, and we have heard of one to such items of cost as may have been overlooked; supply twenty-four thousand lamps. Nor would a machine for this purpose be unwieldy. Three and many towns where two of the six thousand lamp machines would adequately supply all that light required. The machine has the disadvantage—if disadvantage it is—for to what is technically known as an alternate current machine, and cannot be used for the transmission of power, or without mechanism, for the charging of accumulators. There is no doubt this machine has made its appearance at a very opportune moment, when large designs are in contemplation. That other large machines with direct or alternate current will be constructed hereafter is certain, but we are dealing with the present. Before long has been made to accumulators, or secondary batteries. The popular conception of these adjuncts to electric lighting is ludicrous.

THE PROVIDENCE EVENING PRESS

CONGRATULATORY NOTICES
Of the Electric Light Competition
Held at Providence, R. I.
The Electrical Engineer, of New-York, the leading electrical paper of the country, in a recent issue says:
"We have from time to time commented upon the work which the American Electric and Illuminating Company has been engaged in, in introducing the Thomson-Houston electric lighting system in various New England cities, and commended its vigorous methods of dealing with difficulties. It has acted up to the position with which it has been set in establishing itself in Providence, and have inferred ourselves as to the facts in the case.
It seems that in the Congress, since recently elected, issued a building in Providence, suitable for an electric light station, equipped with steel lattice of two hundred feet, and the New Armington & Sims engine of fifty horse-power each, and the necessary dynamos and all the apparatus of electrical excellence for a full two hundred light plant; expending in actual cash over sixty thousand dollars in the work, every dollar of which has been paid. Having thus established with its customers in a business way; it asked the city council for authority to run its wires overhead instead of as now in the streets. Its petition was referred to a joint special committee of both branches of the city council, and a hearing was had on last week, Nov. 21, that committee gave a public hearing, at which the petitioners by attorney and any who desired to oppose, could be heard. The city of Providence, unlike many cities, that has air and hot water should be more extensively used, and no doubt the architects of the day is leaning in this direction. Health and comfort will precede excitement when this happens, other things besides the Street can be considered. Our own impression is that as yet the absolute cost of electric lighting is not sufficiently constant the comparison with that of gas is misleading. We do not believe, with other electricians, we give figures prepared by perhaps the greatest authority on such matters who has taken for what they are worth. The "units of consumption, on the side of gas, "the cubic foot of gas consumed per hour, equal to a light of sixteen standard candles;" on that of electricity "76 volt-amperes of electric energy, equal to giving a light, with a Swan lamp, of 12 candles per hour." The various considerations are given under heads of "cost of supply, how charged for, cost of manufacture, maintenance, management, repairs, and profit. Altogether the estimate is decisive as to the superiority of electricity, the cost of gas being 1900 percent more than that of electricity, that of electricity the same, with 21 per cent. profit.
If this estimate is approximately correct, it will be seen that there is a fairly large margin to meet or are unknown. The work at the New Arcade Castle, which will at first be only temporary, will be watched with great interest, but we think Mr. Crompton, who has done more for the practical introduction of the electric light than any other engineer, is little likely to neglect any precaution necessary for the work to prove successful. The electric light is being introduced into Windsor Castle under the able superintendence of Mr. Massey. In such places as these there can be no reason why, when the original balance-sheet is made, a much truer idea of cost should not be obtained than under the idea of cost in dotted from estimates made under exceptionally favourable circumstances.

Journal, Feb. 4, 1881.

ELECTRIC LIGHTING IN THE CITY.—As was announced by us some time ago, the Commissioners of Sewers of the City of London are about to try the experiment of lighting by electricity some of the principal streets within their jurisdiction for a twelvemonth, and for testing side by side, as it were, three of the most accredited systems on a scale and under conditions which must make it crucial as regards the present conditions of the problem. The task will not be the least attempt of the City in this direction. Acting on the report of their engineer, Colonel Haywood, the Jablochkoff system was tested on the Holborn Viaduct from the 4th December, 1878, to March 9, 1879. During that period sixteen electric lamps were used in place of eighty-six ordinary lamps, fourteen being placed at equal intervals on either side of 473 yards of street, and one lamp at each end of this distance in the middle of the roadway. The lamps illuminated about 888 yards superficially, and were kept burning seven hours per night at a cost of 2d. per lamp. No photometrical observations were made by the Committee during this experiment, because the Metropolitan Board of Works were conducting simultaneously the electric lighting of the Thames Embankment, under exactly similar conditions, and some scientific officers of the Board came to the conclusion that the illuminating power of the light, when mentioned, was about five times that of ordinary gas, and when enclosed in the opal globes used on the Viaduct seven twice as much, while the actual cost was nearly four times as much as gas. The companies have greatly reduced the cost of producing the light since then, and of course there is a more formidable competitor with gas. Under the new arrangements the Commissioners of Sewers have decided to try the Jablochkoff, the Brush, and the Siemens systems. The first will be applied to Southwark Bridge, Queen Victoria Street, and part of Queen Street; the second, to New Bridge Street, Ludgate Circus, Ludgate Hill, the east side of St. Paul's Yard, and thence along Cheapside to Bow Lane (King Street); and the third to the north of Cheapside, the Poultry, King Street, Guildhall Yard, Moorgate Street, Lothbury, King William Street, and Gracechurch Street. The contract price is £2250 for the Jablochkoff, £1410 for the Brush, and £2700 for the Siemens districts. It was intended that the experiment should commence on the 1st of March next, but the severe weather has so delayed the preliminary work that it is doubtful whether necessary arrangements can be completed by then. The Commissioners, in order to bring their arrangements have utilised the best data at their command in regard to guaranteed illuminating power of each lamp, and the superficial area of roadway it will command, but only careful scientific observations will determine the exact photometrical value and economy of these competing systems.

THE SATURDAY EVENING CALL.

THE EDISON ELECTRIC LIGHT.

Yesterday it was announced that the Edison electric light company is now fully formed, composed of our leading business men and capitalists, with a capital stock of $50,000, nearly all of which has already been subscribed. It is proposed to place a plant in actual operation on one of our business streets and furnish the public with the inconsistent light.

To those who have not seen the incandescent system, an explanation will be in order. The light is contained in a small vacuum glass globe, about the size and shape of an ordinary pear. Contained within the glass is a fibre of bamboo, bent in the shape of a loop. The bamboo, previous to its introduction into the loops, is scraped to the right size and weight, placed in a nickel mould, bent in loop form and carbonized. After this, the metal points, which conduct the electricity to and through the carbon, are electroplated into the carbon. The glass globe is then exhausted of air and sealed up to form a perfect vacuum. . .

The lamp being completed, it is tested by instruments capable of ascertaining its resistance with po-itive accuracy. The means of economy is found in those lamps having a resistance of about 140 ohms, all others are thrown aside and used only for experimental purposes. Mr. Edison has surrounded his system of lighting with safeguards against all possible danger of fire by a series of wires are called "safety plugs," which are placed so as to control each and every lamp, from the best one to the machine which generates the electricity.

These safety plugs, which are of lead, melt at an excess of heat in the maine, and obviate all danger of fire by destroying the electrical circuit in that branch. The beauty of the light consists in its antiflam steadiness, absence of heat (there being almost one-sixteenth the heat generated as from a gas flame) and its entire freedom from all noxious gases which are noticeable in all other artificial lights. Parties who have seen it pronounce it the finest artificial light in the world.

Danger to life is absolutely impossible with this system, as in no case is a stronger current than 110 volts of electromotive force used. The human body requires about 1,200 volts to destroy life, which is done, in fact, to its high resistance to the passage of the electricity. The mild current of the Edison machine will in time be used directly as one of the best medical agents for the curing of nervous diseases.

The dynamo machine, in use by the Edison company, is the entire product of the brain of Mr. Edison, and differs in all essential points from all others. The armature is built up of plates of sheet iron, insulated by sheets of tissue paper, and bolted firmly together. By means of this arrangement, the armature which revolves in the magnetic field is kept perfectly cool and nearly every particle of the electricity generated is utilized in the production of light. By means of the construction of his dynamo and armature, Mr. Edison utilizes almost every atom of the electricity generated, which he converts into light. In no other electrical machine is this possible; the highest results which have been obtained from careful tests having given not to exceed fifty-five per cent. Scientific men who have given us the subject of electricity the study of a life time, all unite in pronouncing the Edison system in every respect the most complete in all its details.

Locals is specially favored in being the first city of its size to obtain the privilege of introducing the Edison light. From reports from the district in New York City, which was lighted for the first time on September 4th and has been in continuous operation ever since, the light is giving universal satisfaction, and hundreds of applications are daily received for the light in other portions of the city.

It is probable the Edison light will be in actual operation in Locals in about six weeks' time, when the unanimous verdict will be in its favor.

Snow, May 27, 1877.

THE ELECTRIC LIGHT AT CHATHAM.—After several experimental attempts to utilize the electric light in Chatham, it appeared that the authorities have now succeeded in obtaining a satisfactory illumination of the large building of the Brush Company. The apparatus used being supplied by the Brush Company. The light is supplied by 12 lamps, of 2000 candles each, and is worked by a 14 horse-power engine.

THE ELECTRIC LIGHT AT LINCOLN.—The first attempt in Lincoln to use electricity as a means of lighting large workshops has been made by Messrs. Hoe and Co., of the Globe Works, and the experiment has proved an unqualified success. The Brush system has been selected by the firm, and the spacious workshop devoted to the fitters, turners, and erectors—which in consequence of its great size gleamed offered the greatest difficulties in the way of complete utilization of the light—has been the first dealt with. . . . .

IRON. JULY 20, 1881.

THE FITZGERALD ELECTRIC LIGHT.—A demonstration of the Fitzgerald electric light took place last evening, at the works of the Fitzgerald Electric Light and Power Company, No. Gray's Inn Road, Holborn. The light is one of incandescence, and is produced by carbon loops, the carbon being prepared from vegetable fibre. The carbon is placed within a small globe, from which the oxygen has been previously exhausted by chemical means, but it does not burn in a perfect vacuum. The Fitzgerald electric machine, which was described and illustrated in *Iron* for the 4th March last, was not used upon the present occasion, it being stated that it had not been completed. The Edison machine, capable of producing a continuous current of uniform employed and a mild and pleasant light was produced, such in fact as enabled reading or writing to be carried on with comfort, particularly with an opalescent globe over the lamp. The light can be increased by increasing the number of the carbon loops. It was demonstrated that an available light could be produced, sufficiently economical for interior illumination.

OCTOBER 24, 1882.

THE KANSAS CITY DAILY TIMES.

ELECTRICAL EXHIBIT.

THE WONDERS OF THE CRYSTAL PALACE AT MUNICH.

A Curious Piece of Architecture—The Building Itself Picturesque—A World by Itself—Aerial Costumes—Curiosity Notes.

[Special Correspondence Kansas City Times.]

MUNICH, Sept., 1882.—In the building which for some weeks almost every year is much frequented, while all the other time it stands dead and forsaken, there are, since the middle of this present month, active life and doings. The cause of this motion is the electrical exhibition.* Every day, in the evening, the surrounding streets are occupied by hundreds of people, who partly admire the electrical street illumination, and partly look at the wonders in the interior of the building. Before we also enter let us take a glimpse at the exterior of the building and its history.

The "Crystal Palace" bears its name with right, for the walls and the roof of the colossal building are formed by nearly 80,000 plates of glass, which are contained by an iron skeleton full of 3,000,000 pounds weight; the edifice has a length of 800 feet; in the centre a breadth of 300 feet and an area of 300,000 square yards. The Crystal palace, originally built by Voit, was constructed October, 1853—January, 1854, by Kramer-Clett, on the site of the palm house in the botanical garden, and was only in use for the industrial exhibition of 1854, but when it was to be taken down it appeared that the cost would be more than the worth of the material, and since that time it has been used for various purposes and for all exhibitions.

WHEN OPENED.

The electrical exhibition was opened on the evening of September 16, in the presence of several thousand people, by Luitpold, Prince Theodore, the representative of his majesty the king. About 1,000 particularly invited guests assembled at 7 o'clock in a separate room near the entrance. There were present the ambassador of France, Austria, Holy and Russia, the president of the ministerial council, the highest civil and military officers. A short time before the arrival of the princes Count Lerchenfeld and the Duke of Braganza appeared, and at 7:30 Charles Theodore drove up in full state. He was received by the committee and conducted into the gallery of the assembly, while music was intoning a festival overture by Lachner. At the end of it the president of the committee, Dr. Von Steinheil, delivered a short speech and proposed the illustrious account of which cannot be given on account of the crowd and time. He spoke first of the great hour of opening; then of electricity's wonderful power, and stressed the importance of electricity in their applications; conquered our scientific asset at electricity with that of our materials; expressed the belief, that electricity soon would be accessible to everybody, and then the importance of Munich as being destined to become the centre of this new industry, and she work, and directed the request to the chief that he might open the exhibition in the name of his majesty, who had accepted the protection of it. . . . .

AT HIS DISPOSAL.

The duke replied: that it was the wish of the gracious king, has charged him to express his majesty's satisfaction in his mind with these high exhibition for electricity. The high importance which the branch of physics in science, in industry, even in all social concerns of the human race generally has attained, as in the life of the single individual, has been obtained by travelling. Not only the scientific but every cultivated man will await with interest the result of this exhibition, may it bring information in him who is research in the special study, and offer new marks to the creating genius. I declare the exhibition opened in the name of his majesty the king of Bavaria. . . . .

Prof. Hecker gave a toast which was very appropriate for the occasion, and three cheers were given for the sublime protector of the exhibition, of which all the assembly connected, whilst music was playing the national hymn. In company with Dr. Steinheil, the duke took a stroll through the exhibition building, which occupied half an hour, whereupon the guests went into the theater of the exhibition, which was electrically illuminated. . . . There were executed some night tableaux composed of the leading dances of the ballet corps of the Royal theater. The charming forms in their aerial costumes, Bacchic crowns and connected by colored bands and pearl strings by the beams of the electric light, glistening in many colors, formed ravishing groups, the like of which, perhaps, never before the feast of his majesty. The tableaux contained played in the national hymn, which concluded with great enthusiasm. After a short duration of the illumination of the exhibition another half an hour in the building, whilst the gardens in the rooms in vain expected the illumination of the streets. It could not be executed, because the machine was not finished. . . . .

A WALK IN.

If as we now walk in. On entering the interior we are struck by the numerous rows of columns of magic. We are in a garden like Schönbrunn or the most where, with its riches and its richer. Groups of figures, the most beautiful the most beautiful plants and ornaments of all imaginable kinds are intermingled with the other objects of the exhibition. Opulent ordinances surround in bright clusters the gallery, which, with its flowers and its plants, is a regular silk arbor. Under fan-palms rises the king's throne, the splendid portrait of the exhibition, the king of Bavaria. The background of the throne is a flower panorama, which contrasts advantageously with the deep green of the plants. Adjacent to the throne is a rare stone, our scholars have perfected. The throne is surrounded by the orchestra of the band, but he scarcely knew what he should do with it. . . . . The brilliant scenery of the whole is the full moon, which, at the command of the assembly, rises in the blue heaven. The flowery bandages of the gallery are reflected in magnificent green, and the whole is a light scene of the most charming effect, but through the spectres are brightening and flowering bandages of light, and thousands of figures move past like shadows, and we enter the dream. Suddenly we are aroused by the ringing melody, which sounds from the orchestra. The gallery is filled by the admiring multitude who stroll there and through the building examining the different inventions of genius. . . . .

Adjacent to this parlor is a magnificent reading room and library for the benefit of all the visitors. This room is also illuminated by our genius' light, and contains a large table surrounded by chairs, for the benefit of the tired and weary who sit down, read papers, or write letters to their loved ones at home. In this reading room you can see all the papers of the continent. The Times and Post of two; those are the London Times and the Kansas City Times. The latter I found myself in the enterprise, and directed the Kansas City Times becoming the general organ of the English speaking people. This organ is a world of its own, and our great American genius, Edison, the best inventor of it. My next letter will be to the business and social life of Munich. G. O.

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THE PROVIDENCE MORNING STAR,

THE CITY FATHERS.

They Meet and Count the Votes Cast on Tuesday.

A Victory for the New Electric Lighting Company.

The Mayor Vetoes the Intelligence Office Bill.

The board of aldermen met at a few minutes past 11 o'clock yesterday forenoon and were called to order by his honor, Mayor Hayward.

On motion of Alderman Burnham the reading of the minutes was dispensed with.

On motion of the same gentleman the following petition of the American Electric and Illuminating Company was referred to the chief engineer of the fire department for examination and report:

To the Honorable the City Council of the City of Providence:

The undersigned, citizens of the city of Providence having a favorable opinion of the system of electric lighting used by the American Electric and Illuminating Company, hereby respectfully request that the application of said company to erect and maintain poles and wires in this city may be granted:

Tilden, Thurber & Co.,
H. L. Rose,
Builders' Iron Foundry, Z. Chafee, jr., Treas.,
Armington & Sims Engine Co.,
Henry C. Cranston,
Geo. A Lester,
Boston and Providence Clothing Co.,
Talbot & Co.,
L. H. Humphreys, Hotel Dorrance,
Henry T. Root,
J. B. Barnaby & Co.,
M. Steinert & Sons,
Rhode Island News Co.
Macullar, Parker & Co.,
Wm. Stone, agent Adams Express Co.,
Geo. C. Elliott & Son,
Miles & Luther,
Arnold & Maine,
Wm. Blodgett,
W. H. Low, jr., opera house,
John L. Mason & Co.,
Anthony, Cowell & Co.,
A. J. Magoon & Co.,
Flint & Co.,
James T. Moore,
John W. Butts, Jr.,
Henry Greene,
Samuel W. Peckham,
J. G. Markland,
Edward S. Jones,
Providence Lithograph Co.,
Angell Water Wheel Co.,
J. G. Harris,
James H. Smith,
D. P. Williams,
L. W. Farrington,
C. B. French,
Mulvey & Brady,
H. W. Fenner, Jr.,
William Y. Potter,
W. H. Colwell,
Winsor & Brown,
Belcher Brothers & Co.,
Wm. B. Blanding,
Wm. E. Clarke,
E. A. Hopkins,
S. B. Brown,
W. E. Kinnicutt,
Ira Winsor,
John W. Danielson,
Kenyon, Grimwood & Co.,
James Lewis Peirce,
Theodore H. Colvin,
N. T. Spink,
Cady & Dean,
W. B. M. Stillman,
H. O. Carpenter,
Geo. E. Chase,
David Cady's Sons,
Arnold, Baker & Miller,
Geo. A. Rice,
E. E. Remington,
Cairns & Williams,
Walker & Tucker,
Geo. D. Loveland,
A. Fenner,
John L. Casey & Co.,
E. P. Sumner,
D. Mackay,
W. B. Thompson,
R. W. Sweet,
Holmes & Chadbourne,
Albert R. Briggs,
Chas. Cargill,
Geo. P. Whitney,
Thos. R. Houry,
G. P. Pomroy,
Eben J. Beane,
Edward C. Almy & Co.,
Wetherell & Pierce,
Geo. M. Ardoene,
Henry Valleau,
W. H. Greene,
W. H. Charnley,
P. F. Hoye,
Chas. H. George,
J. A. George,
D. O. Black,
E. T. George,
J. Anthony,
Geo. M. Ashley,
A. H. King,
William Huntoon,
J. M. Studley,
L. A. Tillinghast,
Arthur W. Wellington,
H. S. Bloodgood,
Owen E. Leavens,
Geo. H. Leavens.

THE ELECTRIC LIGHT MATTER.

After dinner, to which the board adjourned at 2:15 p. m., having occupied the time up to that hour in counting the votes cast on Tuesday, the board reassembled, and before proceeding with the counting, Alderman Burnham asked to call up the petition of the American Electric Lighting Company, and presented the following report of the committee appointed to investigate the matter:

The joint special committee to which by resolution No. 446 (C. S.), approved Nov. 7, 1883, was referred the petition of the American Electric and Illuminating Company, a corporation organized under the laws of the state of Maine, report that as required by chapter CCIV., city ordinances, notice of a public hearing on said subject was published in the city newspapers, and at the appointed time the petitioners appeared with counsel as did also the Rhode Island Electric Lighting Company. Both parties were fully heard, the Rhode Island Electric Lighting Company being the sole remonstrant. The petitioners presented evidence satisfactory to your committee that they are, as claimed in their petition, "competent and ready to do business," that theirs is a genuine and legitimate business enterprise, and one in which a large number of our own citizens and business men are interested, many as stockholders, and many as parties desiring to use the light to be furnished by the petitioners. They also presented satisfactory evidence as to the high estimation in which their light is held in cities where it is used. Your committee is satisfied that these petitioners are responsible for any debts or damages for which they may become liable, they having a large visible property in this city, and also an agent or attorney, long resident here, whose name is a sufficient guarantee for the good faith of any enterprise with which he may be connected.

The committee recommends that the prayer of the petition be granted; the petitioners to give bond to indemnify the city against damage resulting to it thereby. A bill for an ordinance is herewith presented, the passage of which is recommended by the committee.

For the committee:

GEO. H. BURNHAM, Chairman.

A request signed by about 100 of our leading business men, asking that the petition be granted, was read, as was also the report of the chief engineer of the fire department. At the same time Mr. Burnham presented an ordinance granting the American Electric and Illuminating Company permission to erect poles and wires, and to use the poles of the Rhode Island Electric Light Company, paying them a suitable compensation for the same; also ordering them to have an attorney here upon whom any process could be served, and to give a bond to secure the city for any damages or losses.

Mr. Brennan wished the matter laid over to the next meeting and moved to that effect, but Mr. Burnham said the company wished to get to work, and the citizens wished the lights as soon as possible, so Brennan's motion was lost.

The ordinance was then passed.

THE OFFICIAL COUNT.

The counting of the votes was then proceeded with and finished. The official announcement showed that Thomas A. Doyle had 3,590 votes; Augustus S. Miller, 1,180; scattering, 43; Doyle's majority, 2,367.

The votes for license were 2,217; against, 1,754; majority for license, 463.

Montgomery had two majority over Carty in the ninth ward, so that the delegation from that ward will be Messrs. Carpenter, Brayton, Arnold and Montgomery.

A VETO MESSAGE.

The following was received from the executive department and read:

CITY OF PROVIDENCE,
EXECUTIVE DEPARTMENT,
CITY HALL, Nov. 28.

Gentlemen of the Board of Aldermen:

I return herewith, without my approval, a bill for an ordinance entitled "An Ordinance for the Government and Control of Intelligence Offices in the City of Providence," which passed the board of aldermen Sept. 10, and the common council Nov. 5 last.

As the authority to license intelligence offices, for the purposes enumerated in the bill, is already conferred, by Chapter 353 of the Public Laws, passed March 29, 1883, upon *town councils*, under which term are included *boards of aldermen*, the ordinance is unnecessary. I have therefore withheld my signature therefrom.

WILLIAM S. HAYWARD.

The veto was unanimously sustained.

MISCELLANEOUS BUSINESS.

A communication from the board of public works, recommending the purchase of two lots of gravel on Hall street, was received and referred to the committee on city property.

On motion of Mr. Burnham, the resolution to transfer $200 from the appropriation for furnishing the Berlin street school house to the appropriation for the Vineyard street school house, which was passed in the last meeting of the common council, was passed in concurrence.

A resolution ordering the board of public works to build a sewer on Nash lane was passed without reference.

A petition of the American Rapid Telegraph Company asking to be allowed to repair their lines in this city, by putting up new poles, the present ones not being heavy enough, was granted, the work to be done under the direction of the city engineer.

A joint resolution was passed to lay out Stimson avenue from Hope to Angell street.

A petition of taxpayers living on Greene street, asking that the lantern on that street, between Westminster and Washington street, be lighted, as the electric lights did not illumine the street, was read and referred to the committee on lamps.

Petitions of Charles B. Fisher for lamps on Providence street, of H. H. Snow for lamps on Blackstone street, and of Henry Pitman for the restoration of a lamp at the corner of Union and Middle street, were read and referred to the committee on lamps.

A communication of City Engineer Gray gave as the estimated cost of bringing Jackson avenue, from Potter's avenue to Beckwith street, to curb grade as $1,052.07, and a resolution ordering the street to be so brought to grade was read and referred to the committee on streets.

A communication of the board of public works relative to the repair of the wall in front of the estate of William Gallagher, on Branch avenue, which was knocked down when the city was curbing the street, was received, and the board of public works ordered to rebuild the wall under the direction of the committee on streets.

A resolution discontinuing the private lights on Young Orchard avenue was read and passed.

Stanton B. Champlin, John B. Gough, John E. Barry, John D. Earle and Alonzo Flint were given permission to erect barns.

Joint resolutions were passed to lay water pipes in Providence street, and Jenckes court.

The Union Railroad Company, on report of the committee on railroads, were granted permission to lay rails on Traverse, Front and Pike streets, to their new barn.

The following petitions were read and referred: To build barns, the following, viz.—Hartwell, Richards & Co., at No. 70 South street; Michael Mulvey, on Miner street; William H. Place, at No. 470 Eddy street; Providence Gas Co., Langley street. To locate and operate steam boilers, the following, viz.—Phillips & Griswold, at No. 493 High street; Providence Pile Driving Co., near Aleppo street; Alphonse Sackford, at No. 103 Orange street.

Ives Post, No. 13, was granted permission to hold a masquerade ball.

The resolution to pay balance of salaries due the firemen for the month of October was read and passed in concurrence.

The resolution to pay George M. Ardoene $160 for refreshments furnished the firemen at the annual inspection of the fire department was read and passed in concurrence.

A petition of T. R. Jenkins to be appointed a police constable was referred.

The weekly reports of Dexter asylum for Nov. 17 and Nov. 24 were read and received, and the time of the quarterly meeting fixed for Dec. 8 at 3 p. m.

On motion, all unfinished business was laid over until the next meeting.

It was voted that when the board adjourns, it adjourn to Thursday, Dec. 6.

The board then at 6 o'clock adjourned.

Iron, May 27, 1881.

A WHOLE TOWN LIGHTED WITH ELECTRICITY.—Akron, Ohio, which, according to the census of 1880, contains a population of 16,512, is the first town or city in the world wholly illuminated with the electric light, the Brush system being used. The lights are placed on two high towers, one of which is 229 feet high, 208 being above the surface of the street. The tower is made of No. 1 boiler plate, of 50,000 lb. tensile strength, and is made in fifty-five sections, each section being 50 inches in length. The outside diameter at the base is 3 feet, and at the top 8 inches Eight feet from the apex is a copper shield or reflector, 5 feet 2 inches in diameter, designed to protect the lamps from the elements. Directly underneath the shield is an apparatus for hoisting and lowering a carriage on which are hung the lamps. On each side of the tower is a ladder, which serves as a guide for the carriage, and which can be used to ascend to the top in case it is necessary. Thirty feet from the street is an iron balcony, reached by an iron ladder, which is used for renewing the carbons. The tower rests on a strong foundation, and is guyed. One hundred feet was riveted together and raised into position, and the remaining sections were added. The second tower, or mast (of wood), is 46 feet high, and placed on the observatory of Buchtel College, a little over four-fifths of a mile from the iron tower. The engine which runs the dynamo-electric machine is located nearly midway between the two stations. It is of 60 horse-power, 24-inch stroke, and 14-inch bore, and will run three electric machines like the one now in use. It makes 100 revolutions per minute, and the dynamo-electric machine 800. On each tower or mast are four lamps, each of which is of 4000-candle-power, making 16,000 candle-power to each station. Each station illuminates an area one mile in diameter. Each lamp is provided with four carbons, and as soon as two of them are burned the remaining ones switch in the circuit automatically. By this arrangement a lamp is expected to shine for sixteen hours. The length of the wire in the circuit is 1·72 miles. A No. 7 Brush machine, placed in the central engine-house, generates the electricity. The entire cost, including engine, machine, towers, new engine-house, etc., is about $8000. The town was first lighted on Saturday, April 23, and it is said the light is entirely satisfactory.

APRIL 14, 1882.

IRON.

THE ELECTRIC LIGHT IN PRIVATE HOUSES.—The Edison Electric Light Company had on Tuesday evening a demonstration in connection with the illumination of the Holborn Viaduct and adjacent streets and houses by means of their incandescent lamps. The station from which the district is supplied is at 57, Holborn Viaduct, in the basement of which two dynamo machines are employed to generate sufficient electricity to feed 2360 incandescent lamps of 16 candle power. The smallest of these machines weighs 22 tons, and supplies 1000 lamps; while the larger one supplies 1300 lamps. Insulated wires are laid in the convenient subways which pass along the viaduct, serving as mains from whence numerous submains, or branch wires, insulated and enclosed in tubes, convey the current to the various buildings which are lighted by the company. The lights exhibited illustrated in a practical manner the variety of uses to which the incandescent lamp is applicable. Chandeliers and brackets, reading lamps, and table lamps in abundance, fitted with all kinds of globes and shades, demonstrated the perfect simplicity and practical usefulness for all purposes of the incandescent light which Mr. Edison claims to have been the first to introduce to public notice. A meter by which the current could be supplied to shops, public buildings, and private houses was also exhibited, and the method by which the amount used could be registered was explained. The Holborn Viaduct Station already supplies some 200 street lamps, besides the 60 in the London, Chatham, and Dover Railway Station, 175 in Dr. Parker's City Temple, and other lamps in the Imperial Hotel and private warehouses. The whole of these lights are under complete control, and can be turned on or off as simply and as easily as an ordinary gas-light—more easily indeed, as the application of an external light is unnecessary.

Iron, Feb. 4, 1881.

THE FOX ELECTRIC LIGHT.

YESTERDAY afternoon a number of ladies and gentlemen assembled in the large hall of the Palace Chambers, Westminster to witness a demonstration of Mr. St. George Lane Fox's system of electric lighting. Amongst the company were Lord and Lady Penrhyn, Admiral Sir Edward Sotheby, Sir Henry and Lady Green, Sir George Dasent, Mr. J. Shaw Le-Fevre, M.P., General Hyde (India Office), Professor Adams, Sir Algernon Borthwick, &c. The visitors were received by the directors of the British Electric Light Company, under whose auspices the demonstration took place. The hall was agreeably lighted by a number of lamps on Mr. Fox's principle, which consists of a carbon loop giving an incandescent light, and enclosed within a glass globe, the light being produced *in vacuo*. A Gramme dynamo-machine was used, and the gist of the system—which we shall describe more fully in our next—consists in the method of sub-dividing the electric current and in controlling it. Mr. Fox proposes a central station at which the current shall be generated, the distribution taking place by means of main conductors laid under the streets with branches laid on to the houses. These branches are to be distributed in the various apartments just as gas is at the present time, and the light is to be turned on and off in the same way by means of a tap or switch. The similarity of the system to that propounded by Mr. Edison will no doubt occur to our readers as it did to us; but it is stated that although the Fox lamp is nearly identical with those of Edison, Swan and Maxim, yet Mr. Fox's patents are of anterior date to those of those gentlemen. Moreover, Mr. Fox's system involves some important additions in the methods of distribution and regulation. Mr. Fox also demonstrated the applicability of electricity on his system to heating as well as to lighting purposes by boiling a vessel of water by the aid of the current.

PROGRESS IN THE APPLICATION OF ELECTRICITY SINCE THE PARIS EXHIBITION IN 1881.

The Paris Electrical Exhibition of 1881 was a fair representation of the condition of electrical science at that date. The practical developments which were there foreshadowed were great as to lead some one to speak of that Exhibition as being the birth of an infant which even at its birth was a giant. A number of letters appeared in these columns which chronicled the condition of the science and of its practical applications, especially to the electric light and the transmission of motive power. Although the time which has elapsed has not been memorable for any discovery or invention of great importance, yet it will be a matter of interest to look back and see what has been done in the practical development of electricity.

Since the date of the Paris Exhibition the principal advance to be recorded in connexion with electric lighting is the more complete working out of the incandescent lamp. The conditions of manufacture required to insure its lasting, to keep the vacuum perfect, to prevent the filament from breaking, and to keep the glass globe from being blackened, have been successfully studied. But there is very little to chronicle in the improvements in arc lights. An arc light consists of two carbon rods between the points of which a current of electricity is passing maintaining a bright arc of light, while at the same time the positive and the carbon rods are consumed at an intense white-ness. Meanwhile the carbon rods are consumed; and the difference between the most copious consumption in the mode of keeping the carbon points at the proper distance apart at the in this way. This "feeding" of the carbons is generally accomplished by the weight of that part of the lamp which supports the upper carbon, and in most systems it is only the upper carbon which moves. In consequence of this the point where the light is most gradually sinks, and for this reason very large globes are required to surround the light. When the public have seen a more ordinal it will certainly demand a lamp with the light in a fixed position, and this will necessitate the mode of feeding the carbons to be effected by a powerful spring.

Of course the main force tending to bring the carbons together must not be allowed to bring them too close. The most usual method is to cause the shunt current, by some electro-mechanical contrivance, to clock the action of the "feed," except when the distance between the carbon points becomes too great. When this happens the resistance opposed by the arc of light to the current is increased; so that in most of the artificial arrangements which have been devised for effectuating this, which is an instrumental measuring of differences of resistance. Thus, when the resistance of the arc becomes too great an electrical mechanism is brought into action which releases the "feeding" mechanism and causes the carbons to approach each other until the resistance is again adjusted, when the "feed" is again checked.

The principle of this has been applied in a good arc lamp as follows:—The shunt current is made to pass through a small change in the resistance of the arc will allow the "feed" to act, and so to the moment of the approach. The adjustment is gained by making the moving parts as light as possible and by employing the most delicate electric contrivance for checking and regulating the "feed." One of the most beautiful results designed to fulfil this condition has been furnished by Sir Charles Bright, in which the delicate apparatus known in telegraphy as a relay is used to determine when the "feed" shall be given. But during the past few years inventors have devoted most of their attention to preventing the overfeeding, which produces a blazing noise, often accompanied by sputtering and flickering. In the Brush and many other lamps this is effected by connecting the moving parts of the mechanism with a piston which falls in a tube full of gravelene. In the Jaspar, Gulcher, and other lamps the glycerine is replaced by mercury. In the arc form of Siemens lamp the "feed" is checked at each beat of a pendulum, and is allowed to continue only if it is required. In the Gramme lamp it is similarly checked by a spur wheel at the passage of each tooth. In the Crompton lamp a light centrifugal governor performs the same office. In the Pilsen lamp and some others an overfeed produces opposing electrical forces which cause the carbons to recede again to their proper distance. This is the principle for the great steadiness of this form of lamp when it is not shaken. If by the irregular action of the steam engine the current is increased, the resistance of the arc diminishes and a sputtering would tend to set in; but no further separation of the carbons was possible. Several arc lamps are used with alternate instead of continuous currents; but in this case there is some loss when the current has to be conveyed to any distance. There is one lamp, however, of this class, the Gerard lamp, which has lately been perfected, and is so remarkable for its steadiness as to attain that it deserves a passing mention.

In some kinds of lamp the feed is given only at intervals. This was the case with the Wallace-Farmer lamp, in which, when the arc became too long for the current to pass, the carbons were brought into contact, and then separated by the strong current thus generated. This produced a momentary blinding flash. In the Brockie lamp this is produced at intervals of about half a minute by a separate current in the place of the shunt current. The arc is never seriously lengthened, so that it is virtually a lamp with a fixed distance between the carbons, subject to a periodical flicker.

Numerous lamps have been invented in which the "feed" is regulated, so that the carbons are fixed and the arc is constant, but the distance between the carbons increases. From these lamps is very steady, and in most cases the position of the arc of light remains fixed while the carbons wear away. This is the plan adopted in the Jablochkoff lamp, which has been described, and which has been successfully used in the office of *The Times* for years. The lamps of the Wilde, Jablochkoff, and Jamin type, in which a fixed distance is maintained by having the two carbons side by side and separated by the distance required, and which, have not found much favour in this country. In the lamps of Sir Benjamin Stone, Siemens, and Joel type, in which a thin rod of carbon is kept in contact with a block of carbon or metal, and a light is given, partly by the intense heating of the point of the rod, and partly by a small arc which appears between the block and the adjacent part of the carbon rod.

There is, however, one of these lamps of a purely incandescent form which deserves special notice. The lamps soleil, or sun lamp, when exhibited at Paris, was almost universally condemned by electricians, but since then it has risen in favour, and is now in daily work in Paris and elsewhere. It consists of two short thick rods of carbon of the cheapest kind, which slide down two platinum tubes in some refractory material, so that their lower points would meet were they not separated by a block of marble, which is shaped so as to throw the light in any required direction. Over this, consisting of a thin piece of carbon, connects the platinum tubes at first. This is heated and burnt away after having heated the marble and rendered it conducting, so that the current can pass from one carbon rod to the other. Although the currents of high intensity are generally used, the light is steady and good in position, the lamp itself is very cheap, and the cost of materials consumed is insignificant.

As would be as ludicrous a task to attempt to say which is the best kind of arc light for a given purpose as to discuss the patent rights of the inventors of electric lights and machines. What has now been said will enable any one to grasp the distinctive features and merits of different kinds of lamps which may be in the form of Siemens

It is now nearly 40 years since the first attempts were made to produce an electric light by the passage of a current of electricity through a material of high resistance. Carbon was selected because it has never been fused, and probably remains in a solid state at the highest temperature to which it has been raised. (The word probably is used because some spectroscopists think otherwise.) Next, when carbon is heated in the air it combines with the oxygen and burns away. For this reason the rod or thread of carbon has been enclosed in a globe of glass from which the air is exhausted. But here a new difficulty arises, for carbon is found to contain a large quantities of gas within its pores. When the carbon is heated this gas is evolved, and partly by combination with the carbon, and it may be partly in other ways, wears away the incandescent carbon, often degrading it as a film, black lamp soon the glass globe. Ultimately the filament or carbon gives way, and the current cannot pass. By keeping the carbon at a high temperature in an electric current, and continuing to exhaust the gas which is evolved, this defect is partially avoided, but a new defect has been met with. In maintaining a perfect vacuum, for making a good connexion between the carbon thread and the metallic connexions, and for securing carbons of uniform resistance, and with many carbons. The carbon threads are generally made from some vegetable fibre in its natural state or in a manufactured condition. This raw material is then generally packed away in charcoal parts in a crucible and put into a furnace for some hours. This converts the material into a charcoal filament, upon which some makers deposit carbon by heating it with an electric current in an atmosphere of hydrocarbon until the deposit of carbon has made the resistance of the filament exactly equal to the standard. The prepared thread is then attached to its wire terminals, which are welded to some glass tubing. It is then introduced into the globe, and the air is exhausted by a mercurial pump, and the globe is hermetically sealed. The current is then passed through the filament, and the electric current is heating the filament to incandescence. This is the process in which, with modifications, is followed in the construction of nearly all incandescent lamps.

The softness of the light of these lamps, their absolute steadiness as compared with a gas light, the small degree to which they heat the air, and their non-consumption of the air by burning, the state of purity, render these lights as perfect as they could be desired. Their lasting qualities are now very good, and the question of expense has now reached a point at which general adoption on a large scale. Their cost as compared with that of gas, with equal lights, is considerable; but it must be remembered that in most cases of lighting by gas the heat evolved is considered than one lamp of 1,000-candle power. The great branch which the Crystal Palace Electrical Exhibition of last year conferred on the public was to give them a practical opportunity of seeing for the merits of the incandescent system of electric lighting, and of its suitability for domestic purposes. The extent of this system at the time of and after the Paris Exhibition was so enormous and so sudden that the display of incandescent lighting at the Crystal Palace was undoubtedly the most magnificent which has yet been seen.

The largest installation of incandescent lamps in the way of town illumination has been partially completed by the Edison Electric Lighting Company of New York. About 14 miles of street conductors have been laid, and a trial of 5,000 lamps has been made. No complete information as to the details of construction, cost, &c., has as yet reached this country, but there can be no doubt that such a valuable illuminant will be extensively used in America as a trial.

In Great Britain and Ireland companies have hitherto been hampered by rival interests. The President of the Board of Trade deserves all credit for his carrying through the Electric Lighting Bill and encouraging experiments. But he is to be regretted that many of the local authorities are averse to making use of their new powers, and the gas interests will raise many opponents at every step in the movements of electric lighting.

There has been a good deal of alarm about the free risks of electric lighting. It is very right that the risks attending every system of lighting should be guarded against, but such legislation caution must not be allowed to degenerate into panic. A very wise course has been taken by the Society of Telegraph Engineers and Electricians in appointing a committee to discuss these fire-risks, and to recommend rules and regulations for reducing them to a minimum. The most common source of danger arises from the possibility of a short circuiting. The wires leading to an incandescent lamp may be very thin, for the current passing through them is feeble, owing to the high resistance of the lamp. But if the wires, by abrasion, bad insulation, or other cause, happen to meet, the resistance of the lamp is then cut out, and a powerful current passes through the wires and heats them sufficiently to inflame any combustible substance in contact with them. The chief precautions recommended by the committee are good insulation, the employment of sufficient diameter, frequent testing for "leakage," and the use of cut-outs and the introduction of "safety fuses." These are usually made of lead wire of such a diameter that they would melt with any current arising from a short circuiting which would be dangerous. Moreover, the supervision of the work should be intrusted only to experienced and skilled electricians. The committee also recommend that the earth should form part of the conducting current, as it increases all the other risks and dangers. Of course there may be exceptional cases where this precaution may be unnecessary. Arc lamps should be provided with separate cut-outs to prevent the carbons and glowing carbon from flying about. Special care has to be taken to the gilsen of the switches, so that they cannot become overheated, nor give rise to a measure gas.

But there are also dangers to life, and several deaths have arisen from the employment of dynamo machines of very high potential which have been used for medical purposes. The committee will be accused by some of being over-cautious. They recommend that a current of electricity of greater than this would ever be used in the present state of electric lighting. The amount of electricity passed would not seriously injure a man, but the danger would be that the respiratory muscles would be interrupted by a lamp going out while his body still completes the circuit. In that case he gets the full force of the "extra current" momentarily, and the muscles of respiration are paralysed. This machine, and this may lead to a most serious and dangerous accident. There is another recommendation which is most wise, but which will affect the interests of many. It is suggested that "the lanterns and all parts which are to be handled should be insulated from the ground."

A great deal of interest has been taken in accumulators, or storage batteries, in the past year. Most people will be aware that the quantity of working with the Faure accumulator in 1881 came to the conclusion that it was by no means perfect. Its chief defects are that the lead plates wear away, that the felt which envelops these plates becomes rotten, that the

minium or red lead which is spread upon the plates falls off, and that great supervision is required in charging and discharging the cells. It had been hoped that these accumulators might be charged at some fixed place—perhaps by the force of a waterfall—and then transported to any place where energy was wanted, and used to drive machinery by means of electrometors. The falling off of the minium proved a serious obstacle to the realisation of such hopes. To make the minium hold more firmly, round holes were made in the lead plates, and these were filled with the minium, or the minium was put upon a frame of some kind. Such accumulators are forrasting in form, but it has never been found that the most regular and efficient action is obtained with plain plates, and any depressions or holes in the plate induce irregular action. The Faure-Sellon-Volckmar accumulator is said to be free from the old objections. Other materials have been used instead of minium, and lithargre promised good results. In all these cases the advantage gained over the old Plantí accumulatory was that, by putting on a layer of an oxide of lead, the process of "forming" was much shortened. This process consists in passing a current through the secondary battery first in one direction, then in the other, reversing and repeating it at times, and treating it in this way for months, after the plates have been put into the cells. It was a laborious and ex-tensive operation, but the result was, if anything, more satisfactory than in any of the forms in which a salt of lead is laid on the lead plate, directly at. Planté has succeeded in rendering the place of his lead plates slightly porous by treatment with dilute sulphuric acid. This is found to facilitate the "formation" of the plates very much indeed, and the porosity is also produced (in lead in a finely divided state) by deposition from the solution of lead salts or other means; and by compressing the powder into a compact mass they have obtained sheets of very porous lead. The rapidity with which secondary batteries made of this material can be "formed" is remarkable, and those who have made experiments on these plates find them to be superior to any others. It seems, then, that after all there is no decided merit which was raised above the Faure battery, we are likely to return eventually to a form which resembles a Planté accumulator of a much greater extent. It is satisfactory to know that the economy of secondary batteries continues to be carefully studied by Dr. Gladstone and Sir. Trike, and also by Professor Hodge. Their chief result is that the action observed in these secondary batteries is largely influenced by the sulphate of lead formed by the reaction of sulphuric acid in the cell. These researches promise to help greatly in the future development of the invention.

It may be confidently said that so soon as a practically perfect accumulator is devised its applications will be very numerous. The current which is required from it is much more steady than that which is obtained from a dynamo machine, so that a light obtained therefrom is more steady, and incandescent lamps are more liable to be injured by sudden changes of temperature. Moreover, when a number of these accumulators are placed between the two wires going from a dynamo machine to a system of incandescent lamps, they act as a regulator on the current from the dynamo machine, much in the same way as a flywheel acts as a regulator on a steam engine. In any extensive system of electric illumination by incandescent lamps it is probable that stores of accumulators in different districts will be fed by the machinery from a central station, and that each of these will feed its district with the electricity required for illumination. At present accumulators require too much care and attention for their introduction into each private house.

In the course of the correspondence from the Paris Exhibition published in *The Times* for 1880, it was stated that the prevalent feeling among electricians was that the problem of electric lighting was solved, and only awaited further development, and that in a few months the greatest advance might be expected to be in the applications of electricity to motive power. A great many experiments have now been made in that direction, and although there is not yet any great advance to chronicle, there is no doubt that these attempts will give electricians much useful information.

It is to be hoped that before very long electricity will be used so much for electric lighting that it will be laid on, like water or gas, through subterreats in our principal towns. When that is done there is no doubt that this constant motive power will be largely used. But at present the cost and inconvenience of generating electricity on a small scale prevent its general adoption. Motors for converting the electric current into work have been invented, and they do not leave much room for improvement. There is one such invention in this branch of the science. The only striking novelty in the invention of Dr. Werner Siemens, of Berlin. He causes a metal ring to rotate, supported at its outside by two sets of three rollers, one set being bevelled and working in a groove on the ring, and the other set working resembles a Gramme ring in form, but only three-quarters of it is wound from the insulating material is of brass. This ring revolves inside coils of insulated wire, like the coils on the ring of a Gramme machine. But in this machine the coils are fixed. The iron ring of the ring is magnetised by a current passed through the coils, and at the same time by the magnetism from ring is induced further into the coils, just as an iron rod is sucked into a coil of wire through which a current is passing. As the ring turns round the current is passed successively through the different coils by means of an ingenious and novel commutator. Of course the reverse machine action might be used to generate electricity. There is no doubt that theoretically this is a very perfect form of motor, but there are great difficulties in the way of making it a really practical machine. Only a model has as yet been made, and although of most beautiful construction, it is said to be one that great difficulties must be met before it can be considered perfect.

In all attempts to utilise electricity as a motive power, the idea has been to generate the electricity at a fixed station, probably a waterfall, where the source of power costs nothing, and to send the current by wires to the place where the power is required, or to use water-power to charge secondary batteries. Whether the railway train or a fixed machine, the current is then passed through an electric motor, which turns round and drives the machinery.

The most interesting part of the Electrical Exhibition at Munich last autumn was that which dealt with the applications of electricity as a motive power. At a distance of two and a half miles from the Glass Palace there is a locomotive factory at Hirschau. At these works the power is obtained from Fontaine or Jonval turbines driven by a large volume of water with a small fall. About 500-horse power are thus made available. Mr. Schuckert, of Nuremberg, utilised one of these turbines to drive one of his large-sized dynamos, and conveyed the current by thick copper wires to the exhibition. There it was utilised in the day time to drive agricultural machinery by means of a second dynamo of smaller size, and at night to light up 32 Pilsen lamps. About one-eighth of the current was used up by the resistance of the conductors.

At the same time, M. Marcel Deprez made use of the ordinary iron telegraph wire from Munich to Miesbach, a distance of 561 miles, to transmit the power generated by a steam engine at the latter place, and utilise it in the exhibition to pump water. Of course, to do this effectively, it was necessary to wind the dynamos with very fine wire, so as to produce a high electromotive force. The former many difficulties to contend with, but he certainly produced half-a-horse power at Munich, and this sometimes found that there was a return of 58·0 per cent., while they added that occasionally the result was even better. These experiments are very interesting and instructive, and any settlements by the same eminent electrician on a much larger scale are now being made. The latest experiments have been made by him at the workshops of the Chemin de Fer du Nord. The total length of the line was 105 miles, ordinary iron telegraph wire being used as the conductor. Such a system would connect two stations 52 miles apart. In the latest of these experiments it is stated that 45-horse power was delivered by a motor; 10-horse power being used to drive the machine which generated the electricity. Thus it appears that when giving off 45-horse power the efficiency of the combination of machines was 40 per cent. These experiments are being carried out under the direction of a committee appointed by the Academy of Sciences. It is probable that the French Government will assist in developing a knowledge of the mechanics of electricity in the same way as they did with the mechanics of steam when they assisted Regnault to carry out his splendid researches on heat. It is to be regretted that so little has been done in this country in this very promising field. Science is even now in a position to utilise the forces of nature more on the pit mouth, and convey the energy by electricity.

Some progress has lately been made with electric railways. The first was made by the late Lord Dunraven of Siemens and Halske, for the Berlin Exhibition in 1879, where a few small carriages were driven round a circular tramway about 50 yards diameter, the gauge being 0·70 of a metre. In April, 1881, the same firm constructed the Lichterfelde and Berlin electric railway, which is three kilometres long. One of the carriages of this line was shown at the Paris Exhibition last year. The current is passed through the rails, which are insulated. It is then taken up by the wheels and so passed through the motor. The motor turns at a very rapid rate, but it is geared to the wheels of the carriage by belting of wire rope, which reduces the speed of revolution so rapidly as to maintain appearances of an ordinary tramway car, and the machinery is invisible. It was expected that some might prove troublesome in such a system, where the current is passed through the rails, but during winter of 1881-2 was so mild as to be no test of this. At the Paris Electrical Exhibition a somewhat similar car was used, but Messrs. Siemens were not allowed to utilise the rails, as though as rails, on account of the danger to horses, &c.; horse they were obliged to carry conductors consisting of split tubes on telegraph poles, and a small current was distributed to each train which made electrical contact with the motor on the car. Another electrical railway has now been completed by the same firm, between Charlottenburg and Spandauer Bock, a distance of two miles, and carriages is used, as at Paris. This line is 3¼ kilometres long. Two-and-a-half kilogrammes are loved, but this line is specially interesting from the fact that a whole kilometre is on the very considerable incline of 1 in 20. Messrs. Siemens have also applied the same principles to haulage in mines. A small electrical locomotive is used in a mine near Dresden with a driver eight metres loaded with coal. In general experience of Messrs. Siemens has gone to show that it is more satisfactory to use overhead wires than the rails as conductors, and that by using a greater electromotive force may be used; and also that rail conductors should never be placed upon the level of the ground, but that elevated railways alone are permissible on this principle.

The electrical railways spoken of in the last paragraph are all *fairs accomplis*. But besides these completed railways there are many such schemes. Special attention may be drawn to the line which is being constructed at Portrush and the Giant's Causeway, in the north of Ireland. This railway is to be worked by electricity. It is intended to drive the cars by means of turbines, which will be driven by water obtained from the waterfalls which abound in the district. These will drive turbines which will be made to generate the current. The electricity is to be conveyed along the iron head, the return current passing through the rails and the earth. It is also proposed to use accumulators, which will be charged by the machines on the locomotive while going down hill.

Mr. Edison is also constructing an experimental line in North Park. But the information which has reached this country through his own agents is of so fragmentary a character that it is impossible to give any opinion upon his scheme, nor has anything been done as yet to add to the engineer's knowledge of the conditions of the problem. Mr. Volkem's representatives in England state that the line is to be eight miles long. He is stated to believe that the only weight (and that small) will go at 40 miles an hour; that the loss in the machines will be only 10 per cent., but that he allows for a loss through leakage of the insulators of 50 per cent., and that the cost will be 33 per cent. cheaper than a steam locomotive. But as he is said to assume that a locomotive costs 6d. per horse-power per hour, it is clear that no opinion can be formed on the subject at present. The electromotive force is stated to be only 110 volts, which will involve the use of large and expensive conductors.

There is no doubt that so long as trains are driven by electrical connection with the electricity generated by steam power, no economy will be gained. This was distinctly stated by Siemens, at the last meeting of the British Association, by the president. Address. No attempt has as yet been made to apply the electrical motive power to any carriage or truck on a train. The advantages of such a system are numerous. The weight of engines would be permissible; a train would reach its full speed after stopping as rapidly as an automatic brake now stops it; and the wear and tear of the lines and rolling stock would be considerably diminished. From this point of view it is not impossible that electricity may be successfully employed through the intermediary of electrical action in some cases.

Messrs. Coulard and Gibbs have lately introduced a novel plan by means of which a small kind of current of high or low tension can be derived by each different consumer of a current from the main circuit. They generate electricity with an alternating current machine, and supply a number of people on a single circuit. Each consumer has a convivence on his premises by means of which he can carry off the current he requires, whether for transformation into heat, lighting or for motive power. This contrivance consists of a coil of wire connected with the main circuit, round which there is another coil of wire, thick or thin, large or small, according to the current required. In the main circuit another coil is quite unconnected with the main circuit, but its two ends are connected with the lamps, &c., which require a supply of electricity. The alternating current in the main circuit induces currents in the secondary coil the character of which depends upon the way in which the coils are wound. The loss by this conversion is slight, and than would have been expected *a priori*.

In the construction of dynamo machines there is no very important improvement to chronicle. Numbers of them have been invented, but these which have any prospect of success are generally

TO THE EDITOR OF THE TIMES.

SIR,—The very interesting article on this subject which appears in *The Times* of the 23rd inst. fully explains the comparative views, from which to base the matter before you from another point of view. Practically all the previous orders are still in force, but for greater certainty I will deal with the Chelsea order of the Brush Company.

The company propose for their area the whole parish of Chelsea. They suggest for the district you describe as the area (district "A") the Duke of Fellowes-row, Sloane-street, King's-road, Oakley-street, and the Thames Embankment; and they suggest that they will spend on the parish £14,000 in the first thing (as regards new mains), and leave there it rests. The parish gives up itself to the company, but the company give nothing in return. The company *need* not spend one penny, and yet they will have the parish in occupation with for two years. They may not sell or underlet by leave of the Board of Trade without any notice to us and without our consent. Supposing the company is serious in proposing to do the work, surely they should be forced to spend the £14,000, or give security that they will do so.

If a lighting centre is ever formed for this district the company may charge at their discretion by meter (when one is found accurate), by unit, energy, quantity, number of lamps, or quarterly rental. Did it ever occur before that a public body had the choice of charging in so many different ways? And is it reasonable that they and not the public should have that choice? The Act of Parliament says nothing about closing for two hours or on a Sunday. This power might cause great inconvenience to the public. The Act of Parliament says the wires should not be overload. The company take the power to go over-load. Twenty-one years was decided to be a reasonable limitation about. I may add the company have the right to say "We are governed by the Act of Parliament, "If so, why not put in 31 years? Clauses 5 and 4 of the Act, read together, show that the Board of Trade have no power to limit. This order takes away the vestry's power and gives it to the company, without inquiring why or how. Conditions or something the vestry at all.

To the penalty for failure of supply is 40*s.*, but at the end of clause 50 the following words are inserted:—

"Provided always that the undertakers shall not be held to be liable to penalties under this or any of the preceding clauses of this Act for any failure to supply or any interruption to the same beyond the undertakers' control, or could not have been prevented by the exercise of reasonable care and skill.

"50. The undertakers shall not be deemed to have committed a default in respect of their supply unless such default shall, from the frequency of its recurrence on the part of the undertakers, be evidence of inefficiency in the undertakers' staff or plant."

And having got over these quicksands the Board of Trade has power only to relieve from penalties.

I venture to say that it would be just as well to leave out the penalties altogether as to put in words which are so full of loopholes. Clause 49 provides that the undertaker shall be present at such testing in this department, which is known by the company that we will test at a given time, when it may be presumed the branch will be exhaustively tested, and not for three months after that the company may go on saying that they are under the direction of Mr. Gordon, Mr. Crompton, chairman of the company, and Mr. Pamphilon, of the Post Office, for the purpose of witnessing the effect produced. This seemed to be all that could be desired, the room to all intents and purposes being a theatre. But a great improvement in the new system of lights is that it has done away with the coal gas in which the room was previously lighted, 16 of the Brush lamps, each equal to 2000 candles, being substituted.

The temperature has been reduced by ten degrees, and the reading of addresses by the employés much facilitated. Indeed, the whole feeling of the latter in regard to the matter is greatly in favour of the new lighting apparatus. The electric machine is driven by a double-cylinder engine of 14 horse-power, supplied with steam from one of the boilers. The experiment, on the whole, seems to have given complete satisfaction, the authorities at the Post Office being greatly pleased with the result of this innovation on the old system of lighting their premises.

Sir,—I have observed the communication from a correspondent in *The Times* of the 23rd inst. on the subject of the manner in which the electric companies propose to manipulate London and several provincial towns by obtaining Provisional Orders from the Board of Trade which will have the effect of enabling private companies to take up the supply of the public thoroughfares and private houses. There is at present no power compelling anything to obtain powers, to the exclusion of others, for lighting the principal streets of London, and it would be a very ill day for the public which should understand the nature of some of the powers which the companies seek to obtain. The Order contains clauses which are contrary to the provisions of the Electric Lighting Act, 1882, and the necessary clauses referred to in the Act are omitted; for instance, it is enacted that no wires shall be fixed overhead without the consent of the local authority, but the undertakers propose to run wires under, over, and along any streets within the area of supply without obtaining any such consent. The Electric Lighting Act states that consumers shall have the right to sheet electricity for all purposes; but the Orders seek to qualify this by stating that the purposes for which the supply of electricity is intended are private and public lighting only. The undertakers offer to give the supply, either directly by the direct system or by the meter system, but they fail to give any indication of the difference in the proposed mode of supply.

The undertakers propose to place house connections, motors and other apparatus under the public ways opened for any house, and to keep the same connected with the supply, but the consent of those local authorities who are the trustees otherwise at the same time of short dividing spaces of streets is not required. The price at which the gas is supplied is regulated by schedules referred to in the Orders, and it is possible under these clauses that certain portions of the scheduled areas to be left without the electric supply, and that the gas companies, which alone are able to do so cheaply to all of the districts, may cut off the supply at reasonable profit to themselves.

Again, it is sought that the notice of supply should be settled by agreement, or, in case of difference, by arbitration, but there are neither provisions for fixing the price over one area nor that the maximum price stated in the Orders shall be the same for all areas. The Electric Lighting Act enacts that every person within an area shall be entitled to a supply upon the same terms. The Provisional Orders which have been obtained necessarily contain a contract to continue to receive and pay for the supply of electricity for a period of at least two years, and that the amount payable shall not be less than 20 per cent. per annum on the capital expended. The local authorities are also by an illusory proviso allowed to compel by way of security, there being no provisions in the Act requiring security, to enter into any such contract or to give any security. This, it will be remembered, has been found formidable obstacle to the Post Office in the matter of contracts for electric lighting of their premises, and which they have had to overcome. But if the undertakers think that it is even worth while to enter into the question, why should they not? Under some of the clauses the undertakers may, after the expiration of seven years, have their undertaking sold to their bonuses and premises, be released from their obligations, and the whole of the undertaking be sold to the local authority upon such terms. The storage of electricity by consumers during the hours of supply is sought to be forbidden, and the supply of electricity by consumers may be altogether without their consent.

These are some of the extraordinary powers sought to be obtained by the undertakers. The local authorities and persons likely to become customers to oppose these being granted by the Board of Trade, and the Legislature and the standing orders of Parliament may desire to have the matter referred to the Board of Trade tentatively.

I am, Sir, your obedient servant,

GEORGE L. WIGGIN.

Ancel-court, E.C., Jan. 26.

46 Cannon-street, E.C., Jan. 26, 1883.

SIR,—In reply to your letter of this day's date, I beg to say that I have no objection to your publishing my letter of the 23rd inst. in the columns of *The Times*.

I am, Sir, your obedient servant,

OLAF MOSSOP.

GEORGE L. WIGGIN, Esq.

more modifications at the outer machines, and this article still maintains rank of efficiency against all the new comers. A very general feeling has prevailed among users that the directness in which machines will be improved will be in making them larger, so that, instead of revolving from 1,000 to 1,200 times a minute, as many do, the speed shall be reduced to between 600 and 700 a minute. In all the way the belting may be done away with, and the dynamos attached directly to the steam engine. The rapid-rotation engines which have sometimes been used are generally condemned by experienced engineers. Mr. Edison has completed machines of this type, the last of which was shown at the Paris Exhibition, and described in these columns. It was constructed to supply the current for 1,000 of the incandescent lamps. It has been successful in giving good results, and it is very much less dangerous than many of smaller dimensions which have largely used.

But the past year has seen the completion of the largest dynamo machine which has yet been constructed. It is designed by Mr. J. E. H. Gordon, and was built by the Telegraph Construction and Maintenance Company at their works at Greenwich. It can generate a current capable of supplying from 5,000 to 7,000 of Swan's 20-candle incandescent lamps; but the engine power hitherto supplied has been sufficient for only 1,500. It is an alternate-current machine, founded upon well-known principles, but containing important novelties and improvements. It has a workmanlike appearance, and mechanically its construction is excellent. The revolving inclosed weighs seven tons, and is 8ft. 6in. in diameter. The wheel carries the inducing magnets. The coils in which the available current is generated are fixed in position. Mr. Gordon contemplates making still larger machines on the same plan, but it is to be congratulated on having already made an immense step in the right direction. The only objection to this form of machine are those common to all alternate-current machines.

Another machine of the same class has been lately noticed in *The Times*. It is the Ferranti-Thomson dynamo. Its armature is made of copper ribbon wound in a novel manner, and contains no iron. It is designed so that the magnets of the one very close together, and the armature revolving between them is very light, and can be driven at great speed. There is no new scientific principle involved, but it is the lightest machine which has been designed to do so much. The one which was publicly exhibited weighed about 1,000lb., including the exciting machine. It supplied 200 of Swan's 20-candle lamps.

Mr. Crompton has been busy in perfecting a dynamo engine upon the same lines, so that it shall feed a large or small number of incandescent lamps equally well, on a principle which has been explained in several people. In ordinary dynamos the current is made to go round the magnets of the machine before it is led away to the lamps. In this case we find that if some of the lamps are put out the others become too bright. In other dynamos the current which supplies the magnets is taken as a branch from the wires which lead to the lamps. In this case, we sometimes find that if some of the lamps be put out the others grow dimmer. This was first noticed by Dr. Siemens. By the ingenious expedient of taking part of the current for the magnets from the circuit of the lamps, and not from a branch circuit, it is found that, when some of the lamps are put out, the others become rather brighter nor dimmer.

Although no startling improvement has been made of late in the principles of construction of dynamos, much has been done in studying their capabilities. A large number of experiments have been made by scientific men in obtain information on the different electrical and magnetical phenomena. The result of this is that a competent electrician is now able to draw out a specification for the construction of a dynamo machine which shall give the results required, on however large a scale, for any proposed installation, with as great accuracy as a mechanical engineer would design a steam engine for a special purpose. Hitherto the duties of the various parts of machines have been gradually arrived at by a system of "trial and error," which in future will not be done by strict calculation. The era of accurate measurements is now according to that of vague statements. This is largely due to the introduction of a universal system of measurement, founded upon the original suggestions of the British Association. It is a matter for congratulation that our engineer, Sir William Thomson, the late Professor Clerk Maxwell, and others recognised so long ago the necessity for a universal system of measurement, so as to have prepared the way so completely for the practical workers in electrical science, who otherwise would have been much impeded without such a system. The most important function of the Conference at which met at Paris in the year before last was to sanction such a system of measurement and nomenclature. At this date, a year and a half later, there are few workmen in charge of electric lighting who have not a good notion of the amounts expressed by a volt, an ampère, or an ohm; and the watt, or measure of work, will soon be as universally accepted. The electrical movement last that they owe a debt of gratitude to M. Cochery, the French Minister of Telegraphs, for having recognised the importance of these functions which such a Congress could effect, and for having so organised it that the decisions have so rapidly and so universally been accepted.

MAY 13, 1881.

IRON.

THE BRUSH LIGHT.—The directors of the Anglo-American Brush Electric Light Corporation find that the wires through their pipes under the streets of the City have not been sufficiently insulated, the gutta-percha covering having been steadily perishing away.

Therefore, ordered the present wires to be taken out of the pipes, and other wires, with thicker coverings, substituted by the Gravesend workmen. This will be done within a few days. The engines, dynamo-machines, and boilers are working perfectly, but the defect of insulation above referred to has been manifested in several places, and this will, with a view to the satisfactory settlement, to the above decision.

THE ELECTRIC LIGHT AT THE GENERAL POST OFFICE.—The experiments with the electric light which have lately been made in the basement of the Post Office have extended to that portion of the Post Office devoted to the sorting out of newspapers and circulars preparatory to transmission by the various destinations. The room used for this purpose is extremely large, so may be imagined when it is stated that from about 200 to 250 persons are daily at work in it. The electric light used in this department, which is known by the name of the American Brush Electric Light Company, being in full working order, a visit was paid to the Post Office on Tuesday evening by a number of persons interested in the question, under the direction of Mr. Scudamore, the superintendent of the company, and Mr. Pamphilon, of the Post Office, for the purpose of witnessing the effect produced. This seemed to be all that could be desired, the room to all intents and purposes being a theatre. But a great improvement in the new system of lights is that it has done away with the coal gas in which the room was previously lighted, 16 of the Brush lamps, each equal to 2000 candles, being substituted.

The temperature has been reduced by ten degrees, and the reading of addresses by the employés much facilitated. Indeed, the whole feeling of the latter in regard to the matter is greatly in favour of the new lighting apparatus. The electric machine is driven by a double-cylinder engine of 14 horse-power, supplied with steam from one of the boilers. The experiment, on the whole, seems to have given complete satisfaction, the authorities at the Post Office being greatly pleased with the result of this innovation on the old system of lighting their premises.

GLORY GALORE!

The Queen City of the Northwest Now Radiant Twenty-Four Hours a Day.

Elgin Confessedly the Best-Lighted City on the Globe.

The Inaugural Light—The Banquet—The Toasts—The Story.

The Favorable Night.

Saturday was a day of expectation. The word that passed from mouth to mouth about the light the night before seen by but few, and the reports of its grandness had aroused the curiosity of nearly everybody. There was a general said about the coming illumination and much speculation occasioned in consequence. So, when the announcement was made that it would probably start at 7 o'clock and splendid centered on that hour; yet the shades of evening had no sooner set in than many a glance was directed upward and many an exclamation was heard as to the probabilities of realization of hopes or of disappointment. When the hour of sunset arrived the streets were filled with gazers waiting for the sudden flash; and in the more remote parts of town not a few had left their houses and sauntering in the yard or standing at the gate had their optics strained for the bright sight of the first new light. "There it is," and sundry ejaculations were heard from time to time, emanating from fun loving folks who enjoyed seeing the sudden start made by their neighbors at the announcement struck their fears; but it was not to be. Mrs. Miss Anna Bowman, daughter of Mr. Geo. A. Bowen, moved the lever at the dynamo connecting with the circuit. The wire pulsated with the current and the beautiful meteor or ellgence on seven towers instantaneously transformed darkness into moonlight. Perhaps there were present fifty persons, in and out of Richards' mill, where the dynamos are located, who witnessed the simple yet important event and transferred their vision as the switch moved, from it to the lights. The delay from the original intention was caused by the incompletion of arrangements on the tower last erected, in West Elgin. So soon as all was ready the electrician, Mr. Sloat, gave the word and pressed the thing was done.

A stroll about town by the writer was at once indulged in and opinions on every hand were heard. In scarcely an instance were they of a derogatory nature. Two of the lamps on the fountain tower did not seem to work entirely well, but the others there did nobly, and the light flooded the business streets and extended in all directions. The fronts of the blocks were brightened by the bale; the ledge stole across the black river and made silvery pathways; the very air seemed warmed by the gentle influence; and when one stood where he could see all the towers at a distance, the lights appeared merged into one large ball on such structure and to stand like sentinels at convenient intervals watching over the destinies of a busy city. It was a magnificent picture.

At 8:30 three conveyances started from the court house. The first contained Mr. Bowen, Mayor Barclay, Alderman Welsby, ex-Mayor Bosworth, Mr. Bailey, of the Vandepeer company, and other representatives of the daily press. The others carried members of the city council and a visitor or two. The object of the expedition was to view the lights by making a circuit of the city and to spy out the dark places if any there were. The route was up Douglas avenue to Lovell street, thence to Spring, down Spring to a turn which took the party over to Dundee street, thence to Park, Park to Gifford, Gifford to DuPage, DuPage to Channing, Channing to Villa, thence to Liberty, Sherman avenue, St. Charles street, Villa street, Chicago street, and across to West Elgin. All along the line the Illumination was all that could be desired. Beneath the towers and for several blocks it was as light as a full moon could have made it. In other places it was light enough to see the time by a watch, and, to keep out of holes in sidewalks and ditches in the street. What more could be wanted? The cities of inspecting the work of the superintendent of streets by night was entertained as novel; yet it was done. Elgin is the first city to adopt the Vandepoele light on towers, and the company's men were highly elated. Words cannot express the beauty of the spectacle about the meadow, which lights appeared to about the best advantage of any on the east side. It will not be necessary hereafter when lawn boards are to assist to wait for the moon, or use lanterns. After a tour of the west side, which was, if anything, better lighted than the east side, the gazers repaired to the Nolting, in whose office by the time 10 o'clock arrived were over a hundred gentlemen, invited by Mr. Bowen to his banquet. "Then they were, all discussing the subject of subjects; earnestly, candidly, thinkingly; lawyers, doctors, professors, journalists and the universal opinion was "success". Men who had sneered at the project; who had ridiculed this or that part of the accomplishment; who had condemned as foolishness any movement by the council looking to a better light than gas all were there, and they were converted. "If to-night is a sample," said they, "give us the whole package. The light this evening is not as strong as last night's, but then it was cloudy and the effect was more brilliant, and the power at the generator was greater than now, not having so many lights to create. We are content."

The Banquet.

At 10:30 o'clock Mr. Bowen threw open the doors of the dining room and invited the guests of the evening to enter. One long table and ten or fifteen smaller ones were beautifully spread with appetizing viands in readiness for the beginning of gustatory movements. The brilliant rays from the large chandelier, suspended from the ceiling center, and from the other burners gave the place a brightness only exceeded by the happiness that was everywhere noticeable. The guests seated themselves as suited their fancy. The following list of those who were present, as complete as it can be made, is a better evidence of the character of the representation than words can tell. Around the tables were Ex-Mayor Bowen, Mayor Barclay, Aldermen Coffee, Fllen, Mann, Towne, Joslyn, Welsby, Bolles, Wood, Hawkins; ex-Mayors G P Lord, W L Pease, E O Lovell, E F Hewes, F S Bosworth, Dr. J Duffy, G W Beswick, Geo D Sherman, R P McGilney, ex-Ald Wall, ex-Ald Sherman, Ald Chisholm, F H Goodman, F H Taylor, C F Kimball, A H Lowrie, P E Allen, F L Allen, G W Raymond, W S Doherty, Byron Clark, Dan Barker, C S Chisholm, F W Warren, J M Kimball, Ed Springer, Jos X Gardner, Mr. Buchanan, Dr. Clark, M C Town, Alfred Bosworth, Frank Crosby, Geo E Bowen, Will O'Hatra, E J O'Hatra, S E Weld, Wm Hart, John B Newman, G E Gregory, D J Chamberlain, Phil Preller, Jos Miller, Geo M Peck, Mr Bailey, secretary, and R J Hamilton, agent, of the Vandepoele Electric Light company, Chicago; Capt Smullen, Col J S Wilcox, Clay Clark Sylin, Thos Field, V E Lovell, Carlos Smith, E D Waldron, Will Elliott, Geo Sinnier, ex-Ald Jackson, J Fisher, ex-Ald Jencks, Will Tobey, G E Lightner, Monroe Wallace, Will Hemmingway, Chas Pratt, Jr., H F Woodward, Ed Starr, Alex Simmons, Geo Van Dyke, S A Kilbourne, Wm Creighton, C Rasmussen, S J Gifford, W J Kline, Chas Wallace, W T Watt, John Newman, J C Russell, D B Sherwood, E Byington, Frank Kramer, Ira Brown, J K La Baron, H H Denison, Prof. Schmitz, A M Lewis, George Sherman, Mr. Sloat Mr Anderson, Gus Pendergast, Will Hubbard, Malcolm McDowell, of Chicago, the European quartet—A. P. Kelsey, W G Merrihew, L Hutchison, W C Torry.

The Enterpeans opened the "exercises" with a song, which paved the way for a discussion of the good things set before the company, and the clear of plates and knives and forks told that the luncheon was being attacked with vigor. The spread was a fine one, the company were electrified with the spirit of the occasion, and the feast of reason and flow of soul, or words to that effect, followed this first act of the program naturally and easily. The banquet was a brilliant affair. The host of the evening, Mr. Bowen, was particularly felicitous in his informal post offerings, and almost, by his pat expressions, placed words in the mouths of those called upon to respond. For two hours the banquet table was merry and the replies were listened to with unflagging interest, and when the hour of separation drew nigh the wit was as fresh and the ear as eager to hear as at the start. As an entertaining affair it was a success, and never, we believe, was he in better mood than at this time, when, surrounded by an assemblage committed in favor of the light for whose success he has long and earnestly labored, his versatility knew no bounds and his enthusiasm was at its height. We wish it were within our power to give verbatim the toasts and responses. No abbreviated report is best under the most circumstances, but under the present circumstances it would be simply cruel. Many of them sparkled with wit and shone with sound sense, and all were characterized by the utmost thought of progress, with the sincerest light pointing the way. The quaint saying, at intervals, was excellent, and the brief speeches were dispersed for hearty laughter and prolonged applause.

It was 11:30 ere the pressure of the inner man told that he was satisfied, and after a song by the quartet Mr. Bowen arose and thanked the company for their presence. It seemed an event worthy of commemoration and the gathering was evidenced good will felt by all towards each other. He spoke of the subject, uppermost in the minds of all present, and said that he believed Elgin in the best lighted city on the face of the earth. The remarks abounded in pleasantness and he congratulated the council on the display of wisdom in selecting the electric light for Elgin. He would not detain the company by extended remarks, but would like to hear from all. He spoke of our famous city, and said he expected great things of electricity. A Rasselan has invented a watch with two wheels that runs by electricity, and he believed that that power could be made to do almost anything except wash dishes. He proposed as a sentiment "The city of Elgin: May she always be well lighted, well watered, and well paved," and called upon Mayor Barclay to respond.

"Mr. President, gentlemen and fellow citizens of the greatest city in the world," he began, and then he went on to congratulatory remarks about the success of our first experiment in electric lighting. He hoped the Russian would not be so successful as to undermine our prosperity and take from us what we enjoy. The speaker had been conservative in the electric matter and though he had tried to imagine the light would succeed he was careful to keep within bounds. The light is abundantly satisfactory, and he believed in saying so he represented the feelings of Elgin's people. It would pave the way to further improvements in the city.

"What's the matter," a hurriedly written original song by A. P. Kelsey was sung by the quartet. It was as follows:

See the people turning out, what's, what's the matter!
What's all the noise about, what's, what's the matter!
"What's the news?" is all you hear—
Timid people seem to fear
Some calamity is near—what's, what's the matter?

Does it, Bowen has come to town, that's what's the matter!
And placed Electric Towers around, that's what's the matter!
We now see right turned into day,
And also hear the people say
"Other lights must not give way"—that's what's the matter.

With this light so bright and clear, that's what's the matter,
Man or woman need not fear, that's what's the matter.
"That bogie or bunnyers will waylay,
For they choose darkness, not the day
Their deeds of derility to play, that's what's the matter.

Our city fathers, now to you, that's what's the matter,
You've always been just men and true, that's what's the matter.
When you decide upon this plan,
And act and wisely, every man,
And the people by you will stand, that's what's the matter.

Mr. Bowen's wish that the Elgin electric lights may always shed as beautiful effulgence as to-night was responded to by Frank Crosby, in the liberal speech of the evening. These are timid vantages, he said, about the business, and he was a sufferer. His boy and he are in the Plymouth Rock business. After the electric light flashed over the city he found a hen on the nest, thinking it was day time a few times time to lay. It was all very well for his hearers to laugh, but what is going to become of his hens? To be sure they would lay two eggs a day for a while, but then their constitution and by laws would be ruined and the trade stopped. As a Plymouth Rock man he was opposed to the electric light system. We must not take on too many airs and believe that at home had seven hills we must have just seven towers. If he has to sacrifice his Plymouth Rocks he would as lief do it to eleven or nine towers as to seven.

The toast maker suggested that as we lived in a great state it would be appropriate to hear from one of its representatives, Dr. Kilbourne. The doctor said he thought it was cruel in Mr. Bowen to call upon him, as he wished to say that he was much pleased with the light. On leaving the hospital in the evening he was astonished at the beauty of the illumination. The ultimate success of the system of lighting was assured.

Alds. Towne council had taken some steps in the lighting by electricity ex-Mayor Bosworth was asked to say something. He protested that he was no speaker, but said he was well pleased with the outcome of the experiment.

Dr. Tefft next spoke, in response to the sentiment, remarks that the Seattle society was appealed to when we want to be enlightened. The doctor told of the many changes that have taken place since he came here forty-eight years ago. Then tallow candles and dips were in use. In 1851 we organized a city of 2,000 inhabitants and our interest has been onward and upward. He was glad to see the step that had been taken. He would pay his assessment as his share of taxes for such improvements as the electric light.

Hon. G. P. Lord was next called upon. He was not, he said, in the Plymouth Rock business, and was not afraid that his Jersey cows would be milked to death by the new light. He congratulated the city. To-night we have the best light of any city in the United States.

Aldermen Welsby, as one who had labored earnestly for the light, was called to say a few words. He arose and said he thought he had talked enough in the past two years to excuse him from further speaking. He would be pleased to hear from Mayor Barclay.

Mayor hereby put in a few kindly words for Ald. Welsby, saying that to him as much as to anybody do we owe for the electric light.

Mr. Bowen suggested that as Carpenterville was talking electricity a word or two from ex-Mayor Pease, who is so largely interested there, would be very welcome.

"I think it useful in Mr. Bowen," said he, "to call upon me as I never made a speech in my life." He was much pleased with the light, and was frightened last night when it suddenly flashed into his bedroom window and he thought there was a fire. Carpenterville will soon have the light. Dundee is growing fast, trying to outdo Elgin.

"I know all here take a delight in our schools," remarked Mr. Bowen, and as a representative of them Superintendent Kimball will be gladly listened to (Cheers).

Mr. Kimball thought the electric light was dim as compared with that by which Illumines the soul, but for which we should not have the former. We are apt to overlook the fact.

With a few words about the press as a disseminator of intelligence, and as largely aiding the peace of books, which we do not find time to read, the chairman asked Mr. Lowrie to speak. The latter was not aware, he said, that the daily press had so extended a circulation as had been intimated, but that it is no doubt it should have. Before coming to Elgin he had heard much of our city—of its condensing factory, board of trade, watch factory. The remarkable zealotry of its people had struck him. He congratulated Mr. Bowen on his success. He trusted that the era on which we have entered is only the beginning of a grander light, for the mind and soul of the people of Elgin and other cities.

Mr. Bowen told how in his travels he had frequently been asked, "Have you the electric light in Elgin?" and had had to answer in the negative, but say that the city was to have. Communication from other places had often gone to Aurora to see the light, but here for he should bring his friends. It wounded his pride to take them to Aurora. The mayor and council of a western city will visit Elgin next week to see our lights. Our railroad facilities are excellent, and as Col. Wilcox was acquainted with the history of our efforts at giving Elgin a second, this he knew the company would like to hear from him. Col. Wilcox said that we many congratulate ourselves on the progress that has been made. He was glad to see so fine a body of men—a better representative of progression than is often seen in our legislative halls. He looked back to the early days of Elgin, when the council was unasked and when each letter brought out the recipient $2 costs. Then he saw the advent of steam, and spoke of the bringing to this place of a line to connect with the Northwestern road. He predicted that that the day was not far away when ride-strictly would be used for warming our houses, and propelling our rail coaches with greater speed and safety than they are now run. We are yet in the infancy of the electric power. He spoke of the O'Hlerne Brothers, the young men full of vim, who went out of our city and received a training which fitted them to take a prominent part in so important a branch of industry as electric lighting.

Hons Mr. Crosby said his friend Bowen was had a suggestion which he desired him to offer. Mr. Bowen differs from the market men. They throw in lights when we buy hay, but Mr. Bowen was throwing in the living Direct because we took the lights.

The chairman in a happy manner referred to one of our solid and substantial citizens who has a sort of fancy—in other words, as all know, our friend R. F. Reeve, is a Grandmaster (Crosby, "Hadn't heard that before"). We should like to hear from him. Mr. R. was observed to the honor invested, upon him was very unexpected. He told of an old tenant who, when he departed from his house, left him a lot of candle molds. Patriotically the speaker commended to use them in lighting the city. He would feel pleased if the Russian previously mentioned should succeed in inventing even a one-wheeled watch to run by electricity. He would remember Olding before a railroad entered her when men were afraid if the road was built there would be no more use for horses; but it has often been demonstrated that as our facilities increase our wants increase. The lights of to-night are a great saving in expense compared with gas. All we want is first the light of knowledge shed upon the minds of men.

"I suppose," began Mr. Bowen, "we all feel proud of the fact that our merchants stand high in the community. We should be delighted to hear from done by one of the brightest of them all—Mr. for the Vanderpoels.

D. J. started in by saying that he was no speaker. He came to Elgin in 1856 to make the almighty dollar. Finding strong competition he had determined to coin money faster in another way. He would engage the top of the town, set Plymouth Rock hens thereon, and catch the eggs in a basket.

Mr. Bowen next called upon Prof. Schuyler, principal of the academy, who made perhaps the most eloquent speech of the evening. He told of arriving from Chicago in the evening, and as he was sitting in the house the flash of the new light flooded the academy and grounds so that it was almost as light as day. He went out of doors and read the letter he had begun, as easily as by daylight. This meeting of representative men was characteristic of all he had seen since he came to the United States. Our watchword is progress, and nowhere is it more clearly illustrated than in "our" country. Though he came among us late it was not too late. As Elgin is the best illuminated city in the United States, so is the United States the best illuminated country in the world, intellectually as well as otherwise. The great Goethe on his death bed cried out "more light." Had he lived fifty years later his cry would have been "More life" that he might see the wonders in the universe. The day is not far off when she light will be used for purposes of which we do not now dream. Fifty years hence the palaces of to-day will be hovels in comparison with the then habitations. I thank you, said Prof. Schuyler, for the privilege of being among the choicest of Elgin's citizens on this occasion (I take this in faith). Elgin is a good place to live in, and I will stay as long as you do.

The chairman mentioned the tower of Babel, which it took so long to build, and then referred to the structures which the O'Hlerne brothers rush up in a day. It would interest the company to hear from E. J. O'Hlerne. The latter said that he was much obliged for the honor conferred in the invitation, but he was no speaker and could hardly enter into an explanation as to tower building at that time.

Mr. Bowen then told the weight of the Fountain square tower and foundation, and said it could not pull out of. Ellwyer, Jr., photographer of City Clerk Sytiff, which he held in his hand. He said was made by the light of electricity by G. H. Sherman, whom all would be pleased to hear from. Mr. Sherman said that he had not expected to be called upon. The work done by him was simply a great end the brightest of them all—Mr. for the Vanderpoels.

In calling for Judge Lovell, the chairman pleasantly alluded to the "old system." Judge Lovell related a story about a sea captain giving one of his sailors a mixture of medicines No. 6 and 8 because he couldn't find No. 11, and he thought the combination would be the same thing. The speaker felt that a judicious admixture of gas and electricity would not be a bad thing.

D. H. Sherwood said he was glad we have the electric light. He spoke of the similarity between the illuminated heavens and the eternal, city, and said that were the streets paved one might imagine himself really in the eternal city.

Mr. Bowen spoke of the faithful, intelligent work done by Byron Clark in putting up the shafting at the gunsteps, and asked him to say a few words. Mr. Clark hoped he would be excused as he had never spoken in public.

In response to invitation Dr. Burlingame said that one good turn deserved another. Mr. Bowen had given us a splendid light and he wished to say that a young lady patient wanted to thank Mr. Bowen for it. The light that shone into her sick room was a great comfort to Her.

Ald. Wood proposed a vote of thanks to Mr. Bowen for his grand entertainment. This was done by a rising vote. Mr. Lord's remark that "The eyes have it" being greeted by loud laughter and applause.

Mr. Bowen asked Theo Grihl if he would explain what could be done with watches whose works had become magnetized by too close proximity to the dynamos. Mr. Grihl responded at some length, explaining the process of magnetizing and demagnetizing, and closed by saying he would be glad to see any present whose watches had been thus affected.

After the quartet and company had sung "America," which the host declared the grandest hymn ever composed, followed it with "Auld Lang Syne," and "Sweet Dy and By," all standing, the banquet was at an end; a most successful banquet-ing of our electric lighting has been participated in; the clock pointed to a few minutes past 1, and the electric light was soon shedding its beams for the guidance of homeward bound footsteps.

The Towers.

Singing the praises of the Vandepoels lights and of the concentrated success we must not forget the chief factor in getting the light before the people, the O'Hlerne towers, as substantial as it is handsome and admitted by all to be the best possible substructure to use in the best possible way of outside electric illuminating, viz., the tower system.

The towers are the invention of E. J. O'Hlerne, of the firm of O'Hlerne Bros. & Co. The Messrs. O'Hlerne have without doubt had more practical experience in the construction of electric light towers than any other firm in the country. During the past three years they have been employed in the building of these towers, several for the Elgin Tubular Tower Co., and wished that company ceased to exist, for its successor, the Detroit Tower Co. Since they have been engaged in the work, the Messrs. O'Hlerne have erected electric light towers of, various heights in the following cities:

CITIES.	NO. TOWERS.	FEET HIGH
Aurora, Ill.	3	150
Dundee, Ill.	1	150
Fargo, D. T.	1	50
Bowling Green, Ky.	1	150
Fairfield, Iowa.	1	150
Topeka, Kan.	1	150
Fond du Lac, Wis.	1	150
Dayton, Ohio.	1	220
Rock Island, Ill.	11	150, 180, 200
Macon, Ga.	3	160
Macon, Ga.	1	160
Macon, Ga.	1	160
Savannah, Ga.	3	160
Evansville, Ind.	3	150
Total.	32	

All of the above towers were built of tubular iron, or what is commonly known as gas pipe. Early in the year 1882 the attention of Mr. E. J. O'Hlerne was attracted to the impossibility of preserving the tubular iron after the tower had been completed, these being in no way of reaching the inner surface of the tubular iron. In places exposed to the extremes of temperature and moisture the rust from the rain beats on the inner surface of the iron will soon become so thick as to cause the bursting of the iron, corrosion will set in, and once begun will continue as long as there is unoxidized metal left in the tower. It therefore became imperatively necessary to use solid iron in the construction of towers, and Mr. O'Hlerne began looking about for something possessing the advantages of strength and economy of material. After investigating the merits of different forms of solid iron he found that could be used with safety the star angle iron, he decided to great interest at the old of Prof. Moses G. Farmer, of Providence, R. I., one of the most astute electrical engineers in the world, and to the combination of iron of Prof. Farmer resulted in the birth of satisfactory proof that star iron possessed the greatest amount of strength due to the least amount of material, excellence of class study and careful computation, on January 18, 1883, he filed his claim in the patent office at Washington, together with drawing of a star iron tower. The patent was granted June 12, 1883. In any structure the angle iron has been stated iron was adopted in preference to other forms. The government lighthouse board chose a tower for Bell Gale, N. Y. The superiority of material and purity of construction quickly demonstrated itself to investigators. It was recognized by Hon. George S. Bowen, president of the Anglo Electric Light Co., who had contracted to light our city by the tower system, and had first designed using the tubular iron towers. Mr. Bowen's views in the matter were commended in by a majority of the committee of the whole, the "Chicago" tract was ordered, all the aldermen being in favor of it save two, who opposed to the electric light and voted against the present pleading and no cause of objection to the tower. So the Elgin Tubular Towers were ordered, and the wisdom of the council we think very strongly demonstrated. Thus early the towers have had several severe wind storms to withstand, and in fact two or three of the towers were subjected to violent wind while in process of construction and were not affected in the least. Only an extraordinary violent storm could make the least possible inroad upon the handsome structures.

Seven of the towers were ordered by the Electric Light Co. six to be one hundred and twenty-five feet high and one, the Fountain Square structure, to be one hundred and fifty feet high.

A lengthy essay on the merits of the star iron is hardly necessary. Our people can see for themselves and all are pleased. The towers are a decided ornament to the city and give entire and complete satisfaction. They are in shape triangular skeleton frames of light material, each twelve feet wide, tapering from a wide and secure base to a point. The last tower to be erected, of two feet at the top, which is surmounted by a platform and railing in the center of this platform is an eight foot iron pole, which carries the top, from which arms are suspended the electric lights. The tower is fastened with steps twelve inches apart, and is provided with a platform at three steps, being directly above and below each other, so, and during the harmony of the tower. In truth they are models in every part of their structure, which is a thing of beauty and a joy forever. The foundations are provided with sockets for the reception of the ends of the four iron posts and girts, the sockets being drilled to receive the ends of the iron, and when the foundation is complete and setting through the star iron posts securely, the girts are then firmly in place. The sections are trussed with wrought iron rods which are also secured and riveted to the coupling, and extending from base to top of tower would without the aid of the steel bolts hold the complete firmly in upon the ends of the posts and girts. The sections are made with a round iron shouldered head upon one end and a thread on the other, the thread end which consists of two plates of iron with a hole in the center, each end being upon and resembling a rod clevice in which the bend of the rod is loosely confined, allowing it to be turned at any angle desired. The two plates being merely bolted together with a single bolt, allows them to form any of the different angles of construction of iron rods. The lower section of the Fountain Square tower is supported by a trussed arch which does away with the ordinary guy rods, as in the other sections. This arch is only used in places where trees are placed over side walks as on Spring street, so as to allow of pedestrians passing under the tower with perfect freedom. The tower, is covered with a heavy coating of mineral paint of a dull red color which should be renewed every

two years at least, and if this is done the iron can be preserved for ages There is no cast iron, whatever, used in the tower, it being composed entirely of wrought and malleable iron. The weight of a 125-foot tower is four tons; of a 150-foot tower five tons.

A novel method is employed in the building of these towers. At each corner of the tower is placed a powerful 22-foot derrick with gearing and tackle attached. The first or top section is built upon the ground, four guy ropes attached to the top and the lower tackle blocks are then hooked to the lower corner or base of the section and the whole raised with the derrick to the height of twelve feet. The second section from the top is then built beneath the first section, the tackle overhauled and attached to the bottom, and the derrick again brought into requisition to raise the two sections. Section after section is thus added until the structure is completed, when it is securely fastened by iron bolts projecting from a large iron plate at base of pier above the foundation surface. In erecting the towers the guy ropes used are of the best manilla and are fastened to posts sunk into the ground at a suitable distance from the tower to correspond with the height when finished. The guys, of course, are not permanent, the tower standing alone in its glory and completeness. Truly the O'Beirne tower is a splendid success, and is destined to beautify and aid in the work of illuminating many cities.

Speaking about apparatus for public lighting, Mr. W. H. O'Beirne has patented a unique mast, the main feature of which is a trussed arm which projects twenty to twenty-five feet from mast diagonally to the center of street intersection and supports an electric lamp at the extreme end. This fills a want that has existed for some method of cheaply elevating electric arc lights above the center of street intersections. The lamp does not lower in the center of the street, but is by a simple working of the wires which supply the current brought to the base of the mast. The plan of this structure is much admired, and one will be immediately built near the Illinois State asylum for the insane, south of this city.

In General.

The electric light here is a success, and much more of a success than even its most sanguine friends hoped for, and it may not be uninteresting to review briefly the circumstances attending its getting and refer, incidentally, to a few of the small coterie responsible for the making of Elgin the best lighted city on the continent. The best-lighted city Elgin certainly is, our location seemingly having been designed by nature to illustrate with more than ordinary emphasis the beauty and utility of the tower system of electric lighting. The improvement marked by so successful a consummation on Saturday evening has been discussed more or less for years, in fact ever since our neighbors at Aurora adopted a similar system of outside illumination. There were objectors, of course, many at first, and a no inconsiderable number until the final step was taken and the projectors of the enterprise, crowned with success, stood illumined in the light of the future and happy in the full fruition of their prophecies and desires. The tale of the continued and energetic efforts of those responsible for Elgin's electric lighting, of the obstacles they had to overcome and of the censure they were compelled to endure, is but a repetition of the history of all public enterprises of moment. However, the outcome successful, we can afford to obliterate the dissensions of the past, and, bathed in the luxuriant light that runs up to every door, that makes radiant the mansion and the cottage, all join in a thankful appreciation of the situation.

Epitomized the history of the preliminaries is as follows: The work was inaugurated and gotten well under way by last year's city council, consisting of F. S. Bosworth, mayor; and Aldermen Volstorff, Joslyn, Sherman, Hawkins, Bolles, Welsby, Wall, Coffee, Kizer and Flinn. At the meeting of the council on Monday evening, March 5, 1883, Mr. Bowen first communicated with the council, making a proposition to erect at such points as might be determined upon, seven towers, one 150 feet high and six each 125 feet, placing upon the same a total number of twenty-three lamps. Mr. Bowen's proposition gave the city the alternative of either itself putting in the plant and paying for the lights at the rate of $5,750 per year, or paying for the light without any proprietary interest in the plant at the rate of $6,500 a year. It was proposed to use the Adams tubular tower, and if the city itself desired to erect the towers Mr. Bowen agreed to furnish the same for $7,500. The proposition, on motion of Alderman Welsby, was referred to the committee on gas and street lamps, consisting of Aldermen Sherman, Kizer, and Welsby. The committee took hold of the matter in earnest. Under their instructions City Clerk Sylla corresponded with several cities where the contemplated light was in use. The committeemen and other members of the council also made personal investigation, visiting Fon du Lac, Wis., and we believe one or two other places. Intelligent and conscientious action, based upon their investigations, caused the committee to report to the council at the meeting on March 20, in favor of the light. In view of existing circumstances the report to-day reads like a prophecy. It was as follows:

ELGIN, Ill., March 17, 1883.

To the City Council of the City of Elgin:

GENTLEMEN—Your committee respectfully report upon the within proposition of George S. Bowen to light the city with electric light.

That upon investigation of the matter we find that under the terms of the proposition the whole city would be lighted instead of only a part of it, and the lamps would give light all night instead of only one-half the night, as at present.

We would recommend that a contract be prepared and entered into with Mr. Bowen with as little delay as possible, to light the city with electric light.

G. H. SHERMAN,
JOHN WELSBY,
JOHN KIZER,
Committee on Gas and Street Lamps.

Alderman Coffee moved that the report of the committee be adopted, and it was so ordained by the following vote: Ayes—Aldermen Sherman, Bolles, Welsby, Coffee, Kizer and Flinn. Noes—Aldermen Joslyn, Hawkins and Wall. Alderman Volstorff absent. At the meeting of April 18 the committee on gas and street lamps reported a contract with Mr. Bowen, recommending that the same be adopted, and on motion of Alderman Flinn the contract was approved unanimously. The contract set forth that Mr. Bowen was to erect at such points as might be designated seven towers of the Detroit company's manufacture as heretofore referred to, and place upon the same a total of twenty-three Brush electric lamps, or some other lamps equally as good or better than the Brush electric lamps, the matter of choice being reserved by the city. Mr. Bowen also agreed to provide operate and maintain for five years the electric plant and to operate and run the same to the satisfaction of the city council, the plant to be completed within four months after the approval of the contract. The agreed price was $6,800 for the twenty-three lamps and three hundred dollars per annum for each additional lamp of equal power that might thereafter be required. The agreement also embodied a proviso that the city could at any time purchase the towers, in which event the light company would furnish the designated number of lights at $6,050 per annum. About this time complications began in the Detroit tower company and this, together with other things prejudical to the towers, caused the insertion in the contract after "Detroit tower company's manufacture" the words, "or some other make of towers equally as good, to be approved by the city council," and in consequence of delay sustained the time for the completion of the contract was made six months from the 7th day of May, A. D., 1883. Those changes were wrought at the council meeting of May 10, and at the same meeting, on motion of Alderman Welsby the mayor and clerk were instructed to execute the contract. At the council meeting on the evening of Monday, July 16, E. J. O'Beirne was present and gave a comprehensive illustration of a tower just patented by him and called the Star Iron Tower. On motion of Alderman Welsby the O'Beirne tower was adopted, all the alderman voting yea save Towner and Wood. At this meeting the locations of the towers were also determined upon. On the evening of October 8 the committee to whom was referred the light to be used, consisting of Aldermen Welsby, Mann, and Joslyn, after a thorough and exhaustive inquiry, recommended without reserve the VanDepoele light as being the best, and on motion of Alderman Hawkins the report was adopted. Unforeseen obstacles seemed likely to work to prevent the lighting of the city by the specified time, to wit, Nov. 7, and at the council meeting on the evening of November 5, Mr. Bowen was given an extension of thirty days, to December 7, and in appreciation of the same promised to increase the number of lights six, making the aggregate 29, the number we have.

Thus endeth the chapter, and the fruit of the work we have with us.

In closing, as a matter of simple justice, the thanks of the community are due the members of the council to whom can be charged the departure from gas to electric light. Especially are thanks due to Messrs. Welsby, Sherman, Kizer, Flinn and Bolles. Convinced that he was on the right track Alderman Welsby has never quit fighting for the accomplishment of his desires. Alderman Sherman was that strong an advocate of the electric light as to carry the question into his candidacy for re-election last spring. That this was the only issue made against him and that he was defeated by an overwhelming majority illustrates the feeling of the people when the agitation commenced and what the advocates of so radical a change in the matter of street lighting had to contend with. Alderman Bolles was in sympathy with the move, and with his characteristic energy Alderman Flinn worked for it unceasingly. As for Alderman Kizer, he convinced himself of the efficacy of the plan early in the fight and labored with all his might for its accomplishment.

Last but by no means least is Mr. Bowen deserving of credit. But for him we would have no electric light, as the council would never have invested in the plant as other cities find it necessary to do. With a pride in his home and being engaged in dispelling the gloom of night in foreign city, he desired to do likewise by our parts. The struggles he has encountered and all the obstacles he has had to contend with, only burnish the brightness of his acknowledged success.

APRIL 8, 1881.

IRON.

THE WERDERMANN LIGHT FOR THEATRES.—A most successful experiment in theatre illumination was tried on March 30 31, at the Athenæum of the Rue des Martyrs, Paris, with the Werdermann incandescent light. The peculiarity of it is that it can be graduated at will for scenic effects, either by introducing resistance coils or varying the velocity of the Gramme machine. These experiments were witnessed by several influential members of the Municipal Council, who on the following morning proposed an inquiry into the propriety of obliging all the theatrical managers to light their halls with electricity.

THE ELECTRIC LIGHT AT THE CANNON STREET STATION.—The Brush and Siemens lights were not the only systems which lighted up the City last week for the first time. The electric light was also used for the first time on the same evening at the Cannon Street Station. The arrangements there consist of Gramme machines and Brockie arc lamps, and the work has been carried out by the British Electric Light Company who own these patents. Eight powerful lights of 6000 candles each are suspended from the roof of the station at a height of about forty feet from the platforms, and there are two lights outside the station. There are two circuits for the ten lights, five upon each, and the current for each circuit is produced by one of the large new type of Gramme machines recently introduced by the British Electric Light Company, which work a number of arc lights in series. The same class of machine is used by them for lighting Victoria Station, Manchester, and numerous other places, and is being fitted for lighting the telegraph instrument galleries and letter sorting rooms at the General Post Office. Although so small a number of lights are employed at Cannon Street the station is filled by a brilliant and well-diffused light. Although the British Electric Light Company have taken no part in the City lighting they have entered into a contract with the Liverpool Corporation for lighting about 2½ miles of the principal streets of that city, and it is expected that the lighting of this large area with sixty lamps will commence on the 1st May.

APRIL 22, 1881.

IRON.

ELECTRICITY AND GAS.—If the figures already available in connection with the electric lighting experiment at South Kensington Museum can be trusted, there is a very considerable saving in comparison with gas. Light is wanted for about 700 hours during the year, and the expense of the electric light—the actual working expense—is 3s. 10d. an hour; whereas gas formerly cost 16s. an hour. There is thus a saving of 12s. 2d. an hour, but from this must be deducted interest on capital and a sinking fund to cover the effects of wear and tear and depreciation.

THE ELECTRIC LIGHT AT GREENOCK QUAY.—The electric light has been used for lighting up Greenock Steamboat Quay with great success. Some time ago the Harbour Trustees, on the motion of Mr. K. M'Caskill, resolved to give the light a trial, and arrangements were soon thereafter made with Mr. Crompton, representing the Gramme system, to place four lights on the quay in order to judge of the effect. Four temporary poles were placed in position, the lights from the lanterns fixed thereon diffusing the light not only along the quay but into the two contiguous harbours, and far into the river. A large party was present at the inspection, which took place last week. The effect of the light was the theme of general admiration, and seen from the river the effect was brilliant in the extreme. The present arrangement is on trial for three months, but it is anticipated that a permanent arrangement will eventually be entered upon to have all the quays and harbours of Greenock permanently lighted with this system.

GAS V. ELECTRIC LIGHT IN NEWCASTLE.—The Swan electric lamps, at present burning nightly in Mosley Street, Newcastle, were on Wednesday night last week inspected by several thousands of the inhabitants, when the relative merits of gas and electricity was discussed in many groups. The admiration which the new lights had evoked appeared to have been accepted as a challenge by the gas company, who in the course of the day had placed at the opposite corner of the street one of Bray's three-light lamps, which was lighted on that evening. The effect produced by the lamp—which was obscured at the top—was really splendid, and its illuminating power excellent. The advocates of gas lighting claimed a victory for the old over the new mode and power of illumination. Amongst the supporters of Mr. Swan's invention, the flickering nature of the gas light was pointed to as a drawback to effective illumination; and it was claimed by them that as the full power of electricity was not on from Mr. Swan's premises, the new lamps were seen at a disadvantage.—*Newcastle Chronicle.*

ELECTRICITY FOR DOMESTIC PURPOSES.—Last week a paper "On the Application of Electricity to Lighting and Heating for Domestic Purposes," was read before the Society of Telegraph Engineers and of Electricians by Mr. St. George Lane Fox. The author of the paper said he regarded it as certain that before long electricity would be applied to many and various domestic purposes, especially those of lighting and heating. He contended that electric lamps could be worked in indefinitely large numbers from central stations with a proportionate cost of working, and this referred equally to any other applications of electricity. He described his lamp (by means of which the room was lighted), showing that the light resulted from the incandescence of continuous refractory conductors of high electrical resistance, mounted in vacuum. He remarked that the light was not at all what the public usually understood by the electric light, the brilliancy not being very intense, but the colour being pleasantly soft, altogether different from the bluish white of an electric arc light. The cause of the unsteadiness of the "arc," namely, the variable resitance, was, he said, not present, and the light was as absolutely steady as it was possible for any light to be. The cost of manufacturing each lamp would not exceed 1s. In a properly-constructed and exhausted lamp the carbon filaments would not deteriorate, provided their temperature was not raised above the point at which one-tenth of a square inch of radiating surface would yield a light of 15 candle-power. The system of distribution was somewhat similar to that of gas, main conductors passing from central stations and branching in various directions, and electricity being forced into these conductors, so as to maintain them at a constant electrical pressure above the earth. The pressure of the mains being always the same, and the resistance of the lamps when in action being always the same, the amount of light given would always be equal. The regulators and other appurtenances connected with this system were also explained. The lecturer further contended that electricity would be at least as cheap as gas for heating purposes.

THE BRUSH SYSTEM OF ELECTRIC LIGHTING.

THE LAMPS.

(For description, see 3rd page further on.

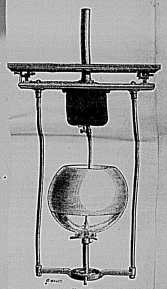

Fig. 8.

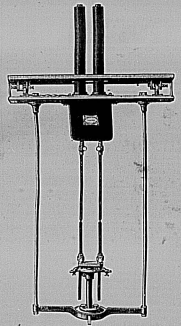

Fig. 9.

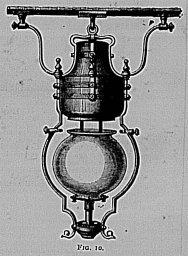

Fig. 10.

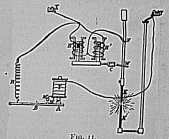

Fig. 11.

Fig. 12.

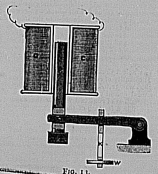

Fig. 13.

THE BRUSH SYSTEM OF ELECTRIC LIGHTING.

THE GENERATOR.

(For description, see next page.

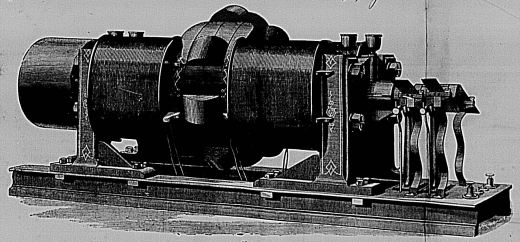

Fig. 1.

Fig. 2.

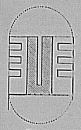

Fig. 3.

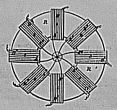

Fig. 5.

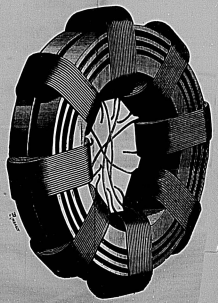

Fig. 4.

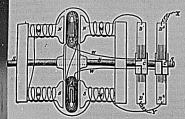

Fig. 7.

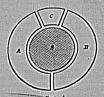

Fig. 6.

IRON.

For illustrations see two previous pages.

THE BRUSH SYSTEM OF ELECTRIC LIGHTING.

(For Illustrations, see pages 308 and 309.)

No much more than a year has elapsed since the Brush system of electric lighting was first introduced into England, and we recorded at the time—December, 1879—the very satisfactory results of the first demonstration effected, which we then witnessed. Since that time the progress of the light has been as rapid as it has been favourable. We have occasionally had to notice various instances of its application, including the Great Eastern Railway, at Liverpool Street; the City and Western Railway, at Paddington; and the South-Eastern Railway, at Charing Cross: these applications culminating in its adoption for lighting a portion of the City, as reported by us at the commencement of the past month. The results there speak for themselves; and our own verdict was given in its favour at the time, and we believe we are correct in stating it to be the opinion of a great majority who have had the opportunity of judging of the brilliant and steady light which is the object upon the present occasion to refer to, and to do so as much as possible briefly, and more, or to point out its special merits—for this we have now before us to describe in detail the construction of the apparatus by means of which the excellent effects witnessed are produced. And this we are enabled to do through the courtesy of the directors of the Anglo-American Brush Light Corporation, who have kindly placed all particulars at our disposal.

From our previous brief notices of the Brush system it will have been seen that it is complete in itself, including as it does both the generator and the regulator. Moreover, the Brush Company manufacture their own carbons, so that the matter from first to last is in their own hands. This system is illustrated in the engravings at pages 308 and 309 of our present issue, and which represent the generator, the regulator, and their details. A perspective view of the Brush generator is shown in fig. 1. The most characteristic feature of the form and construction of the armature core, which consists of a ring, is shown in fig. 2, a cross section of which is generally rectangular, but in the direction of its diameter section it is alternately wide and narrow, as shown in fig. 2. It will be seen that the ring is formed up into as many sections as there are bobbins to be wound, by a number of grooves; in these the coils of insulated copper wire are wound, until the groove is filled up. Fig. 3 is a cross section of one side of the ring, and it will be observed that the intermediate thicker portion is also grooved out by a series of deep concentric grooves, the object of which is partly to reduce the mass and lessen the weight of the revolving armature, partly for the purpose of large industrial electro-magnets whose poles are expanded increasing the ring, and thus carrying away a portion of the air as it is presented to the magnetic poles as a means of reducing heat generated by the working of the machine, but chiefly side, leaving one pair of coils free from their direct influence by the reduction and isolation of local currents generated and this helps greatly in passing through the neutral region by induction in the iron, and which would tend not only to of the magnetic field. reduce the efficiency of the machine by diminishing the magnetic capacity of the armature, but also to produce a heating of the ring, and therefore of the coils, whereby a portion of the current would be lost through their resistance being increased. For a similar reason the interior of the ring is grooved out deeply so as almost to reach the coils; by this means all cross currents are effectually cut off, and Foucault currents are compelled in the direction which are not detrimental to the efficiency of the machine. This again, increases the area of radiating or cooling surface, and consequently helps to prevent the armature becoming overheated.

In the sixteen-light machine, which may be regarded as the normal size of the Brush generator, the armature ring is 20 inches in diameter, and it is wound with eight radial coils of cotton-covered copper wire of No. 14 B.W.G., whose terminal middle planes radiate from the axis of rotation, being distributed round the ring at equal angular distances apart of forty-five degrees. Each coil contains about 300 feet of wire, weighing about 20 lbs., and would therefore occupy grooves shown set coils about six abreast in or 1½ deep as in fig. 2. Fig. 4 represents the armature ring with all its coils wound. The two sides of each groove, and therefore within the machine being inconsiderable. of each coil or wire, are parallel to the central line or radial plane of the coil. All the coils are wound in the same direction.

The distribution of the coils around the ring, and the way in which the connections are made it seen at fig. 5. The inner end of each of the coils is connected by a wire to the inner end of the corresponding coil, at the opposite extremity of the same diameter of the ring, and the outer ends of all the coils are brought through the shaft of the machine, and are connected to corresponding portions of the commutator, where the currents are collected by copper plates or brushes, as we shall see later on. Thus the inner end of the coil is connected to A^4, which is the inner end of the coil 5; A^5 is connected to A^6, A^6 to A^7, and so on round the ring, and the outer ends B^1, B^2, B^3, &c., are all connected to the commutator by conducting wires insulated from one another. The two ends of each pair of diametrically opposed coils are, after passing through the shaft of the machine, attached respectively to two diametrically opposed segments of the same commutator, which segments are separated from one another and from any other pairs of coils. The commutator, which is attached to and rotates with the driving-shaft of the machine, is composed of a set of separate copper rings, of which there are as many as there are pairs of coils on the ring, the rings being cut through at two of their circuits of twenty segments insulated from one another on one side of the shaft by a small air-space about one-eighth of an inch wide, and on the other by a piece of copper separated from the segments by two smaller air-spaces. The arrangement is shown in fig. 6, in which A and B are the two segments connected respectively to corresponding coils on opposite sides of the armature, and stitched by an insulating material to the shaft S; C is the copper insulating piece, the object of which is to separate either of the flat copper bushes or collectors, which press upon the periphery of the commutator, from either of the segments during the interval occupied by one pair of coils passing the vertical, or in other words through the neutral position of the magnetic field. This occurs twice in each revolution of the armature, and therefore of the commutator. At the time when any pair of bobbins is in this way cut out of the general circuit, their own circuit is open, so that no current can circulate or be induced in them. By this ingenious arrangement each pair of coils has to remain in each revolution a period of rest equal to one-quarter of a revolution, or, in other words, each coil remains idle for one-eighth of its revolution, and the time the machine is running. So little is, in a great measure, due the very small development of heat in the Brush machine, and it proves to be another important element of efficiency, namely, that each pair of bobbins as it passes the neutral position of the armature coils and is therefore, incapable of doing work and contributing electromotive force to the general current, is itself cut out of the circuit, and thus two causes operating against the efficiency of the machine are eliminated.

One of the important features of the Brush machine is the arrangement of the magnets by which the magnetic field is produced, and by which the armature coils are, during their revolution almost continuously, passing through a very intense the magnetic field. Upon reference to fig. 1 it will be seen that the armature ring is closely embraced on each side by the most intense directions around the magnet, the inmagnets having their similar poles presented towards one another on opposite sides of the armature coils A A1, and M1, are held firmly together by the connecting bar, the two north poles N N1, while at the same time the corresponding bobbins A1 a receive the influence of the two south poles S S1, a current is therefore induced in the coils in the direction shown by the arrows, the current passing through the shaft S to the commutator C1, and so collected by the brushes B1 and B2, and so on round time the other portions of the circuit, which time the other portions of the commutator which time the other portions of the working armature bobbins are in contact with the brushes B1 and B2, by which the current is collected from the external circuit of the machine. The rectangular cross-sections of the sixteen-light machines as now constructed, as illustrated round the ring at equal angular distances apart of eleven coils, in which the four coils of the field coils, in the circuit, and thus two causes operating against the

Fig. 7 illustrates the connection between the armature bobbins and the magnet coils. M M and M' M' are the two magnets having their similar poles presented towards one another on opposite sides of the armature coils A A1, the field is produced by the two north poles N N1, while at the same line the corresponding bobbins A1 a receive the influence of the two south poles S S1, a current is therefore induced in the coils in the direction shown by the arrows, the current passing through the shaft S to the commutator C1, and so collected by the brushes B1 and B2, and so on round time the other portions of the circuit, which time the other portions of the commutator which time the other portions of the working armature bobbins are in contact with the brushes B1 and B2, by which the current is collected from the external circuit of the machine. The rectangular cross-sections of the sixteen-light machines as now constructed, as illustrated in the engravings, are wound with the four coils of the field coils, and therefore, incapable of doing work and contributing electromotive force to the general current, is itself cut out of the circuit, and thus two causes operating against the efficiency of the machine are eliminated.

Fig. 8 is a diagram, showing the course of the primary circuit, and illustrating the principle of the series system. The bobbins are in contact. It also shows the shunt-circuiting contrivances by which any accident to one lamp or irregularity of working cuts it out of the general circuit, without extending any disturbance of the activity in the series. In fig. 8 the two terminals of the lamp, which are placed in connection with the carbons, are shown at L and L1, and are connected through the two holders bobbins 11 and 10 in the shunt-circuit, which is shown thick and dark in the engraving, and connected with the carbons. The terminals of the carbons are in contact, the current flows through them, and by the vertical coils of the lamp to the terminal lamp, L1. The effect of this is to convert the solenoids, 11 and 10, into electro-magnets, which by its oblique action seizes the carbon plunger, N and S, lift one edge of the washer clutch, W, which by its oblique action seizes the carbon rod (much in the same way as a tent-rope tightener grasps its cord) and the carbon rod is released until its influence is balanced by that of the fine wire helix, which surrounds the thicker coil. The shunt-circuiting apparatus shown to the left of the carbons in the same figure consists of an electro magnet, T, wound with a thick and a fine wire coil similar to those of the regulating solenoids, but both wound in the same direction. When the fine wire coil of this magnet is complete, it forms a shunt of high resistance between the terminals, and therefore a short-circuit of low resistance. The fine wire is wound upon the current to the lamp, and when the fine wire coil of this magnet being in circuit with the fine wire of the regulating solenoids; it follows that, if, through a failure of the light, or through its becoming abnormally long, or through any considerable increase in its resistance, a larger proportion of current be diverted through the fine wire circuit, the attractive form of the electro-magnet, T, would be increased, and its armature, A, which is attached to the pivoted lever, B, would be attracted, and the contact pieces, K, be separated, and thereby be brought together, and the terminals would be short-circuited through the thick coil, and the resistance spring, R. By thus short-circuiting the terminals through a route altogether independent of either the fine or the thick wire solenoids, their magnetic action ceases, and either the upper carbon is dropped, or if it is burnt out, or from any other cause the arc is not established, the contact pieces, M and M1, are held firmly together by the attraction of the magnet, T, and the current flows past the faulty lamp to the others in the series, its extinction calling attention to it, while the other lamps become proportionately brighter.

We now come to the carbon pencils used in the Brush system, which, before being used, are a foot long, and are electro-plated with a thin covering of copper. They last for about twenty-four hours, during which time about 9½ inches of the positive and 4½ inches of the negative carbon are consumed. When the lamps are required to burn for a longer period double carbons are used, as shown at figs. 9, 10, and each is controlled in the same manner as the single carbon lamp, but the controlling apparatus is not duplicated. When the lamp is put into action the arc is formed between one of the pairs of carbons, and when they have burnt out the other pair automatically starts into action, and continues to burn until consumed.

The change from the one pair of carbons to the new pair is effected by very simple mechanical apparatus which will be understood by fig. 8 and 9. C is the hollow solenoid or sucking magnet, which exercises a magnetic influence upon the soft iron plunger, P. The raising or falling of this plunger raises or lowers the frame K by the intervention of the levers, L^1 and R^1, and the carbon rod, which pass vertically through the casing of the lamp, and V1 and W are the clutch-washers which grasp the carbons. One side of each of these washers passes between a pair of the four forming pairs of carbons, as well as the four intervening spaces its action is first to tilt the washers and then to grasp the carbon which the rod or plunger, P, carries. By the simple device of making one pair of jaws a little higher than the other pair, the one pair of carbons first begins to act, and continues to act after the corresponding carbon higher than its neighbour. The consequence is that only one arc is established, viz., across the lowest distance, and, in all the subsequent feeding and controlling, the pair of carbons first started are alone affected, because although both carbons are raised and lowered together, the lower end of the reserve carbon is always higher than the arc by the difference in the height of the two pairs of jaws on the frame K. As time wears, however, and, owing to the shortening of the consuming carbons, they can no longer meet when the frame is dropped, and the current by the same alley are again separated can only be transmitted by the reserve carbons coming into contact, and the circuit is thereby completed, the new carbons are separated, and the act between carbons to be controlled by the magnet and clutch in the same way as the first are wire.

Such is the Brush system of lighting, which, as we have said, is now in regular operation at several places in the metropolis, and is illustrated in the engravings at Charing Cross Station, the meeting-room of the Institution of the Westminster Tower and Westminster Palace Yard, and at large area of the City—and also the machine-room of the company's works in Lambeth. The Treasury has also substituted the General Post Office to make a preliminary contract with the Anglo-American Electric Light Company for a machine and sixteen-lamps, which will be employed in lighting the letter-sorting department. A electric light apparatus and lamps is now being put down at the Rhymney Ironworks. As showing the progress of the Brush system in America, where it is in great favour, we may mention that, during the twelve months ending December last, the American proprietors sold no less than 275 machines and 3300 lamps, of which type of the latter were for use in the United States. This is no wise belies the experience of the Brush system in our own country. With regard to the recent temporary failure of this system in the City experiment, it is to be observed that the cause was not attributable to any defect in the system, but to the insulation of the conductor, which was not apparent until the recent heavy rains descended. This has been remedied, and can be guarded against in future.

THE MANCHESTER ELECTRICAL EXHIBITION.

THE Manchester exhibition is making slow progress towards completion, but many of the exhibits have not yet got into working order, and there are here and there spaces which have as yet only been partially occupied. In the engineering section a moderately good display is made of different types of engines for various purposes, but chiefly designed specially for electric driving. Messrs. Boskin & Parkes, Salford, exhibit the "Sanden," one of the newest types of horizontal engines specially available for electric driving. It is fitted with high pressure expansion gear, with automatic sensitive high speed governor, or with simple automatic expansion gear. The engine shown is an improvement upon the one exhibited at the Crystal Palace, the outer bearing being carried on an arm cast on the engine base, and the fly-wheel being long enough to be carried through the arm. By this means the engine is made self-contained, and the upwards pedestal in previous engines, which increased the labour of setting, has been dispensed with. The same firm also exhibit an excellent vertical engine, specially combined, designed to meet the requirements for electric lighting in a limited space. Messrs. S. S. Stott & Co., Manchester, exhibit their combined engines and fire pumps for cotton mills and works, which in repeated trials have given very good results. Andrew Handyside & Co., Derby, have an assortment of their portable forges with patent blowers. Mr. S. Berland, of Manchester, late works manager to Messrs. Sharp, Stewart, & Co., exhibits a new injector, his own patent, for which it is claimed that whilst the lasklessness of those at present in the market is avoided, the proportions of the nozzles ensure a prompt and continuous action, unaffected by the several lifting and working pressures. At the same time there is provision for ample range in the pressure of steam employed. The Manchester pumping engine, which is shown in action, and attracts a good deal of attention, is exhibited by C. Fearn & Co., Manchester. Excellent metallic pistons and packings, which are extensively used both in stationary and marine engines, are shown by William Buckley & Co., o Sheffield; and Cowburn's patent dead-weight safety-valve, of which large numbers are also in use, is exhibited by the Cowburn Safety-Valve Company, Manchester. Elliott and Eastwood, Manchester, show their fuel economiser with spiral scrapers, which is operated by a "Worthenroth" gas engine. John Chadwick & Son, of Salford (whose stand is not yet completed), are putting up several fine specimens of their engines, including one of the horizontal type, 30 horse-power, with 4-inch cylinder 20-inch bore; a double-cylinder diagonal steam-engine, with 7-inch cylinders and 12-inch stroke; and a vertical engine, with inverted cylinders of 6-inch bore, and 8 horse-power nominal. Benjamin Goodfellow, Derby, exhibits Matthews' patent combined high-speed triplex engine for driving direct dynamos, pumps, fans, and other high-speed machinery. An improved flocking machine (Jones's patent), consisting of centrifugal brush wheels, fixed in a compact case, with fan and treadle, and so arranged that the emery-cloth can be readily changed as required, is shown by Thomas Matthews, Manchester; J. Proctor, Burnley, has an excellent exhibit in his new patent mechanical stoker, which consists of a barrow wheel, spring, and shovel, the wheel having a much easier motion than the type used in a forward movement, whilst a further improvement is introduced by an arrangement of the men and near bar, which enables differences with the rollers for crushing and with the dividers to be run less, which enables the machine to feed not only small, but large and other larger qualities of stone and coal. Crosby Lowe and Co., Manchester, have a large stand. J. Heall & Co., Cardiff; and Williams & Morgan, engineers and blower for steam boilers, and Hall's patent water heater, by Williams & Son, Cardiff. J. Lawson, Gateshead, has a three horse-power engine driving Siemens dynamo, and Robey & Co., Lincoln, a four horse-power vertical engine which will also be employed for electrical driving. Of gas engines there is an excellent display, but these are specially dealt with in another column. In the electrical section a number of the exhibitors have not yet got their exhibits installations forward yet in working order, and this department as regards electric lighting is therefore incomplete. The principal exhibitors are the Edison-Electric Light Co., who exhibit a number of their incandescent lamps, the driving power for which is obtained from an eight horse-power "Otto" gas engine; the Electrical Power Storage Co. (Limited), London, who have not yet completed the arrangement of their stand; and Messrs. Pilsy, Sanderson & Pike, who make an interesting display of electric appliances, for the most varied purposes. Amongst these are electric gas signals, for use between the engine-house on the pit bank and the shaft bottom, and for underground signalling. A specially new feature in these signals, which is accomplished by a new application of relays, is that the bells are rung at both ends when the wires are in use. For signalling underground the arrangement is most simple, not by merely pressing together two bare wires at any part of a pit road a bell is rung simultaneously at both ends—at the pit eye and at the workings. In the case of runaway serves on a tramway, or of any other accident between the workings and the bottom of the shaft, the signal could by this means be at once given from any point. The same firm also show a magneto shot fuse, for use in mines or pit sinkings. The apparatus consists of three magnets of considerable size, enclosed in a box, and by a simple arrangement magnetism is drawn from the magnets, and being transferred to a wire, a magnetic spark is conveyed to the shot to be fired. The instrument enables the operator to fire a shot at any distance which would be required to ensure the safety in conducting the operations. A portable electric bell, consisting of a battery and bell enclosed in a case with 20 feet of covered wire and operating button attached, which can be instantly set up at any place as desired, and the Climax motors, for the small machines, such as light lathes, sewing-machine, &c., are also exhibited by the same firm. Altogether, the apparatus there is a fair collection of various types of furnaces, heating and cooking stoves, showing some of the latest improvements in this direction; and the exhibition, when complete, will be one of a generally interesting character.

Iron, Feb. 9th 1882.

THE VIENNA ELECTRICAL EXHIBITION.—We are requested by the council of the Society of Telegraph Engineers and of Electricians, to state with reference to the International Electrical Exhibition, which will be held in Vienna, in August, September, and October next, full particulars of which appeared in our number for March 10th, 1882, that at the request of the Austrian Minister of Commerce, and of the managing committee of the exhibition, the council of the society have appointed a committee for the purpose of receiving applications from the leading British exhibitors, and for promoting generally the formation of a British Section. All communications should be made as early as possible, and should be addressed to the secretary of the Society of Telegraph Engineers and of Electricians, 4, The Sanctuary, Westminster, S.W.

Iron, Feb. 23. 1882.

ELECTRICAL NOTES FROM SCANDINAVIA.—The electric light is becoming very popular in Sweden. In Stockholm arrangements are now being made for lighting parts of the city by means of the Siemens-Hefner-Alteneck light. The Swedish patent of the electric machine invented by a Swedish engineer, Herr Wenström, has been purchased by the Elektriska Aktiebolag, of Stockholm, for £1,400. The Swedish government have under consideration a proposal for settling the disputes with the telephone companies. Probably most of the telephones already laid down will be purchased by the government. The Bell telephone is coming very great use in the towns of Norway. Nearly all the larger cities possess now the necessary apparatus, and in Christiania alone about nine miles of wire have been laid down, and the number of messages amounts to 8,000 per day.

JOEL'S INCANDESCENT ELECTRIC LIGHT.

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WE recently noticed the successful application lighting to the establishment of Messrs. George Angus and Co., of Newcastle-on-Tyne, and we now proceed to explain the system in detail by the aid of the annexed illustrations, of which fig. 1 represents one form of a complete lamp, fig. 2 the same representing the details. The light is produced by the heating to incandescence of the end of a thin carbon rod or pencil, which forms one electrode, and which is continuously fed through special and simple contact jaws against a fixed cylinder of copper forming the other electrode. The length of carbon between the jaws and the copper cylinder is about 2 inch, and from this the light emanates, chiefly, however, at that part near the fixed cylinder, where it becomes pointed by the action of the current, and therefore more intensely heated. In addition to the light produced by the incandescence of the carbon, there is also the glow or flame from the sides of the burning carbon in the copper cylinder similar to the flame of an arc light—the light thus taking an intermediate position between the purely incandescent system of Edison and the arc lamp of Swan. A peculiar feature of this light is, that the incandescent point of carbon becomes slightly coated in sharp, crystal like a manner, where it wastes away, and is replaced by the gradual forward motion of the pencil, so that the electrode remains intact, and lasts for any required time. The carbon rods are from 2 to 4 inches in length for lights of 100 candle-power and upwards. The carbon rods are of $\frac{1}{4}$ inch diameter and $\frac{1}{8}$ inch in diameter. In a table of the results of different methods of measuring the lighting given by Professor Adams, at the last of his lectures on Electric Lighting, delivered at the Society of Arts, it was shown that 215 candle-power per horse-power is obtained with this system.

The improvements in the lamp consist chiefly in the simplification of the mechanism in connection with the contact jaws, between which the lateral pressure of the jaws and the feeding of the carbon pencil are attained by the combination of one weight as shown in the diagram, fig. 2; the lateral pressure being thus always proportioned to the downward pressure. Also in the details for making the lamps in the same circuit dependent of each other, and its general adaptability for the purposes of domestic and interior lighting. Referring to the sectional view of the lamp, fig. 2, E is the fixed copper electrode with the point of the carbon pencil, c, pressing upon it. The contact jaws are shown at J. The weight, W, which actuates the jaws, is suspended by the continuous cords to the top of the lamp, B, the cords then passing down through the weight and under one of the rollers, R, up again through a roller attached to the carbon pencil-holder, then back through another roller at R, and ending at the weight. The rollers, R, are attached to a light tube, F, which passes down through a nipple, N, and terminates in a flange under the horizontal arms of the cranked jaws, thus producing the lateral pressure on the carbon. The top of this tube has also attached to it the armature, A, of an electro-magnet, S, wound with fine wire, and so arranged that if on are should form between the carbon, c, and copper electrode, E, the electro-magnet, S, would come into action and free the jaws, J, from lateral pressure. The carbon-holder is also arranged (fig. 3) so that when the carbon pencil is partially consumed the lamp is short circuited by the lever at 1, making contact with the arm carrying the copper electrode.

The stem of the lamp, C, c, is formed of metal tubing, cut in halves and hinged, each half forming part of the electrical circuit. When the lamp is opened for the purpose of inserting a fresh carbon, the lamp is automatically short circuited in the act of opening by the button, T, fig. 2, so that it is rendered perfectly safe in handling by the most inexperienced. In the form of a complete lamp, shown at fig. 1, it is fitted with chandelier suspension similar to gas-lamps, and can be fitted by ordinary gasfitters. This suspension allows for raising and lowering the lamp, for putting in fresh carbons, and attending to the lamp generally. We have personally inspected the system in operation, in the offices of the Electric Light Agency, 32, Queen Victoria Street, London, and can testify to the satisfactory results given by it. The current is generated by a Gramme continuous current machine, which is driven by an Otto gas-engine. The arrangement for lighting the offices, the experimental shops, and engine-room, a light being also placed outside the building. The lamps are arranged one in each office, the illumination being very brilliant. In the experimental shop, two lamps have been substituted for fifteen gas-burners, with greatly-increased results as regards light, the light is of a warmer appearance than that produced by the gas system, and is perfectly steady and very pleasing in effect. The lamps can be turned on or off at the side of the room or at the lamps themselves, and are made in a strong and practical way, fit for ordinary wear and usage. In fact, the lamp appears to be one which exactly meets the requirements of ordinary indoor illumination.

FIG. 1.

FIG. 2.

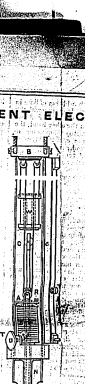


FIG. 3.

FIG. 4.

great throughout the whole of this range as it is at the final-named temperature, it is still, in his opinion, extremely unsafe to put any work whatever upon mild steel within these limits. These facts cannot be too widely known, as the knowledge may lead to the prevention of some of those apparently mysterious failures which have occurred in the working of steel. We need hardly remind our readers that some important information on this subject was communicated by Mr. Daniel Adamson, at the meeting of the Iron and Steel Association at Paris in 1878. He there showed that at certain temperatures steel lost its ductility and became brittle.

ELECTRIC LIGHTING IN THE CITY.

OUR readers are doubtless aware that a portion of the City is to be illuminated experimentally by the aid of electricity. Three districts, in fact, are to be electrically lighted, one by the Brush, a second by the Siemens, and a third by the Lontin light. The Jablochkoff light was to have illuminated one district, but circumstances have arisen which prevent this arrangement being carried out, and this district has been allotted to the Lontin light. The district which has been undertaken by the Anglo-American Brush Electric Light Corporation embraces Blackfriars Bridge, New Bridge Street, Ludgate Circus, Ludgate Hill, Saint Paul's Churchyard (north side), and Cheapside, as far as King Street, and is the second largest of the three districts experimented upon by the City authorities. The lights are thirty-two in number, although forty lights could be maintained on the same circuit. The whole of this section is worked by a single small copper wire strand of 8 B.W.G., and 8,000 feet, or over 3 miles, in length, starting from the works of the Anglo-American Company, near Waterloo Station. The whole number of lights are connected in one circuit and worked by one machine; theseeing for the entire circuit about 3 horse-power indicated. The machine is worked by the same engine which works the lights forming at Charing Cross and Waterloo Stations, and also all the machinery and the testing circuits of the company's factory. The lamps are fixed upon the present gasstandards, standards above which they are raised about 2 feet 6 inches. The street lighting is in fact, is being carried out by the Brush Company, so as to illustrate the utilisation of existing lamp-posts, with the view of demonstrating how easily and cheaply a change from gas to the electric system of lighting streets can be effected. If it is considered that this general effect would be increased by using higher standards, they can, of course, be easily fixed; but in the experimental trial, such as to lamps and lamp-posts, the greatest economy has been aimed at. Keeping this point in view, all the lamps in the district lighted by the Brush Company are of a power which is estimated to be best adapted for such a purpose, but light of any greater degree of power can be substituted, if required.

The district allotted to Messrs. Siemens Brothers and Co. extends from the south side of London Bridge, through King William Street, the Poultry, up to the Guildhall Yard, taking in Queen Street as far as Queen Victoria Street. The number of lights employed is thirty-four, comprising six powerful lights, and twenty-eight smaller ones of about 200-candle power each. The six large lights are mounted on latticed iron poles about 80 feet above the level of the street, and are disposed, one in Adelaide Place, a second at the King William Statue, a third at the junction of Lombard Street and King William Street, the fourth in front of the Royal Exchange, the fifth by the Mansion House, in Queen Victoria Street, and the sixth in the Guildhall Yard. This last light is nearly three-quarters of a mile from the dynamo-electric machine, which generates the current for it. The twenty-eight smaller lights are fixed on iron posts resembling ordinary gas lamp-posts, about 20 feet from the ground, and interspersed between the larger lights in the best manner to secure a good general illumination. Each large light is supplied by its own dynamo-electric machine, separate conductors being led from the dynamo machines to each lamp. The twenty-eight smaller lights are arranged in four groups of seven lights each, and are fed from two separate current machines, each supplying two groups of fourteen lights. It has been thought advisable to make this subdivision for convenience in working, instead of arranging all the lights in a single circuit, as could easily have been done.

The regulators, or lamps, are constructed to take carbons of sufficient length to last eighteen hours without renewal. They are enclosed in lanterns fitted with reflectors designed to intercept and throw down the upward and horizontal rays. The lanterns are suspended from the tops of the latticed iron poles by projecting brackets, against which they are drawn slightly to prevent their being blown about by the wind. A door is let down into the street a platform is lofted to the pole, upon which the lantern is lowered when it becomes necessary to replenish the carbons. The guide wires, passing through openings in the reflector, being stretched between the platform and the bracket to guide the lantern during its ascent and descent. The leading wires which convey the current from the dynamo machines to the lamps consist of strands of copper wire coated with gutta-percha. With the exception of London Bridge these conductors are laid for protection in cast-iron pipes, which run continuously to the farthest lamp. Those crossing London Bridge are provided with an outer sheathing of iron wires and rest upon the broad ledge of the parapet. At the foot of each post is placed a cast iron box, in which the conducting wires from the lamp join those which come from the machine. The electrical generators, and their steam-motors are situated in the basement of a warehouse in Old Swan Lane. With a view to provide against possible accidents, the generators are divided into two equal groups, each of which is driven by a to-horse power nominal steam-engine by Messrs. Marshall, Sons and Co., of Gainsborough. A third steam-engine of the same power is placed, as a reserve, between the other two, and so arranged as to be able to drive either set of generators, when their own engine requires cleaning. In the room over the engines are placed the instruments for measuring the current and for switching it from either dynamo machine to either lamp, and other accessories. Here also indicators are provided so that the electrician in charge can see at a glance if the machinery is working regularly.

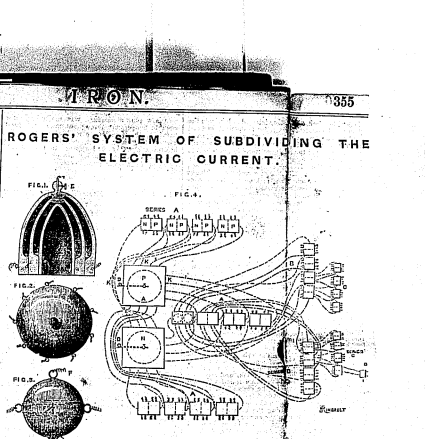
Such are the details of two out of the three systems of electric lighting which by their inauguration last evening mark the commencement of the largest and most important experiment in Electric Lighting that has yet been carried out in London. It is to last for a year, and the streets are to be illuminated by the aid of electricity all night, thus entirely superseding the gas. The district allotted to the Lontin system comprises Southwark Bridge, Queen Victoria Street, Queen Street Place, and part of Queen Street. This light has taken the place of the Jablochkoff, and was to be in operation by the 31st inst. The length of streets covered by the various systems, and the cost of lighting, are as follows:—The Brush system, 1,618 yards, at a cost of £1410; the Siemens system, 1541 yards, at a cost of £1200; the Lontin, 1703 yards, the cost being £2250, the same as was to have been paid for the Jablochkoff light. The total cost of the experiment will thus be £4860—but the expense of gas lighting for the year will be saved. It will be observed that there is a considerable difference in the cost of the three systems, according to the figures furnished, the lighting by the Siemens system will not exceed in cost that of the old lighting by gas, the sum to be paid to the Brush Company being fixed upon that basis, viz., £960, an amount which, we presume, will leave them a very substantial working profit if the lighting is carried out upon an extensive scale. The total to be paid as above for the Lontin light, inclusive of installation, is £1150, as compared with a total of £2250, to be paid for the trial of the Lontin system, and £2250 for the trial of the Siemens system, over an approximately equal area. It will be interesting to see, therefore, whether the lighting by the Brush Company, upon the commercial principle of competing with gas in price, and at the same time affording an increased volume of light (the only practically useful result to be attained by electric experimental), will commend itself to the public sufficiently to ensure its general adoption. With regard to the appearance of the illumination itself we can only say that it forms a splendid electrical display, the pains being unquestionably carried off by the Brush light. We cannot, however, say that we regard the standards with feelings of unmixed satisfaction, but when we get the best light fully developed in practice it will perhaps be time enough to criticise the accessories.

ROGERS' SYSTEM OF SUBDIVIDING THE ELECTRIC CURRENT.

ABOUT a month since we placed before our readers a general outline of the ingenious system of subdividing the electric current devised by Lauchlan Rogers, of Bartholomew Close, London. At that time, the patent not having been completed secured, we could not enter into detailed particulars, but we promised them at an early date a full description, a fulfilment of this promise we now place before them. We may premise that Mr. Rogers has carefully watched the various propositions for subdividing the electric current, but being convinced that the complete subjugation and control of electricity had not been accomplished, he brought forward his system, which, we understand, he had completed and worked under eighteen months ago. The apparatus consists simply of a receiver for each pole of a battery or magneto machine. These are contained, for convenience sake in the first instance, in two separate boxes; from these boxes, that is from the receivers contained therein, proceed twelve wires—that is, twelve from the P, or positive pole, and twelve from the N, or negative one. These twelve pairs of wires are divided into twelve different boxes; these boxes contain a positive and a negative governor, and from each of them proceed four wires, so that at this stage in series A there are forty-eight circuits. Each one of these circuits is carried to four more boxes, being series B; again, from each pair of wires four of which there are four from each box, wires are carried to series C, so that at each box in series C has four complete circuits the result is a grand division, subdivided into sub-sub-divisions; are the original current which entered the receivers, P and N, in two wires from the battery or machine has been finally subdivided into 768 circuits or lights, as the case may be. Fig. 1 is a section of one of the receivers it is not, however, necessary to have the two interior cases for the governors or for the distributors, which may be of the form shown in fig. 3—a simple copper globe of small dimensions. The small rings at the top and bottom can be used as convenient, either one or the other, for connection with the previous divider; the rings on the periphery are for the purpose of receiving the wires to go out on duty. Fig. 2 is a plan of fig. 1, and illustrates the method of drawing off from the mains either P or N. Fig. 4 illustrates the method of the division and subsequent subdivision.

It will thus be seen that the statements made in our previous notice as to the simplicity of this invention are fully borne out, and that this invention is one of a very common-sense character. It will also have witnessed the subdivision of the electric current as produced by one or more machines into a series of twenty-seven vacuum tubes, three on each of nine circuits, and has also seen the light thereby greatly increased by Mr. Rogers. The circuits, moreover, were detached one by one without in any way interfering with the remainder. We have seen to be enabled to carry the subdivision of the system to a dynamo-machine, which will practically test the value of the system for subdivision of a subdivided light.

Before concluding, we may refer to the various inventions which Mr. Rogers has given to the world from time to time, some of which were described and illustrated in our old series—the *Mechanics' Magazines*—for back at that time his life-saving apparatus is perhaps one of his best known and most useful inventions, and it is one which we illustrated and described at page 196, vol. VI. of *Iron*. Amongst his other inventions are his automatic temperators, his system of night signalling at sea, his alarm gun, his clip for mooring and unmooring boats and ships, his cork-cutting machine, and lastly his water motor for working electric lighting machinery, which we described and illustrated in our issue of the 6th inst. Such are some of the results of Mr. Rogers' fertile mind; they indicate that he possesses a wide range of inventive power, and we trust in the present instance his creative faculty will be rewarded with the success it deserves.



ROGERS' ELECTRIC LIGHT.

THE operation of the subdivision of the electric current is the most important and difficult of the whole series in connection with electric lighting. It has been solved in various ways by various inventors, but only to a limited extent, that is—as far as we are aware—none of them, down to the present time, has quite succeeded in dividing and subdividing the electric current from its original source more than by the aid of the one pair of poles forming a circuit. What has not been effected in subdivision may be represented by a tree with its trunk or stem, from which shoot the main limbs, which again bear branches which in their turn carry the twigs. Now a system of electrical subdivision which would present an analogy to this would at the same time present a perfect solution to the problem at issue—other things being equal. Such a system of subdivision we have just seen, and from the demonstration we witnessed we have no option but to say that so far as that demonstration went it proved the electric current to be perfectly, absolutely, and to the most extreme limit, subdivided. The system which affords these results, which we have certainly never seen attained before, is that of Mr. J. Harding Rogers, of St. Clement's House, Lombard Street, London, whose name will be familiar to most of our readers in connection with the rocket life-saving apparatus bearing his name. We have been permitted to examine the details of the system, but the patents are not yet being quite completed, we are not at liberty to explain them, although we shall very shortly be in a position so to do. We may say thus much, however, and that is that the system is of the most simple and practical nature, and bears the impress of the mechanical instincts of the mind by which it was developed. It did not, however, spring suddenly into existence in its present form, the original conception having taken a long time to perfect, and only step by step has it been developed. As it now stands, however, and as presented to us, it certainly marks an important epoch in the history of electrical science.

Although we may not describe the details, we may, however, indicate generally the arrangements. In order to explain what we saw done by Mr. Rogers. The apparatus, so far as external appearance, consisted merely of a bi-chromate battery and 1-inch coil. From the poles of the coil the two conductors, positive and negative, were led each to a commutating box containing the dividing apparatus which is capable of effecting eighteen divisions of the main current, although only one wire was used in the experiment, that being sufficient to illustrate the principle. From each of the accumulating boxes a single wire proceeded to a dividing box. From this box, again, eight pairs of wires could have been led to eight other boxes for the further subdivision of the current, but five pairs were considered sufficient. These five pairs of wires were led, one pair to each of five boxes, where the current was further subdivided, and from these boxes wires forming nine circuits were led. Twenty-eight circuits could have been formed had the battery power been sufficient. On these nine circuits were placed twenty-seven lights represented by vacuum tubes, three on each circuit. The battery having been started the twenty-seven lights made their appearance simultaneously and distinctly, and as remained to the end of the experiment. Circuit after circuit was detached without in any way interfering with the others, and so far as the experiment went it satisfactorily demonstrated the practicability of dividing, re-dividing, and again subdividing the electric current so as to render it available for the smallest apartment, whilst at the same time it is under perfect control. Each apparatus, moreover, is in itself an accumulator, or governor, and a sub-divider. This perfect subdivision was demonstrated to the sense of touch by means of a medical battery, and to that of hearing by means of a series of twelve electrical bells, as clearly as it was demonstrated to sight by the vacuum tubes in the circuit.

This, however, is not all that Mr. Rogers has done towards advancing practical electricity. He has devised an exceeding simple motor for driving the current-generating machines. He uses water, and by the aid of a turbine of novel construction, having a perfect governor at its head, he obtains a perfectly steady motion, and by simply utilising natural laws he obtains a power in the most simple manner. The result is, that we have the two main requirements of electric lighting—a steady driving power and the subdivision of the light—perfectly met, as shown by the experiments. The practical test has yet to be made, but it is difficult to see how it can plausibly prove less successful than the experimental trial. Until it does, we shall hold that Mr. Rogers has successfully met the two most important requirements of electric lighting as regards its commercial success.

April 7, 1882.

IRON.

THE CITY AND THE ELECTRIC LIGHT.—At the meeting of the City Commissioners of Sewers on April 4 a letter was read from Messrs. Siemens, the electrical engineers, commenting on a statement publicly made by the Chairman of the Commission that their system of electric lighting in the City was nearly four times as dear as the cost of gas. They pointed out (in effect) that much of the cost of the lighting had been entailed by the merely experimental and temporary nature of their early installation, as the provision of expensive machinery that it would have been unnecessary to expect if the contract had been more permanent, and if they were permitted to supply private houses in the same district with the electric light. They also urged that the comparison as to the expense of gas and electric lighting to the disadvantage of the latter were always made under the supposition that the lights were of equal brilliancy, whereas the electric lights were far more powerful than gas. Mr. Fellow, the chairman, stated that in the district lit by the British system the contract price was £566, as against £500 paid for gas; in the district worked by the Limtin system the price was £1,460, against £970 for gas; and in the Siemens district £1,170, as against £612. The new contract submitted by Messrs. Siemens, so far from being cheaper because the experiment continued, was £1,500, instead of £1,170, being nearly six times dearer than gas. On the motion of Mr. Jones it was referred generally to the Streets Committee to consider how far the companies might be permitted to light private houses and shops with the electric light within their respective districts.

LIGHTING TRAINS BY ELECTRICITY.—A trial has been made of a system of lighting a train by electricity by means of Faure's battery, on the Prussian State Railway near Frankfurt. The system is stated to be different from that employed by the London and Brighton Company, the apparatus being set in motion by a transmission of power from the wheels of the trains. The current of power not required for the electric lamps whilst the train was in motion was used to fill Faure's batteries, so that when the train stopped these batteries could be used to keep the lamps burning.

Iron, Sept. 15, 1882.

EXTENSION OF ELECTRIC LIGHTING.—The Gare de l'Ouest, at Paris, has been illuminated with the Edison incandescent light. The same system has also been introduced into Besançon, the motive power being furnished by a waterfall about a mile distant. We see it stated that proposals have been submitted to the Markets Committee by the Metropolitan (Irish) Electric Light and Power Company for lighting the Central Meat and Poultry Markets with electricity.

THE PILSEN, JOEL, AND GATEHOUSE SYSTEMS OF ELECTRIC LIGHTING.

(For description, see page 288.)

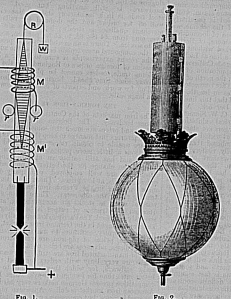


FIG. 1.

FIG. 2.

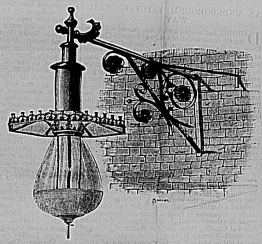


FIG. 3.

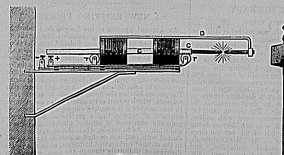


FIG. 4.

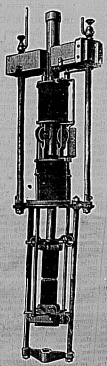


FIG. 5.

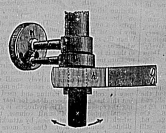


FIG. 6.

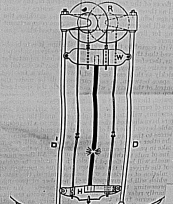


FIG. 7.

THE PILSEN, JOEL, AND GATEHOUSE SYSTEMS OF ELECTRIC LIGHTING.

(For description, see page 290.)

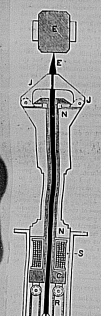


FIG. 8.

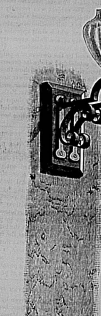


FIG. 9.

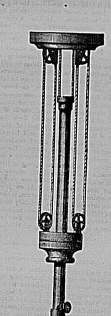


FIG. 10.

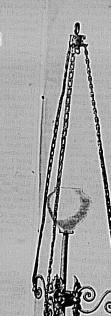


FIG. 11.

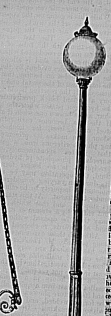


FIG. 12.

property could be effected annually, more than twice; hence positive notice to the approach of the most dangerous storm-direction, pulsie, and this only at certain with the means of obtaining such prior warning; the seaman is he chooses, by up until the danger is generally so make for transmitting the sands of vessels' grounding our channels Now, if by means of the stations pre-either, thirty-six hours' positive notice a service of steamships vessels could ed the coast, such running a couple of more through the most dangerous parts and giving warning to all vessels in their of be prudent to run further. Such only be valuable on account of the cer- formation conveyed, but in the present ones than useless.

many every service rendered by these s in the way of postal, telegraph, intelli- other matters relating to the shipping to e needless to state, be of the utmost value shipowners would be enabled to forward he officers of their vessels, direct their receive notice of their progress and con- ts of four days or so. Disabled vessels ligence of its position, and await provided crews would be within two days' ard, should it be ascertained that these ers, not of any value or importance, but ould not there was every great expense be earned in the prosecution of the opened in this paper, and the author is ion that has been made of the exigencies emand the practical carrying out of such r reasons, then, the desirability of such ave in a position to briefly consider what ntial, and what conditions they should meet

place, the absolute safety of the staff ay should be provided for. The structure, floating body, should be capable of with- lutest accidental shock, such as might be by collision with a ship or iceberg, without ial damage; not only on account of the value of the expensive structure, on the one as in case of its establishment, its presence d upon the other. For there is no more vicious that its floating power should be per- hold depend entirely upon some practically solution. Secondly, although placed in a ed position, the mariner should be so worked as to allow sufficient deviation to be purpose of clearing such irresistible force as ght about by the passage of an iceberg, or of the mariner's intervention. Thirdly, ervation; it should, of course, be capable of a favourable position. Finally, the vessel ld be in every way seaworthy, and of suffi- ly strong construction to withstand hurricane or ch it cannot sufficiently discharge its functions ly, and a signal, telegraph, and meteoro- ys.

ppose to encompass these points is to provide ritual structure, so constructed, floated, and it it will float in an upright position with great, so upper part is to be practically a light-house steel plates and framing for the sake of the tension of strength with a minimum of weight, much dimensions as to provide accommoda- ring machinery, steam power, electric light n of all instruments, stores, and tackle required ant working of an institution, as also comfortable accommodation for a somewhat of officers, assistants, and keepers. The on of the structure would be occupied by a ral of most less specific gravity than water ference cork-wood and pitch), which would ss and unsinkable floating power. This floor would be packed into radial cells or compart- ided by a steel plate and frame partition, floor or deck to the lighthouse, and in- the floating material. By this arrangement cork were to waste or rot, a single cell at the remainder, and the vessel would not be ed. Access to the interior would be obtained ance to the centre of the floating material, tube to the several compartments, or, sec- ently to admit of periodical inspection. This ld be in the centre of the cast lantern, which immediately below. The lower portion of the ld be intended to act as ballast to the upper addition to the weight of the latter to counter- ed by the steel and framing, would be con- heavy framing and plates for that purpose, and ballast would be admitted. The weight of iron, or suit- ld be added to the lighthouse proper.

ion of the structure would be constructed and protected with concrete or ed for the purpose of resisting the surface disso- ly encountered, but which might become attacked, ion of the lighthouse proper, and the cast-iron ight be made for the purpose of resisting and similar arrange- ight be made for the purpose of resisting and

The floating body would be maintained in position by means of chains leading to a sufficient height above the water-line, and moored to sinkers, of the structure would be sufficiently independent of any hollow; so water, or other liquid, would be admitted to the cells of the floating body, so that the buoyancy of the floating power would be unaffected by the admission of water into the cells of the lighthouse proper. The arrangement comparatively simple, and the author is of opinion that it would be found to answer well. The rising and falling motion of the floating body, and consequently of the lighthouse proper, would be counteracted by passing waves would be counteracted by the action of the arrangement and one which would give very ample accommodation and floating power, so as to speak, in erecting the lighthouse lower on, and attaching the counterweights a much greater set of dimensions, in which the whole of the apparatus and stores, and a few suites of apartments and the floating material could be amply provided for. The lighthouse tower might also be of a somewhat lighter construction than in the previously described arrangement, and consequently a correspondingly lighter structure would be required. A feature possessed by the latter in this case would be, that it could be put together in sections, which might afford more facilities in erecting. The lower deck would be convex in form, and shutes or ports might be arranged for relieving the deck of any sea which might be shipped, and similar provision would be made with the upper or lower deck. All hatches would be made specially strong as any other part of the deck, and strongly arranged at intervals round the base of the light-tower, in order to afford a means of egress always on the leeward side. As in the previously described arrangement, a sufficient margin of safety would also in this case be provided by carrying up the inhabitable packing, to a sufficient height above water-line. But the author is decidedly of opinion that the advantages of this latter arrangement would be more than counterbalanced by its liability to be greatly affected by the action of the sea, which might cause it to ride heavily.

The mooring machinery would consist of large rope drums made to revolve by worm gearing driven by bevel wheels capable of being simply thrown in and out of gear, and mounted on the same shaft, actuated by a steam-engine. The end of each mooring rope is made fast to a separate barrel, and by having suitable gear for each attachment, uniformity of strain on the rope could easily be obtained. This arrangement would likewise provide for the flexibility of position previously mentioned as essential in such a structure in case of its being temporarily fixed by means of icebergs, &c. Also, in this manner any number of the mooring ropes would be prevented, seeing that the strain would be equally divided. Should it be taken up exclusively by the latter, the moorings would consist of steel wire ropes covered with tarred hemp, pitch, and tallow, for their preservation. Steel wire rope, two inches in diameter, of plough-rope quality has a working strength of about 17 tons, and each rope would weigh, including covering, 20 tons per mile. Assuming that only one mile deep in depth of water, 3 miles of rope was required, the actual weight of mooring-chains would be 60 tons, and the water displaced by them 60 tons, leaving a margin of strength of 120 tons for mooring purposes. A sufficient number of ropes to resist the strain or tendency of the structure to move could be used, and the proposed displacement of the floating bodies would be about 2,000 tons, and the author considers that there would be no difficulty in providing adequate moorings. The anchor blocks, to which the moorings are to be attached, would be constructed of rectangular iron plate and frame vessels, similar in build to sea-going vessels, with light decks, and being provision for admitting water to the interior. Each vessel would be loaded with a mass of concrete or stone into the lower part to the fullest extent which would permit of its being towed at sea with safety.

In putting down one of these lighthouses, it would first be necessary to make a careful examination of the ocean bed, so that rocky projections, obstacles, or bad ground likely to injure the mooring ropes could be avoided. Suitable foundations for anchorage having been determined upon, the anchor blocks would be towed out and placed over their intended positions. To diminish, as far as possible, the risk of their dragging or breaking the cables, it is proposed to deposit them in the following manner. After being securely and duly connected to the block, the rope would be laid out for a distance exceeding the depth of the ocean, so as to have a bight on the bottom between the ship and the anchor block. The latter would then be allowed to sink as gradually as possible by admitting water through a comparatively small hole. It is suggested as the most economical plan for erecting the lighthouse, that it be put together in sections, and conveyed to and completed in the shipbuilding yard, with the sealskelp portion in place. A heavy cover would be fitted to the lantern end, and the sea-light doors to windows and openings would be screwed on securely. The completed vessel would be launched and towed to the site selected, and the ballast would be employed for the purpose of sinking it. It would be fitted with a view to resisting any strains which it would be likely to encounter when being towed in the same manner as a ship; but the author believes that little extra precaution would be required on that score. When in position, a valve arrangement for the purpose would slowly admit water to the ballast compartment, and the vessel would assume its erect position.

It now remains to consider the question of power for driving the necessary machinery, and the amount of force which should be carried. A steam engine (in duplicate) of 30 horse-power nominal horse-power would be supplied for working the electric light machinery, a syren log-horn, and a crane to lift the heavy weights, &c. Taking the longest working period at seventeen hours per day, and the consumption of coal at 2 lbs. per horse-power per hour, 25 horse-power would be required continuously for that time, 50 or 60 tons of coal would be necessary, assuming two pounds of coal per hour per horse-power per hour, and making due allowance for decreased consumption. The position of the vessel has already been pointed out, a space 7 feet in depth being reserved for that purpose, directly beneath the compartment containing the inhabitable packing. This would afford ample room for the coal, and, if more, as that simple accommodation for fuel could easily be obtained. It is to be observed that, as coal would be consumed, provision would be made to admit water to compensate the weight of water ballast to preserve the margin of floating power as consumption took place.

The author would now draw attention to the glaring defects in existing light-houses with regard to wind pressure. Experiments carried out at a velocity of 100 miles per hour exerts a force of 55 lbs. per square foot; in what is known as a great storm, the pressure rarely exceeds 25 lbs. per square foot. If, however, a force of 50 lb. per square foot be allowed upon the entire section of the light-tower, that section being taken of an average width of 25 feet, and a total height of 120 feet, giving an area of 3,000 square feet, equal in amount to 150,000 lb., or say 70 tons. Such a strain would not be more than momentary, and would be expended long before the elasticity of the ropes (due to curvature) had been taken up. It is to be particularly noticed that the sag of the ropes would form a most effective spring to check any tendency to oscillation caused by wind. Even granting, for the sake of argument, that such a wind pressure might be of some duration, the rope, as specified, would be sufficiently strong to withstand the strain; and beyond the margin of strength provided, the easing of the balancing strain of the opposite mooring would add to the available power of the rope sustaining the force of wind pressure. It is proposed to make the weight of the structure, including proposed load arrangement about 1,000 tons, of which the author is of opinion that a great deal more than one-half could be carried and placed on her as to withstand any wind pressure that could be imposed without any inconvenient inclination of the light tower. The centre of flotation is situated about 20 feet below water-line. The weight of the superstructure, or lighthouse proper, is calculated at 300 tons, and the base portion at 700 tons, giving a difference of 400 tons. As the centre of this difference is situated about 70 feet below water-line, a wind pressure of the amount named would cause the structure to assume an angle of about 10 degrees with the perpendicular, as shown on the diagram. This has been calculated by the rule, that "the force necessary to incline a floating body through any given angle is equal to that necessary to raise it bodily through a height equal to the difference of the vertical displacements of the centre of gravity, and that of the immersed part," inertia and fluid resistance being neglected. The time of oscillation of the lighthouse, which, as well known, should not be equal to the periodic time of a wave, would be the same as that of a compound pendulum suspended from the centre of flotation, and would be four and a half seconds. The moment of inertia would be so adjusted that this time of rolling might not coincide with the period of any waves likely to be met with. Should it be deemed necessary that the tower should incline but under any conditions of wind pressure, deviate from the perpendicular pasture or take a pendulum motion, the wind would a twist exerted by the sails, and from to in suspension surface of the tower further to render all the fixed and rolling motion more easy. A cylindrical case, outside circumference fitted to the bottom of the immersed portion would effect this object. But the author is of opinion that both these provisions shown on the diagram are just needed, that the form of the structure, any extraneous contrivance, but being a reasonable or slight motion producing no discomfort to the inmates instead of the successful working of a deep sea lighthouse.

In conclusion, the author also proposes to employ similar light-houses on a smaller scale for coast service. The immediate saving of life and property around the shores of the United Kingdom alone, which would result therefrom, would be sufficient in one year to recoup their cost many times over.

THE PILSEN, JOEL, AND GATEHOUSE SYSTEMS OF ELECTRIC LIGHTING.

It is now just two years since we described and illustrated the Joel system of incandescent light, and rather more than one year since we did the same with regard to the Pilsen arc light. Since then several modifications have been made in both systems, and they are now being introduced to the public under the respective auspices of the Pilsen, Joel, and General Electric Light Company. The Pilsen lamp has undergone a complete change in its regulating mechanism, the latest arrangement of which are illustrated in the engravings at pages 286, 287, and 290 of our present issue. The Joel lamp, with regard to the Pilsen arc lamp, we may observe that it carries the same principle of regulation as the Pilsen, differing only in the construction of the mechanism. Fig. 1 of our engravings is a diagram showing the electrical construction of the Pilsen lamp, the principal feature of which is the use and action of a biconical or spindle-shaped iron core when suspended between and partly through the interiors of two magnetic solenoids, M, M', placed one above the other, through the coils of the electrical current is passing. When at rest such a core has no positive or balanced position, and is free, and will remain in any one position. The uniform action of this peculiarly-shaped iron core is due to the fact that the magnetic force of the solenoids which appears to be strongest at the centre of each, and which exerts a pull of less in one solenoid being compensated for by that of the other, and the magnetic pull of the solenoids is equal and vice versâ. Turning to the details of this lamp, we observe that the top coil, M, is in the main circuit, the negative wire after passing round this coil, being connected to the contact gutter, refer, and from thence through the frame and tube to the top electrode, and to the positive wire. The current passes from the bottom through the arc to the positive. One end of the sheet attached to the bottom carbon-holder, is connected to coil, M', of the wire and the other end of the wire of M at the terminal at top, the other end of the wire of M at the terminal connected to the bottom arbon-holder. The iron core, or dual bicone, which acts between the two coils, has another bevel tube, round which the cord passes, and from the iron core being counterbalanced by the weight, W, suspended from a pulley over the pulley, it, so that the core is free to move up or down to any position. The two coils, M and M', are regulated that, when the are formed at the carbons is of

£4 to £8 5s. 6d. The finished iron trade of North Staffordshire is in a depressed condition, and it is a long time since the works were so badly off. In no branch, except that of heavy sections, which keep in active demand, are the mills occupied more than three days a time, and many others cannot do that with regularity. The great falling off in the plate trade seems to be largely due to the very low prices now being accepted for steel plates, and the temptation thus offered to boiler makers to try the latter material. The dearth of orders and the reluctance of buyers to purchase are causing prices to become weaker, and makers are in some cases almost glad to accept offers for immediate execution, to enable them to keep their plant running. Crown bars are now quoted at £6 to £6 5s. 6d. The hardware market cannot be said to have improved, and prices are about the same as last reported. Although tinplate works are fairly busy, values of common brands have reached an abnormally low figure. Good coke tins have been sold at Liverpool this week at 15s. 3d. for fair lines. The enquiry for steel rails continues brisk, India and the American Colonies, as well as some of our own railways, being in the market at present. Upcountry trade has been advanced about 10s. per ton, but as yet buyers do not seem very willing to pay the increased prices. The shipbuilding trade is as unsatisfactory as ever, and a cessation is approaching on the wages question, as shipbuilders are giving notices all round for a reduction of pay. Enquiries for new ships are very scarce in all the shipbuilding centres. Engineers are receiving more orders than lately.

THE FOREIGN IRON TRADE.

There is no change to note in the condition of the iron markets of the Continent. Although, in consequence of stock-taking and the usual quietness at this season of the year, there is less enquiry in the Austrian iron markets, business must be considered on the whole satisfactory, whilst prices maintain their present firmness. The Belgian iron markets remain dull, with no prospect of improvement. There has been a slightly better demand for building iron at Charleroi, but competition is so keen that prices are not very low. The greater firmness in the French iron market, noted in our last, continues. Quotations are well maintained by the manufacturers of the Nord and Haute-Marne. At Paris merchant iron is sold to consumers at 165 *fr.*, and trade is active. In the Haute-Marne, coke iron is quoted 175 *fr.*; and mixed brands 165 *fr.* The better tone in the German iron market is maintained, and prices have gained in strength. The firmer tendency of English pig-iron during the last two weeks at home has been reflected in Westphalia, where it is found impossible now to buy it at the lowest rate previously quoted. The American iron market maintains its improved tone. In American pig-iron a better business is doing at unchanged prices. South pig-iron is firm, but the demand is light.

THE BRUSH ELECTRIC SYSTEM.

THE INCANDESCENCE LIGHT.

We recently described and illustrated the arrangements of the Anglo-American Brush Electric Light Corporation, whose offices are in the Belvedere Road, Lambeth. We now proceed to give particulars and illustrations of their incandescence system. In the engravings on pages 88 and 89 of our present issue, fig. 1 is an elevation of Dr. Victoria dynamo, which type of machine has been specially designed by the Brush Corporation for use in incandescence installations. The armature of this machine is built up of thin laminated wrought iron plates, which radiate to a milchrome iron core, whose ends are iron ring, while between the plates are intervening air spaces, thus allowing of perfect ventilation of the armature when the machine is at work. The wire on the armature is wound continuously; that is to say, the end of one bobbin is connected to the inside end of the next contiguous bobbin, and of those two wires being connected to the same segment of the commutator. The field magnets, by which there are four, alternate in polarity in the plane of the armature's rotation, and indium cores are introduced into the armature, which are conveyed out at the commutator. It will be noted from the illustration that, although the magnets are four in number, only two pairs of leading conductors are required. This is effected by means of an ingenious method of connection, which consists in coupling the diametrically opposite sections in the ring, which are entering a field of positive polarity simultaneously, while that of the sections traversing opposite portions of the armature in the same direction are collected as a single current at the commutator, instead of at two, as might be expected.

Figure 2, of our engravings, represents the M. Victoria machine. This, it will be observed, is of a somewhat similar type to the foregoing, and is constructed upon the same basis, but has double the number of poles, and consequently double the number of bobbins only of considerable size. The dynamo is stated to be capable of maintaining 1,000 incandescence lamps or 10,000 light lamps. Designed for the latter class of lighting direct, these machines are, however, admirably adapted for battery-charging purposes, to which branch the corporation has attached considerable importance. These machines may also be effectively used as motors, and when used in this form they return a high percentage of the power delivered to them. The Victoria machines, when arranged for battery charging, are wound with their magnets on a shunt, whereas in cases where the incandescence lamps are to be run off the dynamo direct, the machines are in most cases compound wound. For search-light work the dynamos give good results, the compound winding almost entirely obviating the strains to which the dynamo and engine were subjected by the contact or alteration in distance between the carbon points, and at the same time assisting in maintaining an arc at a constant length.

Fig. 3 represents Allen's hand regulator for the incandescence system. Fig. 4 illustrates an automatic regulator for use with incandescence lamps, in cases where a compound wound self-regulating dynamo is not used, and fig. 5 its accompanying contact maker and break. The action of this apparatus may be briefly described as follows:—A pair of magnets in the base of the frame control a clutch movable upon a feather on the spindle, shown in fig. 4, this spindle being kept continually revolving by means of a band or gut from any convenient countershaft, or directly from the shaft of the dynamo. These electro-magnets are controlled by a small galvanoscope, shown in fig. 5, the solenoid being placed on a shunt circuit across the lamp circuit, the core responding in one direction or the other as lamps are turned on or off, its action being to direct the current in the magnets at the base of the regulator, and thus vary the resistance in the magnet circuit of the machine, by causing a clutch in connection with a worm and wheel, to increase or diminish the pressure between a series of carbon resistance plates. In this way the incandescence light is rendered as entirely under the control of the user as any other form of illumination. Those requiring any number of lamps, driven off one or more machines, do so without any affect the remainder.

We need hardly point out that the incandescence lamp effects the subdivision of the light in a very satisfactory manner for domestic purposes, and while giving a light of beautiful tone, it relieves the air of the atmosphere. Also in factories, workshops, breweries, mines, and all places where large lights are a considerable source of danger, on account of the presence of inflammable materials or explosive gases, the use of this lamp must obviously recommend itself, owing to the fact of the filament being entirely enclosed within an air-tight globe, the fracture of which instantly extinguishes the light. The lamps manufactured by the Corporation range from 2 to 25 candle power, and may be briefly described as follows:—The globe, which is either of clear or frosted glass, contains a horse-shoe shaped filament of carbon, rendered incandescent by the passage of the current. Through one end of the globe two platinum wires are sealed, to the inside ends of which the carbon filament is attached, into a loop, and fused into the globe. This arrangement prevents fracture of the wires at the point where they enter the globe, which is very apt to happen where the lamp is exposed to vibration or constant handling. Figs. 6 and 7 of our engravings shown ordinary incandescence lamp, fitted ina socket as is rendered for electrolysers or for screwing on to gas fittings when the burner has been removed; and fig. 8 a similar socket with an attachment for fixing to gas brackets, without removing the gas burners or interfering with any existing fittings. The two branch wires coming from the main are carried through the bottom of the socket, and secured under screws, which are in connection with two springs within the socket. The lamp wires pass through the cap and are secured under the two screw heads shown at the bottom of the cap in fig. 6. When throwing into circuit, or replacing any lamp, all necessary connections are instantly made, by simply introducing the capped lamp into the holder, the screw head on the cap pressing against the spring within the socket, and the lamp at the same time being firmly held in place by means of the plain projection on the side of the cap, which is pressed into two slots in the socket or holder. Fig. 9 illustrates a wall or table socket intended for use in localities exhibi, to movable tables, or other lamps. The socket is fixed flat against the wall or table, and the lamp would be required; the holder illustrated, to which reference has been made, is screwed on to the socket, the other is connected to the lamp, can be removed from the socket, and used as a hand lamp. The top portion of the room, where a similar socket is fixed, the necessary connections being made by simply introducing the holder into the socket, and giving it one quarter of a turn. An ordinary switch is introduced into the circuit, for the purpose of removing the deadly safe holder.

We now come to those useful and important accessories of every system of lighting, known as switches and distributors. Fig. 10 is a view of a switch suitable for one, two, or three lamps. This switch has been designed with a view to meeting the requirements of the fire insurance companies, and has received the approval of the fire risks committee, appointed by the Society of Telegraph Engineers and Electricians, and they are so arranged that it is impossible to leave the contact pieces in an intermediate or half-way position, while an efficient contact is secured by means of a spring between the two metal surfaces firmly together. An efficient and simple wall switch is thus obtained. The Bipon switch, which has a similar safety arrangement to the preceding one, is made of the size and appearance of the small tap on a gas lamp, and can be conveniently used in the same position when replacing gas jets by incandescence lamps, using the same fittings. There are also reducing switches for varying the brilliancy of the light, by the employment of these, the user is enabled to obtain any desired degree of illumination up to the full power of the lamp, as the simple movement of a handle introduces into the circuit of the lamp a resistance which varies with the position of the tap, and maintains the light at any required brilliancy. Figs. 11, 12, and 13 represent three designs of safety cut-outs, being besides these are many other forms, in order to avoid any chance of the undue warming of the wires, a piece of wire, fusible at a very low temperature, is inserted into the circuit. The Corporation have secured, through Messrs. Johnson and Matthey, a fusible wire, possessing very remarkable properties, which have been arrived at by special mechanical treatment of a new alloy, and which has the exceptional advantage of breaking off short without first bending so soon as the temperature of fusion is reached. This temperature is a very low one, far below that of boiling water, it therefore melts long before the temperature of the cables become appreciably raised, and by reason of a break in the circuit, prevents the current from flowing in that particular branch or portion of the circuit. Fig. 14 shows a switch suitable for a single lamp, fig. 12 one for six lamps, and fig. 13 one for ten or twelve lamps. Fig. 15 illustrates a time switch, which is an arrangement whereby a consumer may have one or more arc or group of incandescence lamps on his premises turned off at any desired time. This is effected by setting the clock, as in an alarum, to the hour at which it may be determined to extinguish the light, when the switch, shown at the top of the figure is automatically thrown out of contact with the wires, while a series of dials at the base of the switch registers the number of hours during which the lamp or lamps have been burning. The clocks in use are such as are employed for various qualities which would be suitable for use in offices and public halls of admission, or would call attention to the compound wound dynamos supplied by the Corporation. These machines are self-regulating, it being possible to turn out any number of lamps, from one without affecting the remainder. The efficiency of the machine is also stated to be very high, it is larger since 96 per cent. of the mechanical energy of the belt being transferred into electrical energy, and 88 per cent. of the same appearing as useful work in the outside circuit. By the use of these compound machines the consumer is enabled to switch off any number of lamps supplied by the dynamo, the increase power required remaining practically proportional to the number of lamps in use, while the necessity for any external appliance for automatically regulating the dynamo to varying loads is dispensed with. On the whole, it will be seen that the Brush Corporation have two excellent systems of electric lighting, and it is satisfactory to know that both have proved that they have two in London—are kept fully employed in turning out machinery and apparatus for new installations.

Occasional Notes.

SILVER IN AUSTRALIA.

Native silver does not appear to have been found in any quantity in New South Wales. The Rev. W. B. Clarke mentions the South Sea Company's claim, in 1830, that silver had been met with in the southern districts, and also specimens of silver in the form of small fragments and atacreous crystals. Count Strzelecki mentions the occurrence of native silver on Mount Kosciusko Range, from Piper's Flat, in New South Wales, in 1839, and says that native silver, native nickel, and native spangles is disseminated in primitive greenstone, and deserves further examination. Native silver also occurs also in the Hocrock Mines, with the chloride, sulphuret, and ruby silver; and at Carlton, Illawarra, Bungay, Hunter, and Manley Districts; and Worrell Creek, to the north of Liverpool. A small plate of native silver found by Mr. C. Sutter, junior, in the quartz of a vein containing galena on the Mount Grenville Estate, near Bathurst. The Australian silver-mining industry would have probably developed if undertaken by parties really possessing the knowledge of separating the metal economically from the ores with which it is generally found in combination. In a recent report of the New South Wales Department of Mines, it is stated that, at Nundumbeah and Umbersnicks, near Mount Gipps, in the Albert District, extensive deposits of silver and lead ores have been opened up. Large quantities of the ore are found as and

BRUSH ELECTRIC SYSTEM.

THE INCANDESCENCE LIGHT.

(For description, see page 90.)

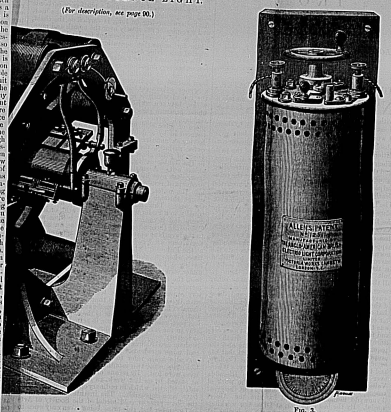


Fig. 2.

IRON.

THE PRACTICAL APPLICATIONS OF ELECTRICITY.

The question of the application of electricity to the illumination of our streets and public places, as well as of the interior of our dwellings, is just now in a transition state. From the stage of huge admiration and amusement easily, if sometimes successful, experiments, it is passing to that in which its practical utility is an accepted substitute for gas will be measured by the only ultimate test—permanent adoption by the general public as its chief illuminating agent. So long as the electric light remains a hobby in which only the wealthy can indulge, or so long as its use is confined to some isolated places or buildings, it cannot be regarded as anything else than a costly toy; and as it be admitted that the predictions of its advocates have even approached verification. The *furore* which was created about twelve months ago assisted, and at the same time damaged, the cause of electric lighting; and it is to be feared that the damage preponderated greatly. While abundant capital was placed at the disposal of the new illuminating agent—in itself a matter of congratulation—the stock exchange gambling which was fostered, and which led to the search for spurious profits by the sale of patents, and by the introduction of numerous bubble companies whose very existence differing, however slightly, from its predecessors' could be got hold of, could not fail to bring a certain amount of discredit upon the matter. Besides this, an undesired currency was brought into prominence publicity, and the attention of those interested in the perfecting of it turned aside from the scientific to the commercial aspect of the question. The effect of these unfortunate circumstances has perhaps been a great measure passed off by this time, but some incubus will always remain on account of the losses some sustained in promotion money and in payment for worthless rights; and it must always be a matter for regret that legitimate enterprise should be so much at the mercy of unscrupulous men.

The action which the Government deemed it necessary to take last year, in view of the large and sudden importance which the question of electrical illumination had assumed, has interposed a further barrier, doubtless, in the way of the supreme attempt being made to attain practical results. But considering the interests involved, it must be admitted that such a step as the Government took was requisite, and that the delay which it has caused may have had a salutary effect in preventing immature plans and projects from being forced on to the public. According to the provisions of the Electric Lighting Act of 1882, the Board of Trade was empowered to grant licenses or provisional orders for electric lighting. The licenses were to be for periods not exceeding seven years, but it was necessary that the consent of the local authorities for the districts to which they related should be obtained, the local authorities having power to such consent to their assent as they considered expedient, subject only to the approval of the Board of Trade. For some reason, which is not very well understood, however, the latter have as yet been granted by that department. The provisional orders which the department was empowered to grant, might be for any period, limited or unlimited, but they have come to be looked upon as practically having the effect of restricting the enjoyment of the privileges conferred to a period of twenty-one years, owing to the clause in the act which entitles the local authorities to take in at the expiration of that term and take over the enterprise of the electric lighting company at its fair market value. The merits of this arrangement are open to criticism, as they were freely discussed in these columns at the time of the passing of the measure; it is unnecessary to refer to them further at present. It is not to be wondered at, however, that, under the circumstances, the number of applications for provisional orders which have been lodged by local authorities has been comparatively trifling. Out of 106 such applications received by the Board of Trade up to December 31 last, only twenty-three were promoted by local authorities, the remaining eighty-three having been made on behalf of companies. The provisional orders so granted by the Board of Trade numbered twenty-seven, but of the number of these have been before the public for some time, we may look at no very distant date for the first attempts at the practical application of, electricity to the lighting of large districts for domestic purposes as well as public. The result of the first experiments will be watched with keen interest.

But it would be well for all concerned in the electric lighting companies, shareholders as well as officials, not to be too sanguine as to the results, at least in the immediate future. Even if the success of the systems before the public at present were incontestible, there is a great *vis inertiæ* to be overcome. People have got accustomed to gas, and, with all its drawbacks, it is an illuminating agent easily used; and, moreover, thanks to the agitation occasioned by the electric light, the quality has latterly undergone considerable improvement, and, in London at least, the price is moderate. The gas companies have, in addition, got a long start of the electric light companies, and will make a desperate fight before they allow themselves to be beaten off the field. So much for an authority as Captain Douglas Galton, while expressing his opinion that electricity as an illuminant in large will ultimately supersede gas, has stated that the new methods of gas lighting which have been introduced bid fair to retard the universal adoption of the electric light for domestic use. It is probably upon the question of cost that the ultimate decision will turn. To be a practical success, electric lighting must be patronised by the general public, and the greater part of that body will judge how it pays from question of price. No matter what purity of atmosphere or other beneficial effects be set down to its credit, unless the price at which the companies can supply it is such as to induce the general public to adopt it, it is difficult to see how it can be rendered a financial success. So far as experience has gone yet, the electric light cannot be supplied at a rate to compete with gas, and when this is the result of competitions where gas is comparatively dear, it follows that in London, with cheap gas, the level price at which the electric light will be placed is still greater. It is noteworthy circumstance that the company, started last year with a most influential board of directors, for the purpose of taking up and working any feasible system, has been wound up, the shareholders declaring that, although they examined numerous schemes submitted to them, found no one which was practicable. In short, there was no work for the company to do. The shareholders have in this case been very more fortunate than we fear those in most companies connected with electric lighting will find themselves, the capital having been returned in full, as the interest earned was sufficient to cover expenses.

In considering the subject of the practical applications of electricity, we have naturally referred first and at considerable length to its use as a illuminant, since it is that matter that it has been principally before the public of late; but there are other directions, in which great efforts are being made to apply it successfully, which demand a brief reference. Perhaps next to lighting by electricity, the propulsion of tramcars by its agency has occupied the greatest amount of attention on the part of experts. But although great energy and perseverance have been devoted to the matter, they have as yet failed to bear any practical fruit, the great difficulty being to avoid the danger to horses where the rails are used as electrical conductors, and to provide against the interception of the current by the other traffic on the same road. On account of these difficulties, an electric railway would appear to be more feasible than an electric tramway, but it is open to question whether scientists will ever be able to develop sufficient power in electricity to make it adaptable to

authorities has declared against the practicability of it, and, without doubt, the remaining eighty-three accumulators, has ridiculed the idea of hauling carriages with land in order to assist in making them move. A revival of an old idea in the application of electricity has been recently made by employing it for the propulsion of small launches. There is no doubt that there is a field for it, and although it would be premature yet to predict cutting out steam, the advantages which the use of electricity offers in this case are such as to augur well for its ultimate achievement. In short, Sir Isaac Holls also we would not have it thought that we consider the prospect as hopeless, but there can be little doubt that considerable patience and perseverance will require to be exercised.

Iron, Aug 4, 1882.

THE MUNICH ELECTRICAL EXHIBITION.—In connection with the forthcoming electro-technical exhibition in Munich, Baierische Kunstgewerbe-Verein has announced a competition for light-fittings (lustres, brackets, candelabra, &c., suitable for the electric light. According to *Nature*, the Edison illuminating, to be maintained by about 8ohorse power, will be no way inferior in extent to that in Paris; the engineering will principally consist of a double line of wires in the streets, and the theatre, will be lit with 800 Edison lamps. The Exhibition, which will be held in the Glaspalast, Munich, is now open for centrally lighting up a whole city quarter with 12,000 lamps and 12,000 test candles. Mr. Schuckert, of Nürnberg, is to be tried in New York. Palace light up the Crystal with a reflector lamp of 10,000 candle-power; also the engineer's theatre with an upper light of 2000 candle-power. There will also exhibit several transportable electric lights for use in mines, and ways, &c. Special interest will attach to that to utilise the water-power of the Elsbachen, about three miles from the palace; the current will work a lift, or hoisting machine, in the palace by day, and illuminate the garden and the Kunstgalerie by night; 24 lamps of 1000 candle-power each. The copper wire will be 3 mm. thick. A monitorial account of the exhibition is supplied with the *Elektrotechnische Zeitschrift* for July.

MARCH 31, 1882.

IRON.

THE LORELEY BY ELECTRIC LIGHT.

There is every probability that the electric light will soon find an application hitherto not thought of. The steamboat company plying their vessels on the Rhine and the Lake of Constance have recently made experiments with the Bürgin lamp, placed on board a steamboat, by which it is possible to satisfactorily light up both shores of the river ahead on the vessel proceeds on her course. We quite recently illustrated in these columns an arrangement by which the paramount way may be lit up for a considerable distance ahead by means of a reflector placed at the stern of a steamer, driven by a motor placed on the platform of the engine. Now, what is practicable in such a position, exposed as the whole apparatus must be to constant oscillation, is equally easy of attainment on board a vessel. The vibration and thumping experienced on board a steamer is considerably reduced in intensity, if it does not wholly disappear, at her head. We also have seen that all be anticipated if the successful experiment carried out on the Rhine will lead to the adoption throughout Germany by the steamers running on it. Travellers by that delightful route will then have their enjoyment heightened by the beautiful effects of the electric light, which will add fresh charms to scenes which, once seen, engender in the traveller the desire to again and again taste of the joys which a trip on the Rhine affords.

MARCH 31, 1882.

IRON.

THE VIENNA ELECTRICAL EXHIBITION.—The applications of electricity are so numerous, and are so universal, and give it a thoroughly international character. From the published lists it appears that, leaving Austrian exhibitors here, there are representatives from the United States, Belgium, England, France, Germany, Italy, Russia, Sweden, and Switzerland. We are further informed that the time for receiving applications has been extended to March 20, by which time the plans will be handed in to the secretary of the Society of Telegraph Engineers, 4, The Sanctuary, Westminster. We are also authorised to state that the committee at Vienna are making arrangements for a reduction in the rates of transit on all goods forwarded to Vienna for exhibit on.

THE ELECTRIC LIGHT AT THE VIENNA EXHIBITION.—We learn that the executive committee of the exhibition have recently come to a decision to light their grounds by electricity, and that they have already made arrangements for the illumination of fifty two-light sets of lamps. Messrs. Davey, Paxman, & Co., so well known for the excellence of their engines in connection with the electric lighting they have undertaken, as most favourable terms, supply us a necessary motive power, which has been calculated at more than 600 horse-power. There will be four engines, one of which will indicate 200 horse-power. We consider this to be the greatest honour paid to any engineering firm in this country at the present time, and we feel sure that we may say the same of the engines and appliances about to be used. The principal men who will superintend the engineering engagements would prevent their presence in the daytime.

THE MANCHESTER ELECTRICAL EXHIBITION.—An electric lighting, gas lighting, and general engineering exhibition was opened on March 25 in Messrs. Heaton's Hall, Manchester. Notwithstanding the efforts of the promoters, the exhibition is not yet in complete order, and some time must yet elapse before many of the more interesting objects of display will be seen in operation, or exhibits in position. Under these circumstances, therefore, it is impossible to enter into details, but we may say that the engines and appliances about to be used. The principal men who will superintend the engineering engagements would prevent their presence in the daytime. The Manchester Electrical Exhibition

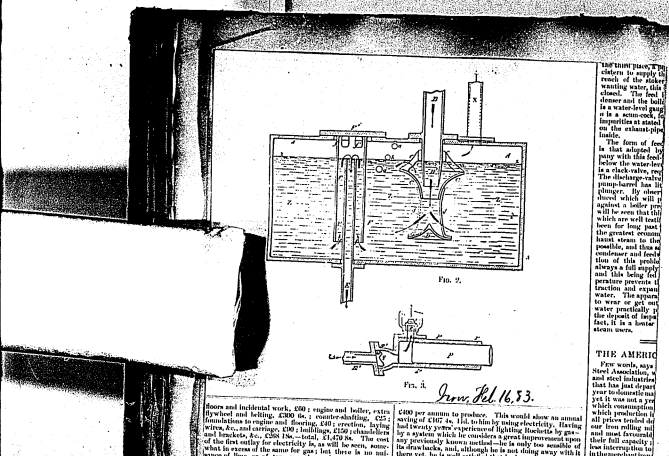


Fig. 2.

Fig. 3.

Iron, Feb. 16, 53.

floors and incidental work, £60 ; engine and boiler, extra flywheel and belting, £360 6s. ; counter-shafting, £25 ; foundations to engine and floor-laying, £40 ; erection, laying and brackets, &c., £205 18s. ; total, £1,470 8s. The cost of the first outlay for electricity is a will be seen, somewhat in excess of the amount for gas; but there is no suffocation of gas into the house, no smell in the manufacture, or damage to garden ; and, in the case of an unsightly encumbrance, Mr. Coope has a compact little engine, placed out of view, and which, when not driving the dynamos, is utilised for pumping water to the top of the house, and can also be employed for sawing wood, or any other purpose of a like nature required.

In estimating the annual working expenses, and in making a comparison, Mr. Coope assumes that it would cost the same to manufacture 1,000 cubic feet of gas at Bochetts as it does at Rochetts. The electric light – 200 16-candle lamps, each working 1,650 hours per annum at 50s. per week, 478 ; renewal of lamps, 120 at 2s. each, £38 8s. ; depreciation 10 per cent. value of machinery, £74 ; depreciation 5 per cent. on engines, £4 Total, £232 18s. 4d. Now for less than half this amount of light it costs Mr. Coope £200 a year at Rochetts, and he is, therefore, if anything, understating the expense when he says that, half he used gas at Herschrede giving an equivalent illuminating power, it would have cost him at least £400 per annum to produce. This would show an annual saving of £167 4s. 11d. to him by using electricity. Having had twenty years' experience of lighting Rochetts by gas by a system which he considers a great improvement upon its drawbacks, and, although he is fully too sensible of there yet, he is well satisfied that he has adopted electricity at Herschrede.

The above very clear statement, however much its details may be disputed, is, as already remarked, unmistakably in favour of the electric light ; but it fully bears out Dr. Siemens' view that the latter is at present only a luxury to be indulged in by the rich. We must, however, speak with Dr. Siemens again, and be satisfied with his old friend—gas, and bear with him a little while longer. Electric light companies, however, whose success depends upon their ability and willingness to supply the general public with a cheap light, ought to pay more attention to the commercial aspect of the question. For reasons best known to themselves, but pretty correctly guessed at by world-be consumers, they put such a price upon the commodity which they wish to dispose of as to make its superity nearly prohibitive. An instance that just came under our notice in which a company, which shall be nameless, offered to supply the electric light at at least three times the cost of gas. It is absurd to suppose that under such conditions the electric light can make headway. It is still more foolish to expect the public to pay extravagant rates for what they can very well do without.

THE ELECTRIC LIGHT AT ALEXANDRA.—Messrs. Allen Alderman and Co., of this city, who have worked the electric light at Ranelagh for the last month, have received £50,000 grass from the Alexandra Park Company. The Alexandra Park Company, which is a limited liability company, has already exceeded the fees of last July, having been expected to do only £40,000 gross. The public benefit, too, has been the great service in supplying H.M.'s troops with various marching orders. The machine used is a Gramme of twelve horse power. The Savoy lamp belonging to the machine is the Crompton. It has been in use for a long time, and is now being made for 2,000 candles. The lamp which is in it is fully expected, three times as large as at present. The Gramme machine is coupled to a portable engine manufactured by Messrs. Rustin, Proctor and Co., of the Sheaf portable engines for pumping out the old cisterns, and this little machine of Messrs. Rustin and Proctor's has been pumping salt water from the sea, near the Ramleh station in town, and feeding the water up to a place close to the Ziania Theatre for the purpose of flushing the town drains.

Journal Jan. 5, 1882.

Iron, March 2, 1882.

THE CHAMBERLAIN LIGHT.

A new process of gas manufacture has recently been brought under our notice, in which oil, water, and air are the three agents from which the gas is produced. This process is the invention of Colonel Chamberlain, and the product is a gas of high illuminating power, and, of low cost, two very desirable qualities. The apparatus consists of a cast iron retort, which is placed within a coke furnace, so arranged that the heat from the furnace passes the retort is conducted to the flue without coming over it. The oil—which is the best quality of petroleum—is stored in a small tank, the water, being stored in the another purpose. From the tank the oil and the water are led by pipes—the former of oil at one-eighth of water—into a small vessel where they unite, and through which they are regulated by stopcocks. In this latter they are discharged in the constituent gas passes away through a pipe of larger diameter to a washer. The mixture of a cubic foot of cast iron, having vertical dividing plates, and being partly filled with water. The gas passes underneath these plates and through the water to the gasholder, where it is stored for use. In the washer is deposited a residue which is found to contain a useful lubricant and a material for staining wood, besides yielding lamp-black. The gas so far is only a product of oil and water; the third constituent—air—has yet to be added. This is forced into the retort by means of a small Roots blower, and there decomposed. From the retort the air flows into the washer and the gasholder, and picks up on its way, much of the oil-gas as may have escaped from the retort, the retort or the washer. The air is added in the proportion of 3 of air to 1 of the gas already mentioned in order to be of 21-candle power, and to cost 1s. 3d. per 1,000 cubic feet. It is stated to be of 21-candle power, and to cost 1s. 3d. per 1,000 cubic feet. It is stated that experiments have been conducted by gentlemen connected with the Board of Trade, which have proved the gas to be of great illuminating power, and of low cost. In one of these experiments it has been found that it is a good, light, steady, permanent, and travelling gas, suitable for dwelling. It is reported to be free from smell, humidity and deposit, and of such a nature that during storage under various conditions its illuminating power remained at a maximum, whether the gas was subject to the chemical properties change. It is moreover said to contain no sulphur, and only a trace of carbonic acid. It gives an excellent light, as was demonstrated on our recent visit to the Lower Belgrave Street, Pimlico, where a working apparatus has been at work for some time past. The good features of the gas were for the most part demonstrated, the gas being rapidly made, and giving an excellent light by the customary cause and is very highly reported of also being clearly distinguishable. Its cleanliness and the absence of carbonic acid were apparent from the general appearance of the room and of the flowers and shrubs in it, which had been subject to the influence of its light ; and the latter also for some time past without any deleterious effects being made visible. The generator measures about 3 feet square in plan and stands 4 feet high, and is capable of the production of 70 feet of gas per hour. A saving of 25 per cent. is said to be obtained in the consumption of coke, 30 per cent gas, 770 cubic feet burning as long as 1,000 cubic feet of ordinary gas. It will mix with coal gas, which it is said it will enrich. It will thus be seen that the Chamberlain light possesses many advantages which commend it, for use wherever the ordinary sources of artificial light are either too dear or unobtainable. Having regard to this fact, and to the circumstance that with it is very easy to manufacture, we do not see why it should not meet with a wide adoption.

Sept. 22, 1882.

THE MUNICH EXHIBITION.—A series of electro-technical experiments on a larger scale are now taking place at the Glaspalast exhibition in Munich. Their object is to give general public, a number of scientific authorities, as well as the electricity in its practical shape, a survey of the present state of electric transmission of force, particularly with reference to the application of electricity to lighting purposes. It is expected that these trials will tend to propagate the introduction of electricity both in public and private life, to the great benefit of the community at large.

THE CROMPTON ELECTRIC LIGHT.

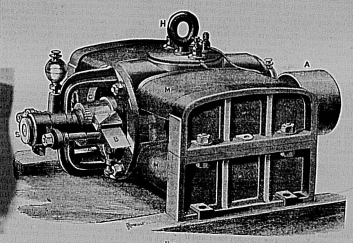


Fig. 1.

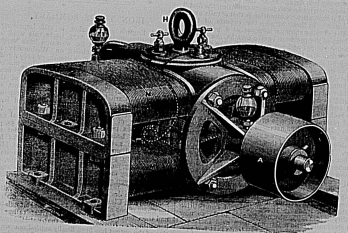


Fig. 2.

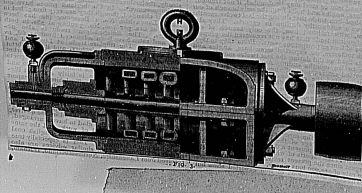


Fig. 3.

The iron markets of the Continent preserve their former firmness. In the Austrian market quotations are becoming much stronger, consequent upon the greater demand for both pig and manufactured iron and steel rails. The tendency of the Belgian iron market has not changed, the demand continuing active, and prices firm. With work assured for a couple of years ahead, the French iron trade has attained a position which nothing but the most extraordinary events could well disturb, and as, as a matter of fact, nothing is likely to happen which could have such an effect, its prosperity for that length of time may confidently be predicted. It is fully expected that a rise in quotations in the German iron market, which are at present extremely firm, will soon take place, partly in consequence of the slight advance secured in the prices of coal. Hoerde pig has already risen 5 marks, and is now quoted at 45 marks per ton. The approaching winter and the great briskness of the iron trade has infused fresh life into the coal markets of the Continent. Advices telling almost the same tale are received from Austria, Belgium, and France, where quotations have a rising tendency, which before long will find it mightier expression in higher prices. The German coal trade is proceeding steadily towards improvement, and rates are very firmly maintained. The Silesian coalowners having raised their quotations from 9d. to 1s. 3d. per ton, the advance to take effect from October 1, a German writer computes that, if their example were followed and the higher values maintained throughout Germany, the increased income would be between £1,250,000 and £1,550,000 per annum, a sum large enough to improve at once the wretched position of the mining population and ensure owners a fair return for capital sunk. The American iron market has become much firmer, Scotch pig-iron is rising in value, Gartsherrie being now quoted at $24. From the returns issued by the United States Bureau of Statistics for the fiscal year ending June 30, 1881, it will be observed that up to that date a very decided decrease had taken place in every item of the iron and steel imports into the States, except iron and steel rails, the imports of which have more than doubled. The values represented by the iron and steel imports were $60,144,611 for the year ending June 30, 1881, and $70,037,771 during the same period in 1880, thus showing a falling-off of over $10,000,000. But as last year was quite an exceptional year in our commercial intercourse with the United States, the imports in 1879 amounting to only $29,926,665, we have every reason to be satisfied with the trade returns for the current year, more especially as the demand from the United States has steadily increased since the date at which the statistics referred to were compiled.

THE CROMPTON ELECTRIC LIGHT.

We recently recorded the successful lighting of the King's Cross Station at the Great Northern Railway by electricity; the system employed being that of Mr. R. E. Crompton, of Mansion House Buildings, Queen Victoria Street, London. We now have the pleasure of placing before our readers illustrations and a full description of this system, including the new circuit lamp recently perfected by Mr. Crompton. The current is produced by means of a Mergin dynamo machine, which was invented by C. E. Mergin, of Aarau, Switzerland. The original machine was designed for a single light; it is, however, due to Mr. Crompton's improvements that a greater electro-motive force is obtained, which renders the machine capable of supplying several lights. It is a very efficient machine, whilst at the same time its portability and small cost are greatly in its favour. The machine is illustrated in the annexed engravings, in which fig. 1 is a view of the commutator side of the machine, whilst fig. 2 shows the other side of the machine with driving pulley. Fig. 3 is partly a longitudinal section and partly a side elevation, and fig. 4 corresponds to this in transverse section, whilst fig. 5 shows the armature. The machine is a ring-wound machine, that is to say, that the coils of the armature should have a high surface velocity, and with the ordinary Gramme ring this is impossible on account of the wires of the coil being so closely confined and so thickly wound as to make them very apt to heat with the current; but the coils of the Mergin ring, being composed—as will be seen on reference to fig. 5, which represents the armature of a three-light machine—of several separate rings, R, attached to the spindle, S, so as to form a kind of cylinder, go all away with the chances of heating; the sections of these rings are connected in series to the sections of the commutator, and the current is then collected by copper brushes in the ordinary way. The armature consists of a circular loop of the Gramme, each core is a frame of soft charcoal wires built up into a square bar. After covering each side of the bar with varnished tape, a coil of wire is wound on, passing the iron corners of the core bare, and the coils are arranged so as to make the general outline circular. This arrangement is shown in fig. 5, R is the ring; C the bare corners; and W the wire coil. It is obvious that a highly magnetised state of the core is obtained by passing so many bar poles of the core close to the poles of the inducing magnets.

THE CROMPTON ELECTRIC LIGHT.

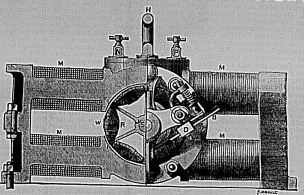


Fig. 4.

Fig. 5.

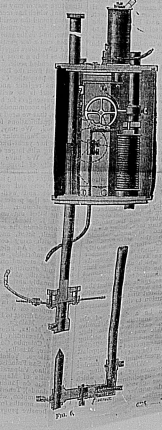


Fig. 6.

of winding causes the small number of layers in free access to the surfaces from unduly heating with machine coil has usually ie Bürgin has only five damage a Gramme coil The contact slips of ably made of phosphor- superior wearing qualities as shown at D, in fig. 1, gative currents from the ies of six sheet copper ers. They are carried ly the adjusting screw a, a whole being carried by on the spindle, F, and at the commutator by the arrangement enables the ly parts to be easily re-

Gramme machine requires ld be mounted on an in- ers an advantage in the nal rings of its armature the spindle. By metal- en at D (in figs. 1 and 4, he necessity for insulation- ccurately balanced, light- d velocity. It consists of 48 feet of cotton-covered n diameter and 1/16 thick- 1/25 in. The whole arma- shes has an electro-motive e electro-motive force at s per minute is 100 volts. imate, it is found that volts. ameter of the coils through 0 feet per minute at 1,500 is machine has the cores of 16 up of separate bars of rgin they are formed of one to admit the armature and al covers which carry the f construction is dangerous olidity, and consequently the means of close and o magnetic power and being truly bored, the with the magnetic poles. eal in section and the pole and crescent shaped. They 4 M in figs. 1 and 4 with ap copper wire 0.141 inches in d of wire on the four coils is d in opposite pairs, so as to ch other, and between ce of a high velocity. These electric resistance of only magnets of this machine was another, continuous current e self-excited by the current When self-excited the magnet suitable terminals in the al internal resistance of the machine is 12 ohms for the armature. When separately d the electro-magnets the ximate electro-motive force is

circuit lamp, shown at fig. f this patent regulator lamp, o those used at King's Cross. carbon is carried by a heavy of which is sufficient to supply current to its descent against of the train of wheels geared the regulating gearing into train. The first wheel of this ngaged by a governor of simple con- form of a brake wheel. The ed so that the evolution of the de to an advance of 1 millimetre he lower carbon holder is fully section. The positive carbon g lamp itself by means of the The upper end of the carbon ch holds it in the top and bottom ce stroke through which the ches work is regulated by the ch there is not working the ed up by means of a large spiral ing screw. The attraction of adding upon the current, and ly to overcome the pressure ewer the current passing through ecessary to give a proper light and older down into close contact ngaged, maintaining it there so e passes.

ps may feed its carbons in- general strength of the current, wound with very fine wire, is ed that the ends of this wire n the leading wires as they enter . This is a fanciful part of the passing through this electro- the current it was or should be ence varies as will vary the proper- ich passes through the coils fore, and, therefore, as will vary the

ELECTRIC LIGHTING AT THE FISHERIES EXHIBITION.

ALTHOUGH the electric lighting arrangements at the Fisheries Exhibition have been completed and in operation for some time past, it is only somewhat recently, by reason of the shortening days, that the bulk of the visitors have been enabled to see the illumination at its best, and to fully appreciate its excellence. As, therefore, it is now in full and perfect working order, we propose to place par- ticulars of this grand installation before our readers. When the magnitude of the exhibition is considered, the extent of the electrical display necessary to properly light it up will be approximately understood. It cannot, however, be fully realised without a per- sonal inspection, but, as indicating its extensive nature, we may mention at the outset that the total illuminating power is estimated at one million candles. The source of this immense volume of dis- tributed light is a fine collection of engines and ma- chinery placed in an annexe 160 feet long by 60 feet wide, situated in the south-western angle of the exhi- bition grounds, and adjoining the machinery in motion annexe. Here are to be seen a number of engines by Davey, Paxman & Co., having an aggregate of over 1,000 horse-power indicated, together with boilers for supplying steam by the same makers. Here also is a fine collection of dynamo machines by various makers, and which receive motion from the engines on the one hand, whilst, on the other, they give out that motion as light. The various electric systems employed are for the most part too well known to require description at our hands, so that we may at once proceed to indicate those systems and the localities lighted by them. Before doing so, however, we may mention that there are sixteen firms who have lent either engines, machines, or lamps.

Turning first to the motive power, we may observe that Messrs. Davey, Paxman & Co., of Colchester, have constructed and lent the six engines which are em- ployed in driving the dynamo machines. The first of these is a fine double horizontal engine of 400 horse- power indicated, having cylinders 19 inches in diameter and 32 inches stroke, making 68 revolutions per minute. The second is a compound engine, of 250 indicated horse-power, and has cylinders of 15 and 22½ inches respectively, with a stroke of 2 feet, and making 103 revolutions per minute. There are also three double-cylinder engines of the semi-fixed type—that is, with combined engine and boiler on one bedplate. These are each of 125 horse-power indi- cated. With another semi-portable engine of 110 in dicated horse-power, there is a total arrived at o 1,135 indicated horse-power. The two large engines and the last named are fitted with Paxman's patent cut-off gear, and on each there is an adjustable governor, by means of which the speed of the dynamo machines may be minutely regulated, and with the result of giving the steadiness of light which will be noticed by visitors to the exhibition. In the new gear the cut-off valve is driven by a pair of eccentrics, the rods being connected by a link the position of which in rela- tion to the valve-spindle is determined by the governor. The cut-off can be varied between the two extreme positions of the link from *nil* to ⅝. The peculiarity of this gear is that the two eccentrics have different throws, the one which cuts the steam off early having a very short travel as compared with the other. The cut-off and exhaust slide valves are upon opposite sides of the cylinder, the exhaust valve being driven by a separate eccentric and having an invariable travel. The automatic regulation of the dynamo machines by the Paxman engines has so commended them to those responsible for lighting of the South Kensington Museum, that the largest of these engines has been bought for the department, and after its term of service in the Fisheries Exhibition is com- pleted it will be moved across the road for permanent duty in the museum. Steam is supplied to the 400 horse engine from three Davey-Paxman boilers of the locomotive type, and to the compound engine by two similar boilers. The other engines of course have their own boilers connected to them. We may mention that the bedplate of the compound engine is of a new type, being formed of girders planed on their sides and upper surfaces. When bolted together they form a strong, neat, and compact foundation. This method of construction was resorted to in conse- quence of the difficulty experienced in finding a good foundation.

Messrs. Siemens Bros. & Co. are lighting the main gallery, containing the exhibition of British sea fisheries, by means of Swan lamps, and the conserva- tory, adjoining the Royal Albert Hall, by four arc lights, each produced by a current of 32 ampères. The incandescence lamps in the main gallery have been supplied by the Swan United Electric Light Company, and give out a light of 20 candle-power each, with a current of 46 volts and 1·34 ampères. The gallery is 800 feet long, and its roof is sup- ported by 80 wooden arches, each having 13 projecting points, on which the holders for the lamps have been fixed. At the western end of the gallery fifty-one lamps have been placed in the three arches forming the entrance to the per- manent building. Altogether, 1,040 Swan lamps are distributed over the gallery. The necessary current is supplied by two Siemens alternate current machines, and the leading wires are connected, so that lamps on alternate arches are worked by the same machine. It is also noteworthy that the lamps in all parts of the gallery burn with equal brilliancy, a result obtained, without any regulating apparatus whatever, by a suitable arrangement of the circuits. A Siemens continuous current machine produces the current for the arc lights in the conservatory, which are connected parallel, and are at a distance of about 420 yards from the machine. The lamps are of the ordinary Siemens pattern, such as are used with single light machines, and have no shunt regulating coil as required when lamps are worked in series. The effect of the incandescence lighting in the British sea fisheries gallery is exceedingly pleasing. As seen from the eastern end, the long arched roof with its western radial screen closing in the view appears to be closely studded with innumerable points of light. The Swan United Electric Light Company, of No. 9, St. Mildred's Court, Poultry, London, illuminate the Royal Pavilion with 190 Swan incandescence lamps of 82 volts arranged in parallel series. The lighting is intended to demon- strate the adaptability of the incandescent lamp to decorative illumination, in which it certainly succeeds. In the conservatory this company have forty half lights of 26 volts, which are employed to give coloured and shaded light and water effects. The machines used to supply the current to the high resistance lamps consist of a Siemens alternating current dynamo with excitor and a direct current dynamo. The half lights are supplied by a small Gramme machine. The Gülcher Electric Light Company, of Battersea Foundry, Battersea, light the east gallery (China and the colonies), the machinery in motion, and the electric machinery annexes. They have four Gülcher direct current low-tension dynamo machines supplying 600 Crookes incandescence lamps in the China gallery, and twenty-six Gülcher arc lamps in the two annexes. The tension of the current throughout does not exceed 65 volts, and the lamps are arranged in parallel series upon numerous circuits running from the machines.

Mr. Charles Lever, of Culcheth Hall, Bowden, Cheshire, has altogether twenty-five of his lamps, six teen of which are in the dining and luncheon rooms These are alternately arranged on two circuits, and are worked by two special compound Gramme dynamos. The others are arranged; two in the council room, two in the lecture theatre, one in the fish kitchen, four in the fish dining room, and three in the kitchen. These twelve are worked on two cir- cuits from two Bürgin dynamos, which are separately excited by an A-Gramme machine. There is one large return for the whole, *i.e.* for the four circuits. The Electric Light Supply Company, of 28, York Street, Westminster, are lighting the lifeboat shed with seven Volta arc lamps, and the literary superin- tendent's room with forty Swan lamps, driven from two Frankland-Bürgin dynamo machines. The en- trance vestibule and the fine arts gallery are lighted by 250 Woodhouse and Rawson incandescence lamps, the current being supplied by two Elphinstone-Vincent dynamo machines. Mr. Henry Edmunds, of Victoria Mansions, Westminster, is lighting the promenade gallery with twenty-five Hochhausen lamps, worked by two direct current Hochhausen dynamo machines. In the eastern corridor and quadrant Mr. Edmunds has fifteen more Hochhausen lamps, driven by a third Hochhausen dynamo. An interesting feature in this machine is that the automatic regulator, which keeps a constant current, but varies the electromotive force according to the demands of the work, enables any number of lamps, from the maximum to the mini- mum, or vice versâ, to be turned in or out as may be required, without varying the speed of the machine, or in any way affecting the lighting power of the lamps still in circuit. Mr. Edmunds makes a very interesting and effective display of this light in the upper grounds of the exhibition, where he has erected a light tower on the same plan as that in Madison Square, New York. Six Hochhausen lamps, each of 2,500 candle-power, are raised on a lattice iron pole to the height of 120 feet, and they are at a distance of about 800 feet from the machines which supply the electricity. The lamps illuminate the upper terraces and gardens very effectively, and are a very prominent feature.

The Gérard Electric Light and Power Company, of Paris, light up the galleries appropriated to Spain and Russia with fourteen arc lamps, seven in each gallery, on the Gérard system. One half of these lamps are worked from a Siemens alternating current dynamo, the other half being driven by a Gérard alternating current machine. Messrs. Ferranti, Thompson & Ince, of No. 3, Fenchurch Avenue, London, have in the aquarium 650 incandescence lamps of the Swan and Mackie type, which derive their current from a Ferranti-Thompson dynamo machine capable of sup- plying 1,000 lamps. The dynamo is excited by a Siemens direct current machine. The British Electric Light Company, of Turk's Head Yard, London, are lighting up the central transepts, occupied by Norway and Sweden, with eighteen Brockie arc lamps driven by Gramme dynamo machines. They also have one large light in the third-class buffet. The Electrical Power and Light Contract Agency, of 71, Bishops- gate Street Within, London, illuminate the Canadian and United States courts in a very steady and effec- tive manner with fifteen Lea arc lamps. They also have thirty Wright & Mackie machine-blown in- candescence lamps in the hall of the Shipwrecked Mariners' Institute. The lamps are driven by four Gramme dynamos, with two excitors, each excitor actuating two dynamos. The Jablochkoff Electric Light and Power Company, of No. 1, Great Win- chester Street Buildings, London, are represented in the main central gallery, where the Newfoundland, Netherlands, and Belgian exhibits are arranged, by sixty-four Jablochkoff lamps driven by three Jab- lochkoff-Gramme self-exciting dynamos producing alternating currents. Mr. R. Mathieson, of No. 74, Romford Road, Stratford, has six of his arc lamps, three of which are placed in the corridor of the Royal Pavilion, one in the mariners' home, and two in the engineering department. They are driven by three Mathieson dynamo machines. The Board of Trade shed is lighted by two, and the fish market by three arc lamps, which are all supplied with the current by Ball's uni-polar machine. In the the western quadrant, Mr. William Johnson, of No. 17, Ironmonger Lane, London, has six arc lamps on the Willard system, which are driven from two Bürgin machines, and give a very steady light.

Such is the remarkable and extensive collec- tion of engines, machines, and lamps which the Fisheries Exhibition has caused to be assembled together, and which has most materially helped to make that exhibition the success it is. All the arrangements of the various installations have been carried out under the direction of Mr. W. D. Gooch, the electrical engineer to the commissioners of the exhibition, to whom great credit is due. It is com- puted by that gentleman that the covered portion of the exhibition lighted is seven acres in extent, that the insulation covers twenty-three acres, and that more than twenty-five miles of conducting wire are employed. Taken altogether, the display is highly creditable, and represents the largest installation yet seen in Europe.

Engineering, Dec 23, 81.

THE ELECTRIC LIGHT.

TO THE EDITOR OF ENGINEERING.

SIR,—In his recent lecture at the Society of Arts, nominally on the electric lights at the Paris Exhibition, but actually on the Edison incandescence system, Mr. Preece took occasion to state that the Paris Exhibition "had sounded the knell of the Jablochkoff system." This is going rather far, even though the object might be the building up the fame of a new (and excellent) system on the ashes of an older one. Unfortunately, how- ever, for Mr. Preece, facts are entirely against him, and although he can conjure well with facts, making them assume various pleasing or unpleasing aspects as his fancy suggests, still in this case he has outstepped the limits of poetic license. Fortunately for ourselves the "knell" of the Jablochkoff system has not been sounded by the public, whose demands upon us are greater than even our large means of supply. In England, it is true that the system has only a limited application, although I could give you a long list of installations in this country. On the Continent, however, and especially in France, the efficiency, steadi- ness, and simplicity of the Jablochkoff candle has led to a very wide adoption, and we, who have from time to time become the proprietors of other very promising systems, have been obliged unwillingly to relinquish them all in favour of the electric candle. The attention of our com- pany has, in fact, been almost wholly directed to meet the Continental demand; hence possibly Mr. Preece's ignor- ance of the striking development we have have made and are still making.

In confirmation of my statement I may add that our present output of candles is upwards of 2,000,000 a year; this consumption does not, I think, point to the probability of a "death knell." The fact is, Mr. Preece is a charming lecturer but too impulsive.

Yours truly,
J. GAUDET.

The Société Générale d'Electricité, 139, Cannon-street.

Exhibitors are not to pay any rent for the space occupied by their exhibits, and the general commission undertakes at its own expense the arrangement and general decoration of the building. Exhibitors, however, will be to bear the expense of the installation and decoration of their own exhibits, and the plans of these must be submitted to and approved of by the managing committee. Motive power will be supplied to exhibitors who require it at 20 kreuzers per horse-power per hour—5d. or 10 cents. The motive power required for the purposes of the scientific commission is to be supplied free. The exhibition is to be open to the public twice daily, during the day and in the evening. The hours of admission will be fixed and published in due course. Exhibitors are to be entitled to free passes for themselves, their representatives, and for the requisite number of assistants and workmen. The general commission will provide that a strict watch is kept over the exhibits, and that proper order is maintained. The commission, however, does not hold itself responsible for any damage that may happen to exhibits through their or fire. The exhibitors are at liberty to insure their exhibits at their own expense. Exhibitors must provide that in the installation and working of their exhibits every danger to the public and to the buildings is avoided, and they must conform in this respect to the special arrangements of the general commission. The exhibits must be accessible to the free inspection of the public every day during the regular hours of admission, during the whole time of the exhibition. No exhibit is to be withdrawn before the close of the exhibition without the special permission of the general commission. Exhibitors must keep the space occupied by their exhibits in their own exhibits. Exhibits not to be sold by the exhibitor, manufacturer, and with his consent they may also bear the name of the firm which is authorised to sell them. Every exhibit must be clearly marked with the name of the exhibitor, the place of his abode, and the number of the exhibit. Price-lists, drawings, photographs, or other-wise, are to be given out by exhibitors only to visitors and buyers of the general commission. The sale and removal of exhibits may take place with the consent of the general commission; every object, however, which has been once sold is not allowed to be displaced. The receipt of goods at the Rotunda is to commence on June 1 next, and by May 15 all exhibits must be entirely unpacked and set up. The general commission reserves the right to dispose of the space not occupied by the 15th of May. The general commission claims the right either to complete such installations as are not finished in time at the expense of the exhibitor, or to exclude him entirely. One month after the close of the exhibition the exhibitors will receive back their goods removed their exhibits. After the lapse of this time all exhibits not removed will be sold. That time will be removed and deposited in the exhibition building at the expense and risk of the exhibitor. In cases of small goods not being removed within six months after the close of the exhibition, they are to be sold and the proceeds paid in the same way as the net proceeds of the exhibition, which, we may here mention, are to be devoted, with the concurrence of the Imperial ministry of commerce, either to further the aims of the exhibition, or to the pursuit of important inventions in the field of electrical science.

The general commission has taken the necessary steps to enable exhibitors to enjoy the advantage of the patent law from the time of the entry of their goods to the exhibition grounds until exhibition, and to enable foreign exhibitors will also receive a from duty in case of the re-export of their goods before the end of the present year. The special conditions relative hereto will be published hereafter.

No prizes will be awarded by the jury. During the exhibition a technical and scientific commission will be organised in co-operation with the exhibitors in order to carry out electrical measurements and other scientific investigations, and with a view to testify results. A scientific and technical lectures to be given during the exhibition, and the conditions will also appear.

The catalogue to be published at the opening of the exhibition. In cases of dispute or complaint the ultimate decision will be reserved for the general commission.

Such are the rules and regulations of the commission, which will be amplified and added to in detail as the necessity may arise. We have only to add that applications for space must be in the hands of the managing committee of the International Electrical Exhibition, I. Wallnerhofgasse 10, Vienna, at the latest by March 1 next. Applications in Vienna, at or from abroad, by means from the managing committee of the Rotunda of Vienna and Commercial Councillor, and Austrian-Hungarian consuls.

The acceptance of exhibits rests with the general commission, and applicants are to be informed of the decision of the commission within two weeks after the receipt of the application. Exhibitors are to be informed of the final allotments of space by May 1 next. The honorary presidency is held Hans Wilczek, the president is Victor Freiherr von Ertingshausen, and the managing committee are Herr Carl Pfaff and Rudolf Ritter von Grimburg. In conclusion, we have only to wish this exhibition the full measure of success which there is every reason to believe it will enjoy. Those who visited the Universal Exhibition of 1873 will no doubt have carried with them pleasant recollections of the metropolis of Austria. Since that time Vienna has made considerable material progress by the completion of many of its public buildings, by which its appearance and the interest incidental to its improvements have both been enhanced.

THE QUADRANT FLUE-TUBE BOILER.

We have recently had brought under our notice a form of multitubular boiler which possesses several novel features in construction and appears to be a very efficient steam generator. This is the quadrant flue-tube boiler designed and manufactured by Messrs. Beesley & Sons, of the Falcon Steel Tube Works, Barrow-in-Furness, and which we illustrate at page 46, of our present issue. In our engravings, fig. 1, represents a front elevation, and fig. 2, a vertical section on the line C D, of fig. 3, which is a horizontal section on the line C D, in fig. 2. These boilers are made in all sizes, having from 50 to 600 square feet of heating surface. The boiler we illustrate is 7 feet high over all, a feet in diameter, has 176 square feet of heating surface, and 3 square feet of grate surface. It is tested up to 100 lb. pressure, and run to a working pressure of 80 lb. The shell is made of 9-inch steel, the crown of 5-inch steel, and the tube plate 1 inch steel, the fire-box sides and smoke-box being of 7-inch steel. The tubes are of No. 12 gauge Siemens steel, 2 inches in external diameter. Messrs. Beesley have one of these boilers working which is 10 feet 6 inches high over all and 6 feet diameter, the fire-box being 4 feet diameter at the bottom and 3 feet external diameter, the total heating surface of the 220 square feet and the grate surface 20 square feet. This boiler is expected to be working very satisfactorily at 75 lb. pressure, having been tested up to 150 lb. by hydraulic pressure. It will be seen that these boilers are suitable for a variety of positions, and are well adapted for use owing to their lightness. They are simple, compact, and strong, owing to their cost and maintenance in working, having no awkwardly sloped plates to clean, no cramped or clumsy plates or brick linings. They possess increased heating surface in the quadrant tubes over straight tubes in the same space, and although there is no undue strain on the tube plates, they afford sufficient resistance to act as stays in boilers of small diameter. In boilers of larger diameter Messrs. Beesley have a simple but efficient plan of staying the tube plates, by means of screwed stays with nuts and tubes, so they all radiate from one centre, therefore are the shorter the larger the diameter of the boiler, and the more the check. Any single tube can be taken out and replaced; and every tube is easy to clean with an ordinary tube brush fitted to a spring steel rod. Then there is the increased effectiveness of the heating surface in the quadrant tubes, the flame being gradually checked all the length of each tube, its energy being spent before it reaches the end, which is far superior to a straight tube fixed vertically or horizontally. Messrs. Beesley have found that all through, no steam joint is required to create one, and the tubes will never require cleaning so often as horizontal ones. The boilers are free to expand and contract, and have been tested to 50 lb. beyond the steam ratio. In all respects then, these boilers appear to be well calculated to meet many of the requirements of steam users.

Occasional Notes.

STEAMERS WITH STRAIGHT STEMS.

A CORRESPONDENT in one of the daily journals, referring to the sinking of the Inman liner *City of Brussels* in the fog, which being going into her by the *Richard Hall*, asks what the advantages are of the straight stem as compared with the ships that it should be almost universally adopted when and vessels in such great demand in the case of low on collisions. We understand that during the last few years, of our large merchant steamer being sunk through collision with another, the vessel causing the disaster has been one with a straight stem. The question raised by this correspondent is undoubtedly one of importance to the shipowner, and appeals generally to all who entrust their lives for the time being to the steam ocean-transit companies. The distinction is that the straight stem colliding with force against the sides of another vessel cuts the unfortunate craft down forward, even underneath, the water line, thus rendering her doomed to sink, in many cases, raked backwards as regards her fore and fifteen inches, in relation to the keel, thus giving to this feature of the vessel much

ELECTRICAL APPARATUS AT THE MANCHESTER EXHIBITION.

The members of "The Junk Club," a new scientific association recently started at Cambridge, held a meeting last week at the Manchester Electrical Exhibition, when Mr. Hays read a paper on the electric lighting of the exhibition, and also gave a rough outline of the principles of the dynamo as illustrated at present in a few typical machines of the class, the storage of currents, and the methods of distribution and illumination. The dynamo machines, he said, might be broadly divided into three types, the series machine, the magnet machine, and the shunt. The strength of an electric current is affected, among many other things, upon the number of wire constituting the coil. In a series machine, the wires used in a short length, a thick wire and few turns. In a shunt machine, on the contrary, the current being weak, a thin wire and a large number of turns were used. Each machine had its advantages, and each was applicable to special purposes was not entirely determined. There were, however, two broad systems of lighting, the arc and the incandescent. For arc lighting the shunt machine was the most economical to arrange the lamps in series, because if they were done separately the external resistance was considerable, whilst if they were arranged in multiple arc the external resistance was very small. For arc lighting, therefore, series machines were used in practice. For incandescent lighting it would be impossible to put the lamps in series, because the failure of each lamp, being a complete break in the circuit, the magnetic force would be required to be so great that the strength of current would be so enormous as to anyone touching a wire, and be fatal. For this reason incandescent lamps were therefore arranged in parallel circuit as being safer for the latter purpose. For arc lighting, a preference existed for currents for these lamps, but if a continuous current, which was preferred, were used, a steam engine should be employed, as in this manner even a single lamp could be kept going. This was not the case with the alternate current, because the resistance of one or of a few lamps would be so high as to practically stop the strength of current used, although the field coils to excite a sufficiently intense force. For light of small power the system of series lighting was the most available for domestic purposes. In the application of electricity for illuminating purposes we were at present very much behind the current could only be distributed economically at a high difference of potential, or, as it was more called, pressure; but in our houses such a current would be dangerous, and quite inadmissible. Many inventors had promised many inventions. Mr. Edison had not got so far as to produce a lamp, but he had published their cost; but as to see Mr. Edison had a few days since taken out a patent for one of these that he proposed to use beginning to think like other people. He proposed a system of series lighting for a few lamps in the current in the future, a local system of distribution would be established. He was not sanguine that such a system of service in that streets was laid at 200 lb. pressure. It was certain that the pressure in the mains would be reduced to a safe point at the houses. Of course there must be a battery for every house, but it would be comparatively cheap, the only way that for every 200 lb. pressure of current there should be one square inch of surface in the conductor. Of course there were serious heating the wires. If an electric light circuit were taken either purposely as at a switch, or not out by the making of a lamp or by accidental severance of wire, an there would be formed capable of doing some mischief. He might be prevented by rain or some extent, for example, by using safety switches or cut-outs, and by employing care in the erection of the lines. For this work it had acquired a considerable number of men should be employed. Circumstances might, however, very easily occur as, for example, from short-circuiting or accidental joining over of the lead and return wire, or from the sudden failing of a considerable number of lamps, when the amount of current would be too great for the safety or the lamps, if not for the conductors. In most this safety under the heat of the increased current. These testing quickly effected before any accident could occur, and so broke the circuit that there was very much danger with the system. Having entered into a description of the Siemens and Edison lights shown in the exhibition, Mr. Hays called attention to several subsidiary machines in connection with the electric light, including an electric exploder, alarm, and to noises; a signal for a railway, by which an electric shock by any one in the galleries of the exhibition, which at present was not so applicable to railways by means of which a telephone could be stamped at once from any part of the works. A conclusion, Mr. Hays briefly touched upon the subject of electric motors. A dynamo-electric machine, either from a battery or from another dynamo, would revolve which it might be converted. Of course they might easily understand that a little rearrangement of the light would be required to give them the necessary amount of power, when driven by steam. It was, however, only when life exhibited two types of motors, the Siemens and the Hesketers, which were employed driving appliances in the exhibition, one in connection with the electric light, the storage batteries of the Electrical Power Storage Company. A vote of thanks to the paper was passed to Mr. Hays for his paper, and the members afterwards made an inspection of

Engineering, Dec. 2, 1878.

PORTABLE ELECTRIC LIGHT PLANT.

In page 646 we publish an engraving of an installation that formed part of the exhibit of M.M. Sautter and Lemonnier, Avenue du Suffren, Paris, at the recent Electrical Exhibition at Paris. It consists of a portable engine fitted with a Gramme generator and regulator and a Jacquin projector, and a length of conductor placed on a reel. The Gramme machine is driven direct by a Heathcoat belt from the engine. This installation illustrates a type recently adopted by the French Government for military services, and is especially intended for use in fortifications and other defences. We shall on a future occasion refer to this arrangement when we come to speak of M.M. Sautter and Lemonnier's admirable exhibit at Paris.

Germania exercise painstaking fore-thought in their work. Nothing is more likely to cause annoyance than complicating a piece of machinery with unnecessary parts. Simplicity of design and construction should be the aim of every engineer.

Boston, with a capital of $1,000,000. Cost of plant: Sixteen steam dynamos (two in reserve), capacity, 1,200 lights each, $166,800; boilers, $62,000; iron structure and foundations for same and for steam dynamos, $30,000; appliances, machinery and miscellaneous items being up the cost of the central station, exclusive of real estate or construction of elevations of building to $329,800. Underground street conductors for the proposed district, $120,000; services, $65,000; meters, $15,000; total cost, $530,800. Operating expenses are figured as follows: Salaries and wages at central station, $33,250; do. in other departments, $9,000; total salaries and wages, $42,250. Coal under, oil, and other supplies, $48,000; total operating expenses, $111,250. Depreciation of steam dynamos at 5 per cent. is figured at $3,150; boilers and settings at 7 per cent., $2,100; other items bring up the depreciation account to $10,650. Rentals at $7,200, taxes at $5,334, insurance at $1,200, and conversion charges at $8,000, bringing up the total annual expenditure to $182,460.

The progress of electric lighting is well illustrated by the electrical machinery now in use on board of the fast ocean steamer, Arizona, plying between New York and Liverpool. Our particulars are from *Engineering*. The Arizona is fitted with two of Siemens compound shunt wound dynamos, each capable of maintaining 300 high-resistance Swan lamps, driven by a pair of Shanks' "Celebrated" engines, with cylinders 9½x15 inches. Each dynamo is fixed upon an independent base plate, sliding upon guide rails in a foundation plate, which also takes the base that takes the strain of the driving rope is lengthened into a long slide, and the two machines are slightly displaced laterally, so that their faces interlock. By means of screws both dynamos may be moved backward to tighten the belts. There are ten grooves in each fly-wheel, but there is only one rope to each machine, and consequently but one belt. This necessitates the use of a guide pulley to lead the rope from the last groove of driving pulley. The axis of one machine is elongated, and is provided with a pulley for driving a tachometer mounted upon the top of the frame. The commutator brushes are set on a bracket, which can be rotated by a worm to bring the points of contact into the most favorable line, and this bracket, which is of large cross section, is jointed, so as not to impede the motion. By this machinery all parts of the great ship are brilliantly lighted with electric lamps. Looking back for only twelve months, immense advances are to be seen in this department of electric lighting. It is no longer a question with the Liverpool companies in what parts of the ship the light shall be used, for it is now applied everywhere, and both cabin passengers and ordinary seamen, in the forecastle, as the

ELECTRIC LIGHTING NOTES.

Despite the attention given to the members of the Liverpool Association of the United Kingdom meeting last month in Liverpool, the back cream of the Free Library was for the first time lighted by electric light. About 30 high-resistance Swan lamps were attached to existing fittings, the current was supplied from Faure-Sellon Volckmar storage batteries; this installation has been carried out by Messrs. Holmes and Vaudrey, Liverpool.

Engineering, Sept. 7, 1883.

THE CAGE ELECTRIC EXHIBITION.

The buildings of this interesting local exhibition in the old Normandy town are lighted by 261 Edison lamps fed by a K dynamo and a Z machine. M. Berjot exhibits his electric lamp in an improved form, and also a selection of Carré carbons, he being now associated with the house of Carré. The chief novelty of the Exhibition is, however, an electric clock of M. Ledoux, in which a heavy vane is added to the pendulum corrects by its mass the irregularities of the electro-magnetic action on the pendulum. There are also exhibited two electric clocks, which repeat the hour given by a standard clock, and thus distribute the time much in the same way as the pneumatic clocks of Paris.

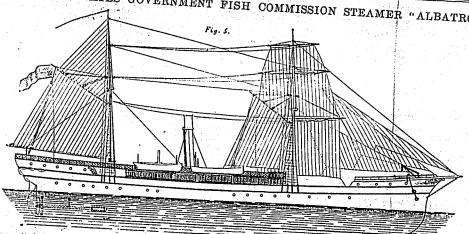
Engineering, Dec. 7, 1881.

THE JABLOCHKOFF ELECTRIC LIGHT.

On Wednesday evening a portion of the Hon Marshal Bazaine was illuminated with the Jablochkoff electric light, and the installation will probably be followed by an extension over the whole building. This system of lighting has had a long and successful career in a number of industrial establishments in this country, among which we may mention Messrs. Stoodleard and Co., who commenced its use three years ago with forty lights now to be increased to sixty; Messrs. Nicols and Son since 1879, and Mr. W. Whitelaw during the last twelve months. All of these gentlemen speak enthusiastically (after their prolonged experience) of the superiority of the arc light over gas, and it is an important fact that after three years' work, in as good a condition as when the machines were started. The Société Générale d'Electricité have lighted the Thames Embankment since the 16th of December, 1878, and during that time there has been no suspension of the light through any failure of the system, the only periods when it was not used being during other occasions invoked from the Board of Works.

THE UNITED STATES GOVERNMENT FISH COMMISSION STEAMER "ALBATROSS."

Fig. 1.



governors are attached to the main engines. An Edison dynamo and engine are used for electric lighting. Heat is provided by steam radiators in all inhabited quarters of the vessel. Ventilation is secured by means of conduits leading to all parts of the ship through which fresh air is drawn by the exhaust fan above mentioned, placed on a platform in the fire-room, and arranged to discharge downward in the direction of the furnaces.

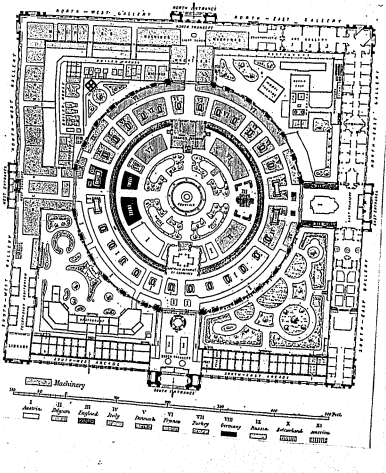
Light is supplied by 1208 candle 31 lamps of the Edison incandescent system and a 2 dynamo driven by Armington and Sims' high-speed engine. These lamps are distributed in all parts of the ship including holds and store-rooms; there are also twelve lamps outside for lighting the deck. In the laboratories the lamps are especially numerous and are pronounced to be quite sufficient for any possible needs. As are lamp of great power, designed by Dr. O. A. Mower, to work in circuit with the Edison incandescent system, serves for illuminating the surrounding surface of the sea. A powerful submarine lamp is also provided, which can be lowered to any depth not exceeding 1000 ft., to be used in deep-sea exploration.

Two steamboats are provided for the purpose of carrying on the work of scientific research. They are fitted with Herreshoff boilers. Other boats of special types are also carried.

A model of the Albatross is shown in the United States Court at the Fisheries Exhibition, together with models and full-sized examples of the scientific apparatus and gear necessary for the work the vessel is designed to accomplish. Amongst these appliances the following may be briefly mentioned, viz.: The Sigsbee deep-sea sounding machine, sounding reels, water cups, and gravitating trap for collecting specimens at the bottom; a dredge for which it is built by D. Halleny, Washington, D. C.; Tanner's sounding machine for depths under 1000 fathoms and for navigational purposes. The dredging boom 36 ft. in length with 10 in. in diameter, the heel of which is pivotted to the forward part of the foremast 7 ft. 2 in. above the deck; the dredging block at the boom end, the chain and register at the heel of the boom for indicating the length of dredge reposed, and thence combined at the foremast head arranged to prevent jerking strains on the rope (the commutator used is of the form recommended by Commander Sigsbee, U. S. Navy). The Negretti and Zambra deep-sea thermometers with the Buffa and Tanner improved cases. A Chester rake dredge, a beam trawl, a deep-sea trawl, a Chester towing net, together with tangles, table nets, trawl lines, and other minor apparatuses, complete the scientific outfit of the vessel.

PLAN OF THE VIENNA ELECTRICAL EXHIBITION.

(For Description, see opposite Page).



THE VIENNA ELECTRICAL EXHIBITION.—No. I.

THE Exhibition of Electricity which has now been opened for some weeks in Vienna, is an interesting illustration of the activities in a new more forward, and developed without any Government assistance, except that the great Rotunda which formed the conspicuous feature of the International Exhibition of 1873, was placed at the disposal of the Executive Committee. The Munich Electrical Exhibition held a year ago, proved the value and the completion of the undertaking at Vienna, and the opening ceremony of the latter, after having been postponed several times, and at last fixed for the 1st of August, did not take place till the 16th. After the time had elapsed for unpacking and displaying the last exhibits, and in getting the various series into working order, the Exhibition, completed and finished on the 1st inst.

The general catalogue gives the names of 372 exhibitors, several of which are repeated. If we divide them by nationalities the numbers are as follow: Austria, 247; England, 29; Germany, 31; United States, 6; Belgium, 18; Denmark, 9; France, 124; Italy, 19; Russia, 29; Sweden, 12; Switzerland, 10; Turkey, 1. The plan we publish on the opposite page shows how the exhibits of nations have been distributed in the Rotunda and its annexes. Austria and France occupy each one third of its area. England, as will be seen, is represented by an insignificant number of exhibitors. This indifference is to be regretted, but finds its explanation partly in the fact that so many electrical exhibitions have been held since 1881, partly to the season of depression that has naturally followed the exaggerated and inflated period of the electric light palaces, dazzling meals, and partly because no large and complete an exhibition of electric lighting is now occupying the attention of various companies and inventors at South Kensington. The arrangement adopted in the catalogue does not take into account the nationalities of the exhibitors. The circular form of the building lent itself to a methodic classification very advantageous for visitors. This classification follows a regular order starting from the main South Pavilion. The numbers run consecutively from this point towards the right, follow the circumference of the Rotunda and are continued further to the point of starting, where the last number is opposite the first. This arrangement, which is very simple and convenient for visitors, would complicate our description if we followed it, and it will be preferable to take successively the great divisions of electrical industry, in such a way as to collect and compare in each article the apparatus of different exhibitors having similar objects.

Before describing, on this system, the contents of the Exhibition in detail, we may throw a general glance over the building as a whole. Access to the Exhibition from some distance may be obtained by a small electric railway laid down by Messrs. Siemens and Halske, of Berlin. This tramway, which we shall describe hereafter, has one terminus at the northern entrance. The road to the south door will be lighted at both sides by rows of incandescence lamps, but until a few days since only a part of these were in place. Both entrances are lighted outside by lamps of various systems. In front of the south door were two 24-h. lamps, on wrought-iron columns, each carrying at the top a group of six arc lamps, covered and protected by a large sheet-iron hood. The violent storm of the night of the 2nd inst. threw them to the ground, breaking them into a thousand pieces. The next day their places were taken by a number of poles, not so high, but stronger, carrying each two arc lamps, which give a finer and more evenly distributed light. At the top of the interior of the Rotunda is a series of arc lamps that scintillate like a circle of diamonds. Lastly, two projectors placed symmetrically on each side of the building throw in full arc lamps. Entering by the southern door, which is the chief portal, we find ourselves in the Austrian Section. We first pass through a transept, the middle of which is occupied by the Imperial pavilion, a small structure simply decorated. We then pass the pavilion of Austrian telegraphy, and arrive in the centre of the Rotunda. This is occupied by a great fountain with nothing however of a monumental character, having in the centre two cement mushrooms covered with zinc, and supported below each of them are Archimedes cochlea in globes; the effect of these behind the continuous sheets of water flowing over the central mushrooms would be doubtless very beautiful, if it retain itself a definition. The first circular zone around this centre is devoted to a restaurant and military bands. It is from this point the visitor looking upwards will best see the lantern of the great dome with its crown of arc lamps, and lower down at the level of the springing of the roof a second and larger circle of similar lights.

Around the central platform are ranged a number of pavilions. They are as follows: 1. Opposite the Austrian telegraph building, and symmetrical with it, is the fine exhibition of the French Department of Telegraphs. 2. Opposite the eastern entrance is the building of the English General Post Office. 3 and 3, near the western entrance, that of the Turkish Telegraphs. 4. Then come the exhibits of railway signals of the Northern of France Railway, the Paris, Lyons, and Mediterranean, &c. Beyond these pavilions, and ascending several steps, we come to the great circular gallery where the chief of the exhibits are arranged. Between the outer walls which enclose a square, and the circle of the Rotunda, are four areas also devoted to the Exhibition. The most interesting of these is the north-western pavilion, in which are placed the motors and the electric generators. We shall devote considerable space to this portion. The north-eastern corner contains a restaurant; in its external gallery is an exhibition of pictures, and a number of apartments richly decorated and furnished to show the effects of the electric light on fabrics, colours, furniture, &c. Leaving this gallery we traverse the eastern transept, the middle of which is occupied by a Turkish pavilion, and arrive at the theatre, where ballets are given every day. The scenic effects and the general illumination are of course produced by the electric light. This section contains also a restaurant; the south-east gallery which limits it, is occupied by a part of the offices, &c. of the Exhibition. Lastly, the south-west section contains a gallery for public telegraphy, a pavilion, a garden restaurant, and the other offices.

Following as rapidly upon the exhibitions of the last two years, this one at Vienna cannot be expected to offer any unexpected novelties. There are collected there machines and apparatus very similar to those shown in Paris and in Munich. But there are besides those well-known types, varied and ingenious arrangements, and characteristic developments, to which we shall return. As regards its official organisation and its general aspect, we may say without hesitation that the Exhibition is an absolute success, and the exhibitors could not expect to find facilities and accommodation in a more spacious and commodious building, the only fault of which is, that it is somewhat removed from the centre of the town. The arrangement adopted for classification is very convenient, and the circular form of the building lends itself to easy examination and comparison of objects, shortens the distances to be traversed, and simplifies research. It is also perfectly adapted for illumination, and attracts thou-

bands of people nightly. The height of the lamps and their arrangement in three concentric circles undermines the light and softens it, while the shape of the dome, which, as will be remembered, is that of a truncated cone, reflects the light well and destroys dark shadows. The great circular gallery, the machinery-room, and the annexes, are also abundantly furnished with light. This part of the Exhibition, which forms the greatest attraction to the public, is daily more appreciated, as is shown by the ever-increasing number of visitors who are not unfrequently refused admission. Thus on Sunday the 9th September, more than 10,000 persons were turned from the doors.

Already a series of conferences has been announced, and several thousands of workmen have availed themselves of the special arrangements made for them, including gratuitous admission. The Technical Committee has commenced its researches on the various apparatus shown. The outcome of the Exhibition is naturally the most interesting for engineers, and it is deeply to be regretted that the publication of the result of work of this kind is usually so slow. It is only now, after a year's delay, that the reports of experiments at Munich are being made known. If the executive at Vienna can reduce this delay, which so greatly detracts from the value of the work done, they will earn the gratitude of all who wish to obtain a solid advantage from the Exhibition.

[DEC. 5, 1882.

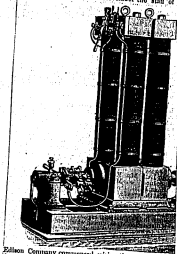
ENGINEERING.

THE ELECTRIC LIGHTING OF CHELSEA.

THE Vestry of Chelsea has received notice of the intention of seven electric lighting companies to apply to the Board of Trade for provisional orders under the Electric Lighting Act of 1882. The applicants are the Metropolitan Brush Company, the Edison Company, the Swan Company, the Edison-Jost Company, the Gilchrist Company, the West Middlesex Company, the Crompton, the Hermuti, Thomson, and Ince (Limited). In addition to these, the Metropolitan Brush and the Jablochkoff Company have asked the consent of the vestry to the granting of licenses. As the terms of the Act oblige local authorities to come to an immediate decision as to whether they will undertake the work themselves, or allow it to be carried out by private enterprise, Mr. George H. Stayton, the surveyor to the vestry, was instructed to draw up a report for the assistance of the members. In this report, which is published, after recalling the chief provisions of the Act, and pointing out the difficulties to be encountered, Mr. Stayton gives a list of twenty questions that he addressed to the companies, and also to Messrs. Siemens Brothers, with the object of obtaining such information as would assist the vestry in deciding what course to adopt. The replies that were received did not answer the intended purpose, being, as a rule, too general to be of any service. Most of the companies propose to begin operations in the main thoroughfare, Sloane-street and King's-road, and gradually extend them as the light became popular. The Brush Company contemplates supplanting the present 1250 street lamps by 400 arc lights of 2000 nominal candle-power each, for which the fixed annual cost is put down at 10,000*l*. They would supply 5,000 8-lights of from 10 to 100 candle-power by other purposes, and would charge for current by measurement at the rate of 8*d*. per 1000 cubic feet. This is about equivalent in price to gas at 3*s*. per 1000 ft. The Edison Company furnished very little information, except that it would employ incandescence lamps only, and that although it was at present lighting the Holborn Viaduct at the price of gas, that contract could not be regarded as a precedent. The Jablochkoff Company mentioned 1*d*. per lamp per hour as the probable cost to the vestry itself. Private users would be charged a price for each candle that would include cost of current also, whilst incandescence lamps would be a matter of arrangement, taking gas as a basis. The Swan Company is prepared to take gas as the standard, and to supply an equal amount of light at the same price, stating that this will leave no margin of profit until improvements are made in the cost of production of the current. The Farmuti Company is anxious that the vestry should be the undertaker, but is willing to equip and work the station for some years on a payment, based on the number of lights, that will furnish a dividend of 10 per cent. on the capital. This, it is thought for street lighting, would be about twice the cost of gas, with three times the illumination. The Thomson-Jost Company proposes to use three classes of lamps—arc, semi-incandescence, and incandescence—but do not give an estimate of the cost of the light. Messrs. Siemens Brothers and Co., who were not among those who applied to the vestry, and who state they do not wish to undertake contracts of this kind, refer to *Dr.* Siemens' late address as an answer to questions relating to cost. Thus, it will be seen that Mr. Stayton obtained little information in answer to his question, except that no one knows exactly what electric light will cost, and that no firm only is willing to contract to supply it at the price of gas. Under these circumstances, Mr. Stayton no doubt acted wisely in advising the vestry not to become the undertakers, and to formally oppose all applications, in order that clauses might be inserted in the contracts to protect the interests of the ratepayers as far as possible.

THE ELECTRIC LIGHT ON THE S.S. "TARAWERA."

THE Edison Electric Light Company, Limited, recently a contract recently for lighting two ships belonging the Union Steamship Company of New Zealand, viz. Tarawera and the Waikera. The Tarawera was built by Messrs. Denny Brothers, at their yards at Dumbarton, and on the 21st of November the staff of the



Edison Company commenced wiring the vessel. The dynamos and engines were placed in a small room, 12 ft. by 11 ft. and 7 ft. high, opening into the engine room, the floor being on a level with the gallery running round the wing of the cylinders of the main engines. The wiring of the vessel is done in the most careful manner, nothing but the most highly insulated wire, protected by an india-rubber covering, and over that a tenacious, which we have already illustrated and described in this journal, and which has been long in successful use.

The engine is fitted with a handy arrangement of steam valves, whereby, if required, steam can be admitted to the low-pressure cylinder for starting the engine with the cranks in any position, the possibility of the arrangement consisting in the fact that the steam admitted has all other steam has to pass through the throttle valve. This simple arrangement removes a difficulty which has been experienced with some engines, as no engine so fitted can never overrun, whatever may be the position the starting valves are left in.

The governor, of which the illustration sufficiently shows the design, is of the high-speed type, running 200 revolutions per minute, and efficiently controls the engine. The boiler is of large size, as is also the fire-box, so that wood, sawdust, or refuse can be burnt. The boiler is machine riveted, and rises can be burnt. with a damper at both front and back, and the fore pedestal is made to serve the purpose of a water-tank. In some cases provision is made for filling each crank-pin by a fixed lubricator, having a sliding cock and wick, which is touched at each revolution by a wiper on the connecting-rod collar, thus only once taking off a drop of oil. This plan, which has been found to in marine practice, is convenient when the lamps have to make long runs without stopping. The engine illustrated is of substantial proportions, and all working parts are made strictly to gauge, so as to facilitate renewals.

THE HARLEM RIVER BRIDGE.

(Concluded from page 406.)

We this week complete our illustrations of the bridge over the Harlem River at Eighth Avenue, New York, with a two-page plate showing the turning gear for the central swing span. At 2 is a plan of the arrangement, and Figs. 31 and 32 are axial sections at right angles. Upon a cast-iron base ring is fixed a toothed roller path, and around the edge is fixed the toothed circle shown in Figs. 30, 31. The rollers are connected to a ring placed around the centre socket in which the centre rests, by means of rods converging radially. The upper roller path is attached to the ring girder which carries the superstructure of the bridge. The drawings show clearly the arrangement of the engine, boiler, water tanks, &c., as well as the mode of transmitting the power required for turning

GINE.
RS, BASINGSTOKE.

ELECTRIC LIGHTING NOTES.

Hitherto the electric light installations in Scotland have shown that the Brush system is the most popular north of the Tweed, whatever it may be elsewhere. It is certainly the one that has up to the present been most extensively selected in the shipbuilding yards and engineering works of the Clyde and the Glasgow district, and launched are some of the installations. Three out of the last six installations fitted by Mr. Richard Miller, of Glasgow, who was agent for the Brush system in Scotland prior to the advent of the Scottish Brush Electric Light and Power Company, Messrs. Russell and George Thomson, the firm of engineers and shipbuilders at Cardonald, have certainly got the most extensive electric light installation in hand. It consists of 37 2000-candle lamps, 17 of which are driven by one dynamo, and the remaining 20 by another. The same firm are also fitting with the arrangements for carrying out an installation of from 20 or so of Swan's incandescence lamps, distributed through the offices, model room, &c., and worked by a Gramme dynamo, formerly used with some dozen arc lamps. Next in order, mention should be made of Messrs. Mirrlees, Watson, and Co., the enclosed engine and mill engineers, Glasgow. They have two Brush installations. Some of the lamps were in use in the firm's extensive foundry, but we understand that they have been withdrawn from that establishment, there being greater need for them in the engine works. We are informed that these, Messrs. Mirrlees, Watson, and Co. are also going on with an installation of at least 70 5000-candle lamps. At the marine engineers' shipbuilding works of Messrs. Caird and Co., Greenock, there are 16 Brush lights in use. Messrs. D. Napier and Son have just completed a Brush light installation, giving six lamps in each; and the firm are said to be making arrangements to place the electric lighting engineer, At the Newton Works of the Steel Company of Scotland there is an installation of 17 Brush lights in use, all driven from one machine. In this case, it is said, there is no mention that the works are considered as beyond the range of the present gas supply—namely, beyond Cambuslang. The Hopetoun Works of the same company, which are inside the burgh of Glasgow, are lighted with gas. There are six Brush lights in use at various points of the works of the James Watt Dock, Greenock, and in this case progress towards completion. The first shop in Scotland to be lighted with electricity is a very extensive retail grocery establishment in Glasgow, that of Messrs. Cooper and Co. There are a couple of 2000-candle lights worked by a small Brush dynamo, which is itself driven by an Otto gas engine.

At the last monthly meeting of the Town Council of Renfrew it was reported that the Magistrates' Committee had had under consideration the question of supplying for payment under Mr. Crompton's plan the numerous lights in the town-hall's dark to see that not to do so, and to oppose any private company applying for such powers, as the ground would be protected in the Report for the Board of Trade to grant a further order to any company for that purpose. The action of the committee was approved of by the Council.

One of the most interesting electric light installations yet attempted in Scotland was completed and opened for public view on the evening of Thursday, the 30th ultimo, in the extensive drapery, millinery, and fancy goods warehouses of Messrs. Walter Wilson and Co., Sauchiehall-street, Glasgow. No fewer than three hundred lights are employed in this installation, and in each case a Crompton-Hopkinson dynamo is used for generating the current. In two circuit there are eight lamps, and in the other three Crompton arc lamps are used. Sixty Swan incandescence lamps are in the premises and other out-buildings throughout the shop. Owing to the lowness of the ceilings throughout the premises and other out-buildings throughout the shop, the arc lamps have not yet been put up, but will be fitted to the roof of the building forthwith. The installation has been carried out by the Crompton Electric Light Company, Limited, of Glasgow, and the contract is to last for the next three years. The electric engine and the dynamos are kept on their own premises, and provide their own property. In fact, in a word, the firm simply contract to supply the light, and to keep it in repair. The whole of the new light will be cheaper than the old one. Certain parts of the warehouse are still lighted with gas, and are likely to remain so. This is, we believe, the first instance of a soft goods warehouse in Scotland using the electric light.

A Bill is being promoted in Parliament by the Harbour Commissioners of Berwick, which, along with other things, asks for powers on the part of the Commissioners to provide for the lighting of their harbour, dock, and other works by electricity or otherwise, and for that purpose to do any, or all of the things that are being asked for by municipal authorities in provisional orders under the Electric Lighting Act, 1882. They also wish to be authorised if necessary, to enter into agreements with the Berwick Town Trustees for lighting with electricity the harbour and dock works of the town and burgh itself.

On board the steamer Tarawera, the latest vessel built by Messrs. William Denny and Brothers, Dumbarton, for the Union Steamship Company of New Zealand, a most successful display of the electric light by means of the Edison incandescence lamps, was given last Saturday afternoon and evening, whilst the vessel was lying in the Albert Harbour, Greenock. For a period of three hours there was a private view, at which there were present by invitation a very large number of guests representing the shipowning, shipbuilding, engineering, gas manufacturing, and allied interests of Glasgow, Greenock, and other towns on the Clyde and throughout the West of Scotland; and subsequently for another period of three hours the exhibition was open to the public on payment of 6d. per head, the proceeds being devoted to the Greenock Infirmary. This is the first public exhibition of the Edison lamps in Scotland, and the success attending it will doubtless have excellent results. On another page of the present issue we publish a more detailed and illustrated notice of this installation. The arrangements for the exhibition were made by Mr. Charles T. Great Hope-street, Glasgow, agent for the Edison Company; and the practical arrangements for the lighting of the ship were carried out under the superintendence of Mr. Alexander Macdonald, the electrician for the company in Scotland.

At the last ordinary meeting of the Philosophical Society of Glasgow, Sir William Thomson read a long and interesting verbal communication on "Anticontinuities and Discrete Measurements of Size, No. 2, Cloudy Air, Electric and other Artificial Lights." He experimented on the diffraction spectra used in illustration of the remarks made by the distinguished professor. We hope to return to the subject in a future issue.

The contract for lighting the Courts of Justice by electricity was given to the Swan Company some time ago, but there can be before the opening day it was decided that the hall should be ready for the inaugural ceremony. As it is, the original scheme of lighting is being carried out throughout with Swan incandescence lamps with the available lines, and Crompton's are lamps of 2000 candle power each were placed in the great hall for the opening day. The fittings in the cloisters and approaches to the great hall on the ground floor, in the east and west spire staircases, in the corridor and in the corridor, and in some of the courts were so far advanced that the lamps were able to be supplied in time, a 60 horse power Crompton engine has been fixed outside the main building. The whole installation is an example of extreme rapidity of execution. Within fifteen days a huge mound of rubbish was levelled, foundations laid, and the engine fixed. A line of 3in. steel shafting, with all its bearings, couplings, and pulleys was manufactured and fixed in five days, a dynamo erected, and a line of wire laid over the whole of the inside the building four miles of Swan lamps have been fixed, and 200 sets of fittings for the lamps and holding gear have also been made and fixed.

The "duplex" incandescent light has been installed in the Wemyss Chapel of St. Amiel, Dunvastle. This is the largest installation of the kind yet made in the county. There are now twenty lamps of 20-candle power each, and these are fed by the current from a Siemens dynamo of one of the type running at 1200 revolutions per minute. The machine lamp, devised by Dr. Siemens, has two sections so connected that the current can be sent through one or through both either in multiple arc or in series. This forcibly gives it a practical advantage over the ordinary single filament lamp in that it yields two different intensities of illumination at will by turning a cock in the stands of the lamps, and this without changing the quality of the light, as happens when the current is reduced in single filament lamps. The "duplex" lamp would therefore seem to be specially adapted for churches and places of worship, where they are lowered during the services. We may add that Canterbury Cathedral is to be lighted by these lamps by the South-Eastern Brush Electric Light Company.

Engineering, Dec. 1st 1882.

ELECTRIC LIGHTING NOTES.

The Swan United Electric Light Company have published notices of various applications they propose to make to the Board of Trade, under the Electric Lighting Act of 1882, for powers to establish lighting installations in different parts of London. One of these, the so-called Victoria District, includes portions of the parishes of St. Margaret's, Westminster; St. John the Evangelist, Westminster; St. George, Hanover-square; St. Martin-le-Grand; and St. Anne, Soho; St. Paul, Covent Garden; St. Mary-le-Strand; St. Clement Danes; St. Andrew, Holborn; Trinity Church, Marylebone; St. Pancras; and other Artificial Lights." No. 2 of the Strand, the Liberty of the Rolls, Lincoln's Inn, Staple Inn, and the Inner and Middle Temples. A topographical map of the district to be lighted is part of the application. Another district, known as No. 3, includes St. Margaret's, Westminster; and St. Luke, Chelsea, parts of the two last-named parishes being also included in the first notice.

The vestry of the parish of St. Pancras give notice that they will apply to the Board to establish electric lighting within their parish, as well as to erect the necessary buildings, and to place the requisite mains, lamps, meters, conductors, &c., for the production, distribution, and utilisation of the current.

The Pilsen Joel General Electric Light Company proposes to deal with the Holborn and St. Giles districts, including parts of High Holborn, New Oxford-street, Tottenham Court-road, Little and Great Queen-street, Dudley-court, Field Court, Theobalds, and Wakeley-street, Clerkenwell, Chalk Farm-road, High-street, Camden Town, and part of Hampstead-road.

The South-Eastern (Brush) Electric Light and Power Company will apply for the necessary powers for producing, storing, and distributing electricity in Fulham, Hurgate, Canterbury, Maidstone, Richmond (Surrey), Croydon, Catchem, Gravesend, Rochester, and Chatham. The same company also will seek similar powers for Lowestoft, Aldeburgh, Great Yarmouth, Ipswich, Bury St. Edmunds, Cambridge, Luton, Bedford, and High Wycombe. The company, in fact, appears desirous to cover the whole of the districts in which they work.

Messrs. Fernsall, Thomson, and Ince, the proprietors of the Fernsall system of electric lighting, to which we refer on another page, are applying for compulsive powers in the metropolitan districts. One area they propose to supply includes the whole of the parish of Chelsea, except the district of Kensal New-town. The second applies to the parish of St. John, Hampstead, and besides a long list of streets comprises such parts of the following as lie within the parish: the North London, the London and North-Western, the Midland, the Metropolitan, and the Metropolitan and St. John's Wood Railways.

At a recent meeting of the Nottingham Municipal Council a resolution was passed to make applications direct to the Board of Trade for power to supply electricity for public and private purposes within the area of the borough, and a special committee was nominated to take charge of the work.

One of the first instances of the employment of the incandescent electric lamp for the lighting of a West End shop front is probably that of Mr. Smyth's at the corners of New Bond-street and Grafton-street. Since September last thirty-six Swan lamps fed by a Gramme machine have brilliantly illuminated the life-size photographs in the window. The work has been carried out by Messrs. Parsky and Son, of Berners-street, W., who have designed special fittings representing a Renaissance pilastered arm, flanked by vines, from the tendrils of which the little bulb lamps are made to depend. The cable is a complete departure from those in vogue for other installations, while the central feature of the arm has an appropriate reference to the photographic art.

After a good deal of coquetting and negotiation, continued over two or three months, between the British Electric Light and Power Company on the one hand, and certain members of the Queen Council of Stornoway and other persons discontented with the treatment which the gas concessionaires have meted out of the local gas company on the other, all symptoms of immediate or even an early electric illumination being started in that town is now at an end. The British Company seem to think that the "game is not worth the candle."

ENGINEERING, Dec. 1, 1882.

THE MUNICH ELECTRICAL EXHIBITION.—No. V.

RAILWAY working was represented at the Munich Exhibition of Electricity, by the Administration of Bavarian State Railways, by the Austrian State Railway Company, and by the French Northern Railway Company. This last-named exhibit, organised by M. S. Sartiaux, chief of the Telegraph Department of the railway, comprised a number of apparatus that had previously attracted great interest and attention at the Electrical Exhibition at Paris. In our present rapid review of the contents of an exhibition, closed several weeks ago, it would occupy too much time and space to give anything like a detailed description of this highly interesting collection; moreover, many of the apparatus are far from new, and have been already described either in this paper or in separate memoirs. We will, therefore, content ourself with little more than a list of the objects shown. These included (1) types of the electric semaphore of MM. Tesse, Lartigue, and Prudhommeau, employed for working the block system, which exists over the whole system of the Northern Railway, about 600 miles, and possessing 435 signal boxes. These semaphores are supplemented, in cases where they are out of sight of the station employés who have to be advised of the arrival of a train, by a repeater of the signals given by the semaphore. Such a repeater was also shown. (2) Sources of electricity for the bell signalling, and commutators for changing the direction of the current. The source of electricity employed by the Northern Company is a Siemens induction machine, constructed by M. Digney, and composed of a large coil, revolving between the poles of twelve bar magnets. The apparatus is a very simple one, and a half-turn of the driving handle is sufficient to release all the bells in connection with the system, and to enable the telegraphists to employ for occasionally signalling various running latterns any two stations, the commutator of M. Sartiaux is employed. This consists, when, in the form of a box, does not interrupt the circuit when it is closed, but breaks it as soon as the box is open, and contacts are so involved in the desired directions. (3) Level crossing alarms. These are employed to notify the guards of trains when they approach level crossings. They comprise an automatic pedal and whistle, an automatic mercury pedal, electric bells for single lines, and the semaphore repeater on lines worked by the block system. The first of these dates from 1859, and was designed by M. Lartigue and M. Tesse. The second is due to M. Lartigue, and is now being tried. It consists of a very light pedal fixed to the levels of the rail, and placed 2 kilometres from the level crossing to be protected. It carries a small ebonite key, containing mercury, and is connected to a spring which projects a little above the top of the rail. The flanges of the wheel depress this spring and slightly incline the mercury key, the displacement of which produces electrical contact between two platinum wires which put the bells and earth wires in communication, and the circuit in which a bell is placed is thus completed. The bell once started by the passage of the train, continues to ring until the signalman stops it. This is effected by a shoplike device that has been added to the bell mechanism. A small lever turning on a metal pin is in connection with the battery. When at rest the lever is held by a stud of insulating material fixed to the pallet of the hammer. When at the moment that the pedal is depressed by the train, the hammer is attracted towards the coils, the lever is released and falls on a metal stop which thus throws the bell into the circuit, and the ringing continues until the lever is replaced by hand. A slight pressure on the lever which projects beyond the box of the apparatus is sufficient to effect this. An electro-semaphore repeater for level crossings in use on the Northern Railway. The type of apparatus that was exhibited is placed between two semaphore stations and in the circuit of the lines connecting the apparatus of the two stations. When the employé moves the long arm of his semaphore to block his section and signals the train to the next section, the current which forms the small arm first traverses the repeating apparatus and throws up the arm of a small signal outside it. As long as this small signal remains visible, one of the bells (there are two, one for each line and each of different tone) notifies the employé at the level crossing that he must not lower the small signal until the train has passed. The repeating apparatus consists of a small iron box containing two Hughes electro-magnets, which hold each of the two small signals slightly inclined to the direction in which they fall. When by the passage of the current the effect of the magnets is reduced, the signals fall by their own weight outside the apparatus, and as soon as they have fallen to their full extent they make contact between two springs, to which are connected the two poles of a local battery and two bells.

(4) The electro-automatic whistle and electro-automatic actuator for the vacuum brake. As a rule all dangerous points and crossings are protected by visible signals, supplemented as far as possible by acoustic signals calling the attention of the employé. The apparatus for the latter purpose was exhibited by the Compagnie du Nord, is the electro-automatic whistle of MM. Lartigue, Forest, and Digney, and which is in use on 289 locomotives. The company having adopted the vacuum brake, MM. Debilecque and Hunsdorff have changed this apparatus into one for working the brake automatically. An example of this system was shown on a model locomotive and train. The mode of action is briefly as follows: In the centre of the track, at a fixed distance from the signal, is placed a "crocodile" made of a wooden sleeper, covered with an insulated leather, and connected by a wire to the positive pole of the battery working the bell for the disc signal. Upon this piece rubs a metallic brush fixed to the locomotive. This brush is connected with the wire of the coil of a Hughes electro-magnet. If the signal is open, the circuit is also open, and the passage of the brush on the fixed contact produces no effect. If on the contrary the disc and the circuit is completed, and the current through the electro-magnet and the starting apparatus releases the brake, the noise of which notifies the driver, who will then leave the brake on, or take it off according to circumstances. The fixed contact is about 6 ft. long, and the speed of the train of course for one-tenth of a second at the highest speeds, sufficient to start the brake. The automatic whistle in use before the adoption of the vacuum brake, differs from the foregoing only in that the starting apparatus is replaced by a steam whistle, the valve of which is operated by the rod projecting from the starting box. It continues to sound until the driver sets back the armature.

(5) Electro-automatic apparatus for protecting stations or junctions. The company exhibited the special apparatus now being tried at several places on their system, and which is intended to secure the same advantages as the automatic disc signals, without the danger of break-down to which the latter system is liable. The apparatus worked out by MM. Forest and Lartigue, on data afforded by M. Mantion, is based on the use of the electro-automatic whistle, and on the employment of fixed contacts. The ringing spy of the arrangements or mode of working the ordinary disc signals, the inventors have obtained the following results, by the addition of a special electric commutator placed near the lever of the disc, and by the addition of a second fixed contact to the foot of the signal. When an engine fitted with a metal brush passes before an open disc, the friction of this brush on the first contact actions. It then releases the electric apparatus placed near the lever of the disc and rings a special bell in the station, which notifies that a train has entered the section between the disc and the station, and that it must be protected. In the second place, by the act of releasing the apparatus, the first contact placed 200 metres in advance of the disc is automatically set in relation with the source of electricity, without which it would be necessary to turn the disc round to the stop. From this it results, that if a second train passes over the fixed contact either the automatic whistle or the Smith brake is put into action and the driver is notified that the train has passed a disc, and has not been protected by setting the disc to close the line. He will therefore stop the train as rapidly as possible. As soon as the disc has been restored to its normal position, the train apparatus also resumes the same condition as before the train passed.

(6) Electrical controlling apparatus for working points. Points are often placed at a considerable distance from the men controlling them, and are consequently removed beyond the range of his intelligible observation. In order that the man may know whether the points have followed the action of the lever, and if they have been completely thrown over, M. Lartigue designed a contact apparatus, subsequently somewhat modified by M. Sartiaux, and which was approved by a ministerial decision on the 17th of December, 1878. This apparatus in its general use on the Northern Railway, and is as well known that we consider it here only because it was included among the company's exhibits at Munich.

(7) Apparatus for controlling the releasing gear of Messrs. Stanley and Farmer. The Northern Railway Company has added to the latter apparatus a releasing gear a system of electrical control devised by M. Sartiaux. By means of this the man at the central station shall be able to ascertain whether the disc signals are in proper working order. Four models of these apparatus were shown.

(8) Electro-magnetic bells for lines only becoming occasionally independent of the telegraphs, as usually sent by telegraph, providing for the exchange of a certain number of momentary communications that can be made by imperfectly educated servants, and for whom the ordinary instruments are too complicated. The Northern Company, also showed several types of commutators applied to the electric control for the working of distance disc signals. These commutators are generally formed of a piece of cast iron, fixed to the upper part of the signal post, and carrying a lever, turning on a copper axis, and provided at one end by a contact spring. When the disc is brought against the stop, a finger placed on the back of the disc signal raises the lever and closes a circuit, the battery of which is placed at the foot of the signal, and starts the bell ringing. A small model of a train illustrated the Prudhommeau system of communication, used by the company since 1865 on all passenger trains. Among this interesting collection contained various telegraphic apparatus, Lockwoke's dials of Paines used by the company, electric water level indicators, on the Verdi and Lartigue systems, electric apparatus employed since 1875 for lighting the Chapelle stations, and considerable Siemens generators, and Serrin and Siemens' lamps, telephonic stations, &c.

Nature, p. 1877

NATURE

OUR Paris correspondent writes: We were present at the Alliance Electric Works to witness an experiment on the new candle-light, which we had seen in operation at the Physical Society, and which was recently described in NATURE. The Ruhmkorf machine was fed by a more powerful primary current given out by an Alliance electro-motor of three-eight centimetres long, and fully equal to eight gas-burners. At the same time three arc-called electric candles were in operation, each of them giving about forty gas-burners, and fully equal to five candle lights. Consequently not less than twenty-five lights could be fed at once in separate parts of the same building or at any distance. The light is admirable for its constancy and steadiness; the quantity of candle destroyed is quite insignificant—no more than 1 mm. per hour; the thickness of the candle plate or bar used is not more than 4 millimetres. The electric candles are formed, as is known, by two graphite bars separated by a candle bar. It was proved that the agitation of the candlestick produces no interruption of the current. Consequently a single Alliance-work machine can feed the three lights required by the regulations for steamers. The graphic pencils are consumed at the rate of eight centimetres per hour, which is a difficulty; but it is expected that any length required may be supplied by means of a proper clock-work. Experiments were tried on the same day at the Palais de l'Industrie for the purpose of illuminating the exhibition of pictures with electric light. The ordinary Gramme machines were set into operation. The light was found steady, but the effect was not quite favourable esthetically. It is expected that with the system of light division, an improvement may be effected. The experiments were made in order to test whether electric light may be utilised on the occasion of the forthcoming International Exhibition.

ENGINEERING.

ELECTRIC LIGHTING NOTES.

The Corporation of Bury St. Edmunds will apply for a provisional order empowering them to lay down mains and plant, and charge for current supplied, and also to make agreements with companies and persons for supplying electricity. The Corporation of St. Pancras and Hastings have similar powers.

The Telegraph Construction and Maintenance and the West London Electric Lighting Companies work has recently supplied the Swan electrolizers for the statement, G. H. H.M.S. Orontes, are now making a similar class of fittings for the White Star Ice Steamboats. The same firm has just completed the electric fittings for Mr. W. S. Gilbert's house at South Kensington.

The Westminster District Electric Lighting Company have given notice of their intention to apply to the Board of Trade next session for a provisional order to supply electricity within the district of the Westminster Board of Works. The area comprises Vauxhall Bridge-road, Grosvenor-road, Horseferry-road, Victoria-street, Tothill-street, Queen Anne's Gate, Birdcage Walk, the Mall, Pall Mall, Cockspur-street, the Government offices, the Houses of Parliament and the Government buildings, Whitehall-place, Scotland-yard, Northumberland-avenue, Trafalgar-square, and Prince's Gardens. Suitable powers will be asked for carrying on the works.

The electric lighting station at Brixton, which was established by the Metropolitan Brush Company, has been leased to Messrs. Clark and Co., who are now feeding forty-seven arc lamps and ten incandescent lamps from a forty-light Brush machine. They have discontinued the use of the greater part of the Brush lamps, and have replaced them by Clark and Bowman lamps, which give a very superior result, and will be supplied with self-trimmings with any lamps in the market. Clark, Bowman and Co. have also illustrated candelabra, brass lamps in daily use in the room like we may help create that the same two-holder has a positive feed, and is reversed by a current sent into it by a relay, which has no other effect to perform, and therefore responds readily to any change of resistance in the arc. The feeding takes place with great regularity at intervals of about fifteen seconds, and if it be assured that the movement will be one of an inch, the lamps are let to the neighbouring sleepkeepers at a rental of ten shillings a week, and it is stated that a good profit is realised at these terms.

The first ordinary general meeting of the Swan United Electric Light Company was held on Tuesday last. The chairman, Mr. J. S. Forbes, stated the business of the company had been chiefly in the manufacture of lamps, and that it was probable it would increase next year. The attention of Mr. Swan and Mr. Sievey was being directed to further improvements, and it was to be expected that they would derive great profits from this branch of their business. They would not be injured by their assignment with the Edison Company, and on the other hand they would share in any benefits which might be effected from their patents. Owing to the novelty of the enterprise and the great consumption of the old companies, their progress in other directions had not been so great as would otherwise have been the case. It was a question whether they should not discontinue making detached installations at present. Some of those already erected had not paid, although they had been useful as advertisements, and it would be better in future to receive their value "out and out." Several cases in the metropolis had been secured for lighting districts, and the installation at Victoria Station was looked forward to with great interest, as it would prove whether isolated-source lighting could be done on a large scale as a profit. The sum of 50,000*l.*, which included the whole of the preliminary and other expenses, had been charged against the year's profits, and had reduced them very considerably. The directors were now in possession, a waiting game, and were watching to see in what direction they could develop the business with advantage.

Electrical World,
April 19th 1884.

St. Johns, Quebec, to be Lighted.

Some years ago Messrs. A. Perry, of Montreal; Chas. Archibald, Alex. Macdonell, G. H. Wilkinson and A. Beaucage, of St. Johns, Quebec, associated themselves together for the purpose of organising a gas company in St. Johns, Quebec, and accordingly like $10,000 was subscribed, but this beleaguered sufficient to warrant the directors to go to an allowance the scheme was abandoned and the town seemed forever doomed to darkness. Dr. Gustavus Griffin of the Phœnix Electrical Company for Canada, opened negotiations with the City Fathers about three weeks ago, says the Montreal Witness of the 7th inst., and seeing the need of light offered to supply thirty arc lamps of two thousand candle power each, to be placed on the streets and to supply his company's system of incandescent lamps for stores and private use at a five cents per light per night. So much encouraged was Dr. Griffin that he gave a free exhibition of both the arc and incandescent lights in the Messrs. Macdonald Stone and Chinaware Company Works and in front of the St. Johns Hotel, which was witnessed by more than half the entire population. After the exhibition was over negotiations were opened with the mayor and aldermen to supply the arc light for street lighting and with Louis Molleur, Esq., president of the Banque St. Jean, to supply the incandescent lamps for the merchants and private use, as he had a gas engine at his water works lying idle. Mr. Franklin H. Smith, president of the Phœnix Electric Company, received a telegram on Saturday afternoon last from Dr. Griffin stating that he had closed with the authorities for 2,000 incandescent lamps to be used in lighting the streets as well as the houses, and that more than 200 lights had been signed for by the merchants on Richelieu street. On receiving this news Superintendent McConnon, of the Phœnix, left to assist Dr. Griffin in swapping out the plans for lighting, etc. The Phœnix has received the first contract ever awarded to any company for lighting a town in the Dominion exclusively by the electric light. President Smith with his superintendent, Mr. McConnon, will visit St. Johns during the week to commence the work of laying on the wires and putting up the lamps. This is probably the largest contract ever awarded any company in the Dominion. It looks as though electric lighting will soon be brisk throughout Canada.

most effectual method of raising the cage to the height required for the various floors in use.

The committee being composed of practical men of business, were soon convinced of the necessity of throwing their preconceived opinions to the winds, and without loss of time following the advice of Mr. Abernethy and Mr. Williams, determined upon remodelling the scheme upon the lines of Mr. Williams's report, and gave the necessary instructions to prepare plans, &c., for depositing this autumn, so that the sanction of Parliament might be sought at the first possible opportunity. This decision was arrived at in the latter half of October last, and as we have before mentioned, the necessary notices have been issued, and plans deposited in compliance with the Standing Orders of the two Houses of Parliament, and ere this bill we may expect the great Parliamentary fight of next session will take place.

We are told that in 1824 a bill was promoted in Parliament for making a ship canal to Manchester. The proposed entrance was on the Dee, crossing by Parkgate and Saney by Frodsham, Runcorn, Lymm, Altrincham to Manchester. The scheme was most strenuously opposed, and thrown out, it is said, through not having complied with Standing Orders. In all probability, it was hastily advised and ill considered, and no doubt justly deserved its fate.

THE ELECTRIC LIGHT COMPANIES.

We have received from the publishers of the *Mercantile Shipping Gazette and Commercial Review*, of 65a, London-street, Fenchurch, a copy of their second annual supplement, which this year is devoted to an account of the constitution, progress, and resources of all the electric light companies, with explanatory tables and remarks. The value of having a financial history of the companies from their birth, if properly prepared, and even approximately compilation it is difficult to speak too highly, for although it has been kept within a moderate compass, put every line represents considerable patient labour and research, not only among prospectuses, ments and documents filed with the Registrar of Joint Stock Companies at Somerset House, but also in other and more private directions. The task of wading through a legal document, in which the respective positions of vendors, promoters, and shareholders are carefully defined is that undertaken by few, and which, if done by the ordinary individual and the despair of the laity, is sufficiently formidable to deter, but when it has to be done for ninety companies, many of which are related to each other in a single or double way, the difficulty enormous, and when accomplished deserves the recognition of the public. In this case we have no doubt that both electricians and commercial men will be much obliged to the *Mercantile Shipping Gazette* for the publication of this supplement, as there has long been a very eager curiosity to learn the success of the electric companies, and a fear that rumours have been afloat as to the amount of money subscribed by the public, and that many who have gone into investors' pockets, but no definite comprehensive statement has been issued until the present, and now we see how largely exaggerated have been the statements that have been put forth and accepted even by moderate men.

The chief portion of the matter of the supplement consists of a list of all the companies, arranged alphabetically, stating the date of formation, with the registration number. Under each company there are given, wherever the particulars are available, details of the nominal amount of the company's capital, of the number of shares allotted as fully or partially paid up in payment for the public, and of the arrangements whereby the property, patents or other, was transferred from the original vendors through the intermediate promoter or syndicate. In some cases the companies having purchased plant, have since formally wound up. In others an unsuccessful issue may be inferred from failure to fill the register of shareholders, or even notice of the office of the company, although this occasionally is no doubt simply the result of neglect. As the size of the offices has been to adhere rigidly to facts, and to avoid making invidious distinctions by appertioning praise or blame, the particulars are left to speak for themselves without comment; but to facilitate comparison and the formation of a just conception as of the whole, the leading facts have been summarised in the form of tables, of which we give one that will, we think, be found by our readers to be replete with interest. The Table is divided into four sections and a summary; the first deals solely with the British Companies, of which there are no less than twenty; the second relates to companies that are nationally at work, or prepared to work, and of these there are twenty-three, or only three more than the British list; the third refers to companies that do not appear to have been proceeded with particularly; and the fourth to companies mostly recent, about which information is wanting or not yet attainable.

The first point to which attention is called by our contemporary is the extent of shares and debentures issued, 7,888,440*l.*, or 45 per cent. of the nominal capital of the companies comprised in Groups I. and

SECTION I.—BRITISH COMPANIES.

	Number of Company.	Nominal Amount of Capital.	Amount to be Paid in Cash.	Amount to be Paid in Various Ways.	Actual Issued Capital.	Actual Amount Paid in Cash.	Actual Amount of Shares Allotted in Cash.	Actual Amount Paid in Various Ways.	Actual Amount of Debentures Issued.	Actual Amount Paid up on Calls Made.
	£	£	£	£	£	£	£	£	£	£
Anglo-American Brush Electric Light Corporation, Limited	14,700	588,000	49,000	169,000	406,000	49,000	169,000	188,000	76,000	471
Edison Electric Light and Power Co., Ltd.	15,049	300,000	15,000	60,000	75,000	15,000	60,000	15,000	37,500	15,000
Electric Light Co., Limited	16,911	250,000	...	35,000	125,000	...	35,000	90,000	44,000	44,000
Electric Power Storage Company, Limited	16,595	250,000	12,500	12,500	125,000	12,500	12,500	125,000	25,000	25,000
Electric Power Storage Company, Limited	16,712	300,000	15,000	45,000	150,000	15,000	45,000	150,000	60,000	60,000
Electric Telegraph Company, Limited	16,715	100,000	12,750	7,000	100,000	12,750	7,000	80,000	40,000	40,000
Edison Gilbert Electric Light and Power Company, Limited	16,750	250,000	12,750	12,000	125,000	12,750	12,000	125,000	25,000	25,000
Electric Supply Light Company, Limited	16,752	300,000	15,000	45,000	150,000	15,000	45,000	150,000	60,000	60,000
Electric Power Storage Company, Limited	16,773	200,000	20,000	...	20,000	20,000	...	20,000	40,000	40,000
Electric Power Storage Company, Limited	16,782	250,000	12,500	12,500	125,000	12,500	12,500	125,000	25,000	25,000
Electric Power Storage Company, Limited	16,783	250,000	12,500	12,500	125,000	12,500	12,500	125,000	25,000	25,000
Anglo-American Brush Electric Light Corporation, Limited	16,784	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,785	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,786	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,787	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,788	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,789	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,790	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,791	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,792	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,793	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,794	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,795	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,796	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,797	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,798	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,799	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
Anglo-American Brush Electric Light Corporation, Limited	16,800	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,801	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,802	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,803	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,804	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,805	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,806	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,807	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,808	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,809	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,810	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,811	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,812	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,813	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,814	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,815	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,816	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,817	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,818	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,819	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,820	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,821	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,822	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,823	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,824	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,825	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,826	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,827	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,828	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,829	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,830	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,831	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,832	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,833	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,834	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,835	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,836	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,837	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,838	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,839	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,840	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,841	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,842	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,843	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,844	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,845	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,846	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,847	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,848	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,849	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,850	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,851	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,852	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,853	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,854	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,855	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,856	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,857	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,858	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,859	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,860	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,861	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,862	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,863	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,864	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,865	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,866	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,867	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,868	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,869	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,870	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,871	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,872	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,873	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,874	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,875	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,876	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,877	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,878	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,879	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,880	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,881	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,882	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,883	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,884	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,885	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,886	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,887	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,888	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,889	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,890	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,891	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,892	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,893	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,894	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,895	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,896	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,897	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,898	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,899	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,900	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,901	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,902	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,903	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,904	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,905	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,906	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,907	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,908	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,909	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,910	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,911	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,912	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,913	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,914	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,915	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,916	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,917	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,918	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,919	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,920	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,921	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,922	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,923	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,924	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,925	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,926	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,927	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,928	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,929	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,930	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,931	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,932	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,933	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,934	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,935	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,936	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,937	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,938	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,939	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,940	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,941	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,942	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,943	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,944	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,945	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,946	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,947	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,948	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,949	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,950	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,951	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,952	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,953	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,954	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,955	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,956	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,957	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,958	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,959	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,960	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,961	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,962	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,963	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,964	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,965	1,000,000	50,000	...	200,000	50,000	...	200,000	100,000	100,000
	16,966

ELECTRIC LIGHTING MEMORANDA.

Two shareholders of the Electrical Power Storage Company have held their annual meeting, at which the usual tale of disaster had to be told. This is the only rival to the Faure Accumulator Company, whose troubles have recently been mentioned in these columns; and is not in much better case than the hybrid French-English speculation which it is supposed to have relished of some valuable inventions. The loss of the Company on their year's working is set down in the balance-sheet at £19,765; but *Money* says these figures are perfectly illusory, and gives the loss at £56,581 for the year, with a deficiency, on the general balance-sheet, of £520,810. This is a melancholy state of affairs; but yet the meeting passed off fairly well, although the capital was reduced from £800,000 to £200,000, or a clean sweep of three-fourths of the shares. This most drastic measure was pleasantly recommended from the chair in decidedly novel terms. The Chairman said that the proprietors would receive a new £1 share for every two £2 shares, and "as the capital was fully paid, it was really immaterial to the shareholders what the nominal amount of each share was." That is to say, if a man gives £4, and gets a receipt for a sovereign, it is all the same. Of course it is in this sense in regard to the Company; for when the inevitable smash comes, the nominal value of the shares will be of small moment to the unfortunate holders; but this cannot afford much permanent satisfaction to people who place their money in a concern that will keep going until all the capital is run through, and then stop.

The question of overhead wires for all kinds of electrical circuits has not attracted in England so much attention as it has abroad, and especially in New York, where the clusters of wires along the streets are not only an eyesore, but frequently denoted for the possible dangers of breakages and even of contact. Yet it is undeniable that the matter is of overhead of England; and it is not surprising that, as announced, the Government have decided to move for the appointment of a Select Committee of the House of Commons to examine into and report upon the whole subject. The initiative has been taken by the Post Office authorities, who are probably anxious that the interests of their own Department shall not suffer from the multiplication of wires.

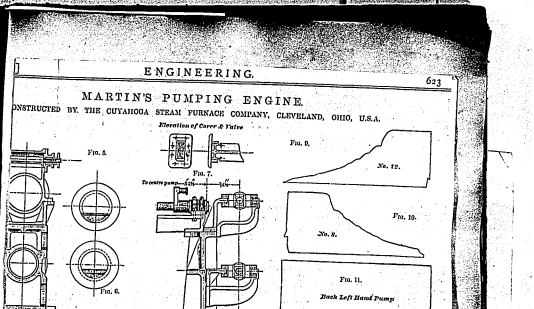
There seems to be a considerable amount of free-trade in incandescent lamps; for, notwithstanding the claims of the great patentees, Swan and Edison, to say nothing of the claims of second magnitude, such as Maxim and Crookes, which, as they contend, are not only equal to, but infinitely surpass the wares of the world-renowned Company, there is a considerable sympathy with the smaller manufacturers, who, while the great people already named are losing money by tons of thousands a year, are quietly continuing to do a remunerative business, and make and sell electric lamps for as they would make and sell parasite lamps—as a matter of trade. If there is anything like a popular demand for electric lighting, it is probable that these minor manufacturers will reap the benefit of it, after the inflated joint-stock concerns have run their allotted course. It has been seen how the installation of arc lighting at Paddington, that came to grief in the hands of the Metropolitan Brush Company, has been more successfully worked by local people; and now, in respect of incandescent lighting, Messrs. Woodhouse and Rawson have issued a circular, in which they offer to supply lamps of 80 per cent. higher efficiency than the ordinary Swan lamps, at about 2s. each for 16 and 20 candle power. According to this statement, electric lighting *per se* will not suffer much from the proximate extinction of all the stock-jobbing speculators who have hitherto claimed a monopoly of interest in the matter.

Bradstreet's (N.Y.) Feb. 1884.

If economy were the sole consideration the future of the incandescent light in England would be far from encouraging; but, happily for its production, it possesses so many and important advantages that, despite its higher price, it is in no danger of losing the ground already gained and of failing to make substantial advances. The demonstration of experience, therefore, that it cannot compete with gas on an economical basis causes no apprehension on the part of its supporters. The London *Engineer*, in a recent issue, after confessing that it is dearer than gas, asserts its belief in its future well-being, and various other journals have expressed themselves to the same effect. The *Engineer* says: "As to the future of electric lighting there is no room for doubt. It will succeed. The inherent merits of the light are so great that it cannot possibly be dispensed with, and, under the most adverse circumstances, it is steadily pushing its way. . . . Electricians may take heart. Bad as their prospects are just now they can rest assured that there is a good time coming for the light which they advocate. But fortunes will neither be made nor lost in a hurry, and this is the best guarantee that the electric light will enjoy public favor and commercial prosperity." In this country also the merits of the light rather than the cost is being increasingly urged as the chief consideration, but there is less need for this mode of advancing it here than abroad, and in time we may expect to see this need wholly disappear.

MARTIN'S PUMPING ENGINE.

CONSTRUCTED BY THE CUYAHOGA STEAM FURNACE COMPANY, CLEVELAND, OHIO, U.S.A.



...repulsed in either of the western ...outer part can be disconnected ...or while the other can be run ...by an entire stoppage of the ...wealth, a very important con...ity of cities or large industries.

...e, Figs. 9 and 10, from steam ...e Cleveland Rolling Mill Com...y, of four million gallons capa...ing day, and might be far ...xpected. The diagrams have ...fully urged as the chief ...these diagrams:

...	... lb.
...	... 10
...	... 30
...	... lb.
...	... 70
...	... 120
...	... 160

...pout end, and No. 8 from back

...ED VENTILATING OF ...IRTS OF JUSTICE.

...ntilation of the Courts of ...to which the architect, the ...ch thought, and it was not ...ben elaborated and matured ...ments were decided upon. The ...the plan of the building into ...the floor running at right ...of the Great Hall. To each ...ts apparatus, for hour being ...uction; they are capable of ...other, and are arranged so ...each other's distance. The ...water over the lower portion ...ugh pipes formed into ranges ...ing in all a little more than ...ch water is heated in four ...ds, each section of which ...Hall. There are two other ...for the generation of ...the engines used for propel...for heating the coils of ...atts. The scheme will thus ...rangement of boilers for ...ave been again divided into ...tends. Each section and ...with the boilers directly, ...which are carried round ...ir boilers together. While ...ts are provided for, special ...ired upon the warming and ...ratuses, each court being ...regards its heating and air-...each there is a chamber ...compartments; in one the ...d to warm and maintain the ...courts to a temperature of from 55 deg. to 60 deg. in the coldest season, with an interchange of air, equal ...to something like 10,000 cubic feet per minute. In ...other compartment is used for cold air. These two ...chambers merge into one, and are covered with ...fine cotton cloth, which is used for misting and ...filtering the air before it passes into the court ...through numerous vertical openings provided behind ...the wall linings, as well as other convenient points. ...The entrance to these two compartments is under ...control from the lobbies in the court, so that the air ...driven in by the fans can be shut off through one or the ...other or partly through both, and can be regulated ...at will to suit every condition of the atmosphere. The ...supply of air, which in summer is calculated to reach ...the total volume of cubic feet per hour, is drawn from the whole of the areas surrounding the ...Great Hall, and is freed from dust and smut by being ...passed through a fine water spray. The withdrawal ...of the vitiated atmosphere is accomplished by means ...of powerful steam coils placed in the ventilating shafts, ...to which access is given by numerous openings in the ...ceilings and galleries. Thus far the arrangements we ...have described have been for the purposes of warming the building. It was felt, however, that it ...would be necessary to cool the air in hot weather, as ...well as to circulate it, and for this purpose an entirely ...distinguishing machine has been erected on the roof, ...consisting of a pair of engines, vapour pumps, refrigerators, and condenser. This machine is of ...sufficient power to receive 1000 gallons of water ...per minute from 72 to 40 deg. Fahr. The water thus ...received is converted in five sprays by an "ejector," and the cool vapour through the coils. The cold water ...that is not absorbed is collected in a cistern, and conveyed to the condenser, where it is used to obviate the ...heat given off by the ether in liquefying, and is finally ...allowed to escape at a temperature of 70 deg. A recording thermometer is attached to the inlet and outlet pipes of the cooler, so that the temperature of the services under the system can be regulated accurately. The works have been executed by Messrs. Haden and Sons, of Trowbridge, and carried out under the supervision of Mr. Frederick Blake, of Manchester, who assisted the late Mr. Street in working out the scheme.

ELECTRIC LIGHTING NOTES.

At the present time, when the relative costs of combustible gas and electricity are keenly debated, a pamphlet entitled "Electric Lighting by Water Power," and bearing the date 1883, cannot fail to attract attention. Whether the author, Mr. T. B. Grierson, who considers of this when he republished the paper which twelve months ago he read upon this subject before the Institution of Civil Engineers of Ireland, we do not know, but after a perusal of its contents we cannot help thinking he must have had a glimmering perception of the facts. If not, we are at a loss to understand why he now ventures to transfer it from the small circle, for which it was originally intended, and offer it to the public.

Even twelve months ago it received a good deal of sharp criticism from the meeting to which it was addressed, at least so we gather from the tone of the reply which is bound up with the paper, and a great many things have happened, from an electrical point of view, during the past year. We have been unable to decide whether it was electrical science or the utilisation of water power, with which Mr. Grierson professed to be familiar, which we undertook to prepare his composition. We suppose it must have been one, and we presume he would purport to learned societies on subjects with which they are not acquainted.

Now, instead of a description of the Brush apparatus, we can find room on our columns, the only information we can find relating to electricity beyond the normal commonplaces, (1) that although the Jablochkoff candle was a most beautiful and simple arrangement, (2) "the reversals of the current was an troublesome and inconvenient in the case of the lamp, was in many cases discontinued in consequence," and (3) that Faraday discovered "the principle by which to generate a current of electricity by rapidly passing wires between the poles of powerful steel magnets." It must be confessed that these two assertions, although not without a certain amount of originality, do not convey the idea that the author is perfectly acquainted with the theoretical and practical aspects of electric lighting. What he says about water power is certainly correct, but by no means novel. No one doubts that "the turbine is one of the most, if not the most, economical of water motors of the present day," or that an abundant supply of water must always be the cheapest power in the generation of electric currents to be utilised in the immediate neighbourhood. Now, we do not complain of Mr. Grierson having presented a paper of little value to his own society—it appears to have elicited a lengthy discussion, and, in so far no doubt, served a useful purpose—but we think when he undertook to instruct the public he might have taken the trouble to ascertain what was being lit up to the enormous standard of wattage upon the subject. It is possible that a local interest in the matter has been excited in Dublin by exhibitions for international orders under the Electric Lighting Act, and if such be the case information bearing on the matter will be greatly in request. If that be so there was every opportunity for our author to have done a service to his fellow citizens. He mentions at least two possible sources of water power in Dublin, and he would not have been difficult to have formed a rough estimate of the probable amount of power from each, and to have given its equivalent in candle power under the various systems of arc, incandescent arc, and incandescence lamps. A page devoted to details of this kind would have more value than twenty of generalities, for the battle of electricity *versus* gas is being fought upon points of detail, and if our author can show a cheap and sufficient supply of water power in Dublin he will render a better service to the interests of the gas company than he has done by the publication before us.

The Faure Accumulator Company was formed about

ELECTRIC LIGHTING NOTES.

We notice that the Gloucester County Lighting Association have acknowledged the fitness of the electric light for every-day use by adopting it in their new asylum. This large building is going to be lit with incandescence lamps, and the work has been entrusted to Messrs. Woodhouse and Rawson, of 11, Queen Victoria-street. The motive power will be supplied by Otto's gas engines run with Dowson's gas. Fares, Sellon, and Volckmar accumulatory batteries, and Woodhouse and Rawson incandescence lamps will be employed.

The s.s. *Clan Macarthur*, which has been built for Messrs. Ogilvy, Gillanders, and Co.'s Clan Line, by Messrs. Scott and Co., of Greenock, started from the Clyde on Saturday last for Natal, for a preliminary cruise with a large party on board. The vessel has been lit throughout with the Swan incandescent lamp by the Glasgow Incandescent Electric Light Company, who will undertake that the owners have no further trouble with the complete system obtained, that they have placed the lighting of another steamer, the *Macindoe*, with the same company.

We understand that the order for the lighting up of the Huddersfield Technical Schools Exhibition has been secured by Messrs. Kingsford and Smith, of Leeds, agents and district managers for the "Yorkshire Brush" Company, and Messrs. Fernald, Thompson, and Ince, Limited. A 40-light Brush machine will be used for lighting up the weaving and other sheds by arc light, while a 200-light Fernald dynamo will be used for feeding incandescence lamps in the rest of the building. This Exhibition, which will be similar to the one held at Bradford last year, is to be opened by the Prince in July, and is expected to remain open till about November.

The Electric Light Contract and Maintenance Company, which lately went into voluntary liquidation, has paid a first dividend to its shareholders of 1l. 15s. per share, the result, after all up to date. It is expected that a second dividend of about four shillings per share will follow, and thus the subscribers will practically receive the whole of their money back again. The company was started with the view of supplying electric light in the same way that a gas company supplies gaslight, and has adhered rigidly to its programme, steadily refusing all offers of amalgamation and declining to undertake any business that did not rest upon a commercial basis, that is, which did not promise to give a profit. The result has been that the company has done nothing whatever, and has not lighted one solitary additional lamp. The liquidator has received a powerful corporation, managed by so influential a board, and provided with ample capital, remaining in a state of repose for twelve months, and finally wisely declines to do business on such conditions as obtained, signifying, as it confirms the idea that the electric light, although a fine field for speculation, is not at present a subject for the genuine investor.

Mr. Lane-Fox's patent for the employment of secondary batteries in electric lighting, which dated October 3, 1878, came before the Solicitor-General on Friday, but as none appeared in opposition to the application for the revocation from his patent all the claims originally made by him, except that which covers the employment of secondary batteries in combination with parallel arc distribution, as described in his specification. His application was opposed by the Swan United Electric Light Company, Messrs. R. E. Crompton and Co., and the British Electric Light Company, upon various grounds, among which were that the invention to which Mr. Lane-Fox wished to limit his patent by the proposed disclaimer was not a novelty, that it was not sufficiently described in the provisional specification, and that the proposed disclaimer would alter the character of the patent. Mr. Wilkinson, Q.C., and Mr. Moulton (instructed by Messrs. Graves and Humphreys, solicitors, for Mr. C. C. Mewburn, patent agent), appeared for Mr. Lane-Fox in support of the disclaimer, Mr. Aston, Q.C., and Mr. Chadwick Healey (instructed by Mr. F. H. Johnson, solicitor), appeared for the Swan United Company, Mr. Aston, Q.C., and Mr. Phipps (instructed by Messrs. Brooks and Son, patent agents), for Messrs. R. E. Crompton and Co., and Mr. Carpmael (instructed by Messrs. Wilson, Carpmael, and Edgerton), solicitors for the British Electric Light Company, Robinson in support of the disclaimer was given by Mr. Aston, Professor Stevens, Professor Fleming Jenkin, F.R.S., Professor Silvanus Thompson, Mr. Preece, Mr. R. Sabine, and in support of the opposition by Mr. J. W. Swan, Mr. R. E. Crompton, Dr. Hopkinson, F.R.S., Mr. W. H. Preece, F.R.S., Professor Ayrton, F.R.S., Professor Oliver Lodge, Mr. D. G. Fitzgerald, and Hon. R. Brougham. After a long hearing the Solicitor-General decided to grant Mr. Lane-Fox's application for leave to disclaim. The claim under this patent will therefore be for the employment as described in the specification of secondary batteries, as conveyers of electricity in combination with a mode or system of distribution such as is therein explained.

Engineering, June 16, 1882.

JOEL'S ELECTRIC LIGHT.

This promising illuminant has been fitted up in the offices of the Prudential Assurance Company, Holborn-bars, by Messrs. Rowatt and Fyfe's Electric Light Company. One-half of the extensive upper floor is lighted by one Joel lamp of 160 candles-power each, and those replace 45 gas jets. The other half of the floor is still lighted by gas, and the contrast is very striking in many ways in favour of the electric light exhibits the various insurance cards in their true colours, a matter of convenience to the working staff, and it enables the atmosphere to be maintained far more fresh than under the old system of gasburners. Joel's lamp is an improvement on that of Werdermann, which has been installed in the Paris Opera House, and is well adapted for lighting offices. The burner consists of a pointed pencil of carbon resting on a knob of copper. The positive current flows from the carbon to the copper rod in doing so heats up the fine carbon point to incandescence. But there is also a small shadow-box at the junction of the carbon and the copper which greatly increases the intensity of the light, without appearing to detract from its steadiness. It is, therefore, intermediate between the proper arc light and the purely incandescent light of Edison, Swan, Maxim, and others. The lamp is not so small and handy as these lamps are, but its greater power is an advantage for some purposes. At the Prudential Assurance Office the nine lamps are fed by a B Gramme machine of low tension, driven by a 20 horse-power steam engine kept on the premises; but the energy absorbed is estimated at 35 horse power. According to the report of Professor W. G. Adams, the Joel system is capable of yielding a light of 715 candles per horse power.

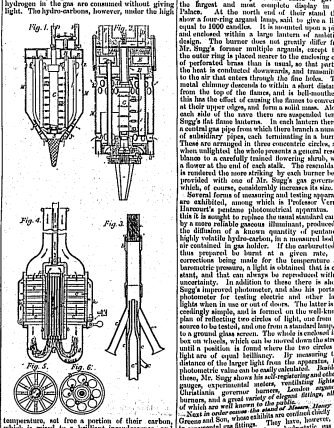
establishment were 10222, and salaries and wages 2960l., the balance in hand at the end of the year being 963l. or 193l. more than at the commencement. A legacy of 1000l. (less duty) has been left to the Council by the widow of Mr. Henry Robinson Palmer—well known to the late generation of engineers as Telford's chief assistant—for the foundation of a scholarship at Cambridge University, the gift to be by the son of a civil engineer who may need help, and who should be nominated by the Council of the Institution.

A society blessed with ample funds and an active executive, should have little cause for anxiety, but a successful past demands an equally successful future, and so we find the Council still canvassing for communications of a complete and comprehensive character. A light of thirty-eight subjects is published to show how catholic is the taste of the Institution, and to serve as hints to members and others whose position or experience has given them special opportunities of acquiring knowledge in any of the many branches of engineering science. It is not only to the *esprit de corps* of the members, or to their zeal for the diffusion of knowledge that the Council appeals, for it sets forth a list of annual premiums, medals, and prizes at its disposal for approved original communications submitting to the value of 467l. Looking to the number of members, and particularly the large proportion of young life, much of which is engaged in active research of some kind or other, there should be no lack of valuable contributions. To Mr. James Forrest the Institution is so much indebted, for the individual services so freely and untiringly rendered to its members, and to the engineering manner in which its business is conducted, and its Transactions published, that it seems to us that every year, the welfare and prestige of the Society become more and more dependent upon its secretary.

THE CRYSTAL PALACE ELECTRIC AND FISHERIES EXHIBITION.

The Electrical Exhibition at Paris continued late into the autumn of 1881, and scarcely was it closed before active preparations were made for that at the Crystal Palace. From midwinter to early summer exhibitors were busy, and during that time many were called away to Munich to maintain their claims to precedence in Germany. And now, again, almost before they have fairly returned, the Crystal Palace Company urges them to repeat the show that last winter proved so remunerative to the shareholders, and so attractive to the public. But there is a limit even to the patience of inventors and to the claims of electricians, and consequently to most of the leading companies are not represented at the Palace. Some, as Siemens, have already appeared since the spring; several millions of pounds sterling have found their way from the pockets of the public into those of patentees, and of their friends the promoters, and systems of electric illumination, which then had little beyond their merits, or the eloquence of their partisans, to recommend them, are now upheld by rich corporations. Those reasons of themselves would be sufficient to account for the absence of many of last year's exhibitors, but there is a still more powerful one to be found in the operation of the Electric Lighting Act, which has evoked a host of applications for Provisional Orders, and all those interests that are devoted to do business on a large scale, have their attention set upon schemes which they hope will prove more profitable than instructing the public. To make up the deficiency in the electrical part of the exhibition, and to stimulate the feeling of competition that always attracts the public, recourse has been had to gas; the Palace has been equally divided between the two illuminants, and a fair field offered to each in which to vie with its rival. The unsatisfactory of gas lighting apparatus have responded warmly to the challenge, and all the well-known firms have already commenced their coatings with an energy that should command success. The south nave and its precincts, which is the area allotted to gas, is a blaze of light, every notest burner, and some that have only lately been brought before the public, being represented. The north nave on the other hand is, for the present, almost dark, and although the catalogue presents a very respectable list of firms who are eventually to join in its illumination, most of them have yet failed to give any sign of their presence.

Deferring our notes of the electrical exhibits until they shall be more complete, we shall confine our remarks this week to the older and more successful competitor, gas, and shall begin our examination at the junction of the south nave with the centre transept, where we enter one of the areas lighted by the Siemens Patent Gas Company. It is but little more than two months since we illustrated and described the new regenerative gas burners of Mr. Frederic Siemens (see page 328 of the present volume), it will be needless to do more than recall to the minds of our readers the fact that they depend for their action upon the temperature of the gas not being raised, while on their way to the point of combustion, but upon an intense heat being maintained in the neighborhood of the flame. During combustion the hydrogen, carbonic oxide and unconverted hydrogen in the gas are consumed without giving light. The hydro-carbons, however, under the high



temperature, not from a portion of their carbon, which is raised to a brilliant incandescence, and affords the illuminating power. As the temperature increases so does the brilliancy of the flame, which at 2050 deg. Fahr. assumes a very white hue, and the lowest cost of the light. The rate of consumption at which we have referred, shows that the power of the lamps varies from 5.5 to 7.2 cubic feet per cubic foot of gas burnt per hour. There are 1000 burners suspended in the south nave, each consuming 85 to 90 cubic feet of gas per hour, and each giving a light of about 600 candles. The cost of their gas per hour, at 3s. per 1000 ft., is 3d. each, or 4s. for the whole of them. The roof of the concert room is lighted by three lights of a similar size, and also by five smaller lamps, each consuming 50 cubic feet per hour, and giving 330 candles light. The hourly cost of the latter is 1.5d. each. Those who have not seen the Siemens burner since it was shown at the Smoke Abatement Exhibition, will notice with pleasure the great improvement that has been made in its appearance by the removal of the two unsightly side flues by which it was formerly discovered. The chimney, instead of being bifurcated and led outwardly to the lower part of the burner, is now carried down in its centre, and, as its diameter is considerably reduced a short distance above the flame, the lower portion is scarcely noticeable. Of course this does not remove the old objection that a massive body of the burner is of considerably larger diameter than the annular flame, and that consequently there is a large area of floor space below the lamp that is only lighted by reflection from the under side of the cornice.

In close proximity to the Siemens Company are Messrs. Williams Sugg and Co., Limited, who maintain their reputation and continue their enthusiastic advocacy of the cause of gas by the largest and most complete display in the Palace. At the north end of their stand they show a four-ring argand lamp, said to give a light equal to 1000 candles. It is mounted upon a pillar and enclosed within a large lantern of noticeable design. The burner does not greatly differ from Mr. Sugg's former multiple regenels, except that the outer ring is placed nearer to the enclosing case of perforated brass than is usual, so that part of the heat is conducted downwards, and transmitted to the air that enters through the fine holes. The metal chimney descends to within a short distance from the top of the flame, and is bell-mouthed; this has the effect of causing the flames to converge at their upper ends, and form a solid mass. Along each side of the nave there are suspended ten of Sugg's flat flame batswing burners. In each there is a central gas pipe from which there branch a number of subsidiary pipes, each terminating in a burner. These are arranged in three concentric circles, and when unlighted the whole presents a cluster of gas blusos to a carefully trained flowering shrub, with a flower at the end of each stalk. The combustion is rendered the more striking by each burner being provided with one of Mr. Sugg's new governors, which, of course, considerably increases its size.

Several forms of measuring and testing apparatus are exhibited, among which is Professor Vernon Harcourt's pentane photometrical apparatus. In this it is sought to obtain the usual standard candle by a more reliable gaseous illuminant, produced by the dilution of a known weight of pentane, a highly volatile hydro-carbon, in a measured body of air contained in a gas holder. The carburetted air thus prepared be burnt at a given rate, due corrections being made for the temperature and barometric pressure, a light is obtained that is constant, and that can always be reproduced without uncertainty. In addition to these there is shown Sugg's improved photometer, and also his portable photometer for testing electric and other large lights when in use or out of doors. The latter is exceedingly simple, and is formed on the well-known plan of reducing the intensity of the rays from the source to be tested, and one from a standard lamp, on to a ground glass screen, by the inverse squared law's box on wheels, which can be moved down the street until a balance is found between the two circles of light are of equal brilliancy. By measuring the distance of the lamps from the screen the candle-power is readily calculated. Besides photometers, Sugg also shows his self-registering and other gauges, experimental burners, ventilating lights, Christian's governor burners, a variety of elegant fittings, all burners, and a great variety of *bijouterie*, some of which are well known to *Engineering* readers.

Next in order comes the stand of *Messrs. Henry Greene and Son*, whose exhibits are confined chiefly to chandeliers and fittings. They have, however, constructed a gas fire for a hydraulic gas two novelties; the first is the usual diaphragm or floating governor is replaced by a bellows that constantly fills the valve, is replaced by a bellows that constantly fills and empties the bellows, and in so doing figures accompanying the notice by which the gas pressure is regulated. The first shows the valve which commands the inlet to the bellows, and the pipes which communicate with the gas pipes from which an exceedingly simple form of governor is constructed. The second illustrates the governor gas burner, and is described in detail in Messrs. Greene and Son's pamphlet on the subject. The first consists of an ordinary argand chimney, or cylinder, of glass, but within a second chimney, or cylinder, of the same form, of larger diameter, but shorter in length. The space between the two is filled with air by the outer chimney descends to the bottom by a circular burner, and is then carried to support the inner chimney. The air thus drawn there through a mass of narrowly glass tubes before it can reach the combustion two glasses before it can reach the between the two is thereby heated, and thus rendered less dense. In passing it becomes greatly heated, and

Engineering, June 16, 1882.

ELECTRIC EXHIBITION AT KÖNIGSBERG.

It will be new to the greater number of our readers to learn that an electric exhibition has been open at Königsberg, in Prussia, since the end of April. It was projected with the view of giving to the population of a large district, separated by many considerable distances from the central and more favoured parts of the kingdom and empire, an opportunity of becoming familiar with a subject of which, under other circumstances, they must have remained ignorant, as they are but little accustomed to travel. Königsberg, a strongly fortified and university town of 123,000 inhabitants, stands on the Pregel, which goes to the Frische Haff, one of the bays of the Baltic; it is the capital of the province of East Prussia, which has plenty of lakes and forests, but, if we except the coasts and the rich and fertile districts of the Vistula delta, a sterile soil, and a scanty, poor population.

The nearest large town, Dantzic, is 130 miles distant, while Berlin is more than 300 miles. To the south there is Poland, with its single important and capital town of Warsaw, at 160 miles distance; and on the coast there are those parts of Russia which have a strong German element. To start an electric exhibition at Königsberg is no less an undertaking than similar perhaps in the case of Aberdeen. But such an exhibition may serve the interests of both the public and the manufacturer just as well as some of those which have taken place in more important towns. There was no Crystal Palace available at Königsberg; but suitable accommodation has been obtained in the public gardens belonging to the town. A fine Renaissance building has been erected and tastefully furnished to show the various appliances of electricity for its different purposes, and most of the fourteen groups into which the exhibits are divided, have been entertained in special pavilions. The historical and educational group occupies, besides others, the very valuable collections of scientific and technical instruments of the university and various institutions of Königsberg; one section has been assigned to the medical group; further, a very instructive and complete reading-room has been established, to which nearly fifty of the leading publishing firms of Germany have contributed copies of their respective works and periodicals. Batteries, &c., have been supplied by eighteen exhibitors; telegraph apparatus by various firms and the Eastern Railway, which is under Government management, like most of the important German lines; there are more than forty persons employed as light-meclinists, besides a number of others for electro-plating; for these, fifteen steam and three gas motors are at work, and there is an several hand dynamos. To illustrate the illumination of ships, a ship's skeleton 200 ft. in length by 60 ft. in width has been erected. There is telephonic communion with the Königsberg opera, an electric railway, and of course no lack of refreshment rooms. The apparatus which, with the help of the electric light, is to illustrate the diving opera, is under the direction of Mr. Siemens, and consists of a number of hermetically tight or smaller quantities all along the south and east coast of the Baltic, but mainly in the rectangular peninsula of Pomland, which on the north lands on the River Pregel, on which on the north lands on the River Pregel, on which Königsberg is situated; stretches from east to west into the Baltic between two of its bays, the Frische Haff and the Kurische Haff. The valuable coast of which it is washed by the sea, carrying it towards the shore where, especially after a rough wind from the west, there is a rough searching, and formerly the only source of this trade, which is known in most ancient times; in which, it appears the name "Electrum," it was the first object, under the production of electrical phenomena. There is no record of this manner in which it was carried to the more civilised parts of the world, but probably the Phœnicians obtained it with other products by overland trade, and that they did not, as has been asserted, send their ships all round Europe and Africa for the amber and sifting the clay in digging for the amber and sifting the clay in the sea thrown out voluntarily or by tides to the river.

Engineering, June 24, 1882.

ELECTRIC LIGHTING.

The Victoria Station, Manchester, in the joint occupation of the Lancashire and North-Western and Lancashire and Yorkshire Railway Companies, is the scene of an interesting durable installation of the electric light. From the centre of the main platform may be seen on one hand the Brockin lamps of the British Electric Light Company, and on the other hand the alternate current lamps of Messrs. Siemens Brothers, and an opportunity is thus afforded of comparing on an extended scale the merits of the two rival systems and their relative adaptability to railway illumination. The British Electric Light Company employ two B Gramme machines, driven by a 20-horse power engine, and their arrangements follow the general plan adopted by them elsewhere. Messrs. Siemens Brothers feed nine lamps from a small alternate current machine and an emitter actuated by a pair of Tangye's three horse power engines. The method of driving is, we believe, new for the purpose. In each adapted to receive a three-quarter inch discmeter rope, and in the gullyes of the alternate machine and of the exciter there are respectively three and two such grooves. A single driving rope is carried round the pulleys much in the same way, as if they were a pair of five-sheave pulley blocks, the two lower pulleys representing the lower block, and the coils of the rope being tied together. The lamps are hung from the roof by cords and counterweights, and are so suspended that the act of drawing any one of these down first short-circuits the leading wires, and then removes the lamp out of electrical communication with the machine. The arrangements in the London and North-Western Company's station have been carried out by Mr. Haworth, Messrs. Siemens Brothers representative in the North.

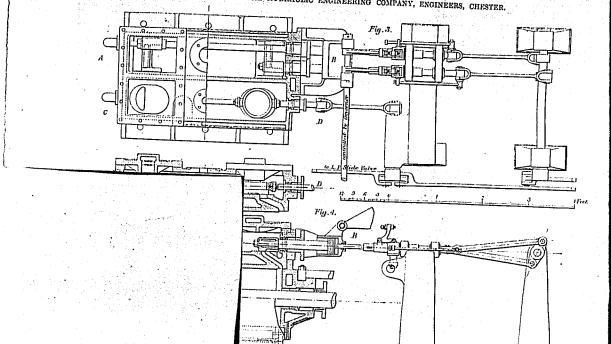
Engineering, June 30, 1882.

THE ELECTRIC LIGHT AT STAFFORD HOUSE.

The Duke of Sutherland has set a good example in adopting the electric light for the illumination of his residence in St. James's. Seven lamps on the Lane-Fox system have been installed in the grand staircase, hanging-hall, and picture gallery, with very fine effect. The lamps have been fitted to illustrating lunches fastes hours as far as possible, but additional lamps have been added, especially in the picture-gallery. There are some 250 lamps in all, for six B Gramme machines, which are excited by the current from one E Gramme machine, which would suggests of the B machines are fed in series; but the revolving rings are not coupled in multiple arc. The resistance of the external circuit, plus the lamps, is only 3.6 ohms, the lamps being connected in parallel arc, and loads having a strand conductor equivalent to a solid rod of copper 7 in. in diameter being employed. The speed of the machines is about 1900 turns per minute, and they are driven by a Marshall engine of 20 horse power nominal. All the generating apparatus is located in a shed placed in the garden to the west of the house, and skirting the Green Park. The lamps displace some 8000 candles, and cannot be injurious to either gilding or stuffs. In fact, together with the undoubted sanitary advantages of the incandescent light, cannot fail to hasten its introduction into sumptuous where assemblages are held. The Duke of Sutherland's example will doubtless soon be followed.

HYDRAULIC PUMPING ENGINE AT THE WEST DOCKS, HULL.

CONSTRUCTED BY THE HYDRAULIC ENGINEERING COMPANY, ENGINEERS, CHESTER.



ELECTRIC LIGHTING NOTES.

MESSRS. FARADAY AND SON have lately brought out two enlarged Swan lamp fittings with safety fuses for factory use. These have been applied successfully in some of the largest cotton factories in the north. Messrs. Faraday are also engaged on some special fittings for Messrs. Simons Brothers at the Perth Bridge works.

The Yorkshire Brush Electric Light and Power Supply Company, Limited, and Messrs. Furnell, Thompson, and Lee, Limited, will in the future be carried on by the Hammond Electric Light and Power Supply Company, Limited, with which the above mentioned companies are now amalgamated. Mr. Thomas Smith is their agent and representative for Yorkshire; the Yorkshire office being at 1, East Parade, Leeds.

An Industrial Exhibition was held last week at Hampstead, in Hampshire. In order to enable the exhibition to be kept open at night, Messrs. Woodhouse and Rawson instituted a temporary installation of six Pilsen arc lamps, driven by a Pilsen dynamo and dynamometer. Notwithstanding a slight contraction of the engine, the lamps burnt very well, as the Pilsen lamp carries 30, and some then 25 up to the last. Messrs. Woodhouse and Rawson also showed some of their microscopical and surgical lamps, in from a small battery, together with Clark's apparatus for lighting gas by electricity, and other novelties.

An electric lighting installation was last week started at the yard of Messrs. Swan and Hunter, Shipbuilders, Wallsend. It consists of one Crompton-Burgin dynamo machine, and six arc lamps for ordinary power each. The lamps are of the double differential type with two sets of carbons. The machine is driven by one of Marshall's six horse-power Compound engines fitted with Hartnell's automatic governing gear. The installation was carried out by Mr. Wilson Hartnell, of Neville-buildings, Leeds, who it will be remembered was also connected with the lighting at the Leeds Town Hall, which proved such a success.

The subject of electric lighting was also under consideration last week by the Dundee Gas Commissioners at their monthly meeting, a report having been submitted by the Finance Committee in reference to the "Electric Lighting and Power Company of Scotland." By the terms of an agreement entered into with the Gas Commission the company were bound to deposit a certain sum of money, and that lastly as a guarantee for the due performance of the contract to proceed with the lighting of a certain portion of the town in accordance with the terms of the provisional order obtained by the company. But the company are now liquidating, their business in Scotland having been so small and unremunerative; and on the recommendation of their Finance Committee the Gas Commission have resolved that no claim be made upon the liabilities of the company for the costs incurred in connection with the provisional order. In connection with this matter it may also be stated that public lighting under the Electric Lighting Act seems to have made no practical progress in any of the large towns throughout Scotland. The municipal authorities of Greenock have marked out a portion of the town in which they intend to provide the electric light for such of the householders within that area as may wish it; but up to the present it is their intentions, rather than their practical efforts, that have to be spoken of, the latter being still in the future.

Messrs. J. Holmes and Co., electric light engineers, of Wortington-road, Newcastle-on-Tyne, have lately completed a very satisfactory installation at a new and recently opened Wallsend-on-Tyne. The plant comprises two dynamo-electric machines driven by means of a six horse-power Tangye engine provided with a high-speed Pickering governor. The dynamos, and furnishes the requisite current for sixty Swan lamps, arranged mostly en clusters of four electric lights. Around the windows of the cafe there runs a massive tube carrying 41 intervals fifteen special brackets together with gas jets, so as such as the only morning when the machinery is not running. On the outside of the building are placed two arc lights supported by hinged brackets capable of being swung round in front of a window, for the purpose of removing the carbons, &c., without the use of ladders or bending apparatus. Arrangements are made for hanging one of the lamps when required in the concert hall, and also for using it to work a magic lantern for illustrating lectures. Amongst the novelties of this installation may be mentioned a new arrangement by which the electric current is utilised for the simultaneous lighting of the arc burners in the ceiling of the concert hall; this is done by small coils of platinum wire, the hour each burner which are rendered incandescent as the circuit being completed through them on pressing a push.

There has recently been an exhibition, at 21, Austin Friars, E.C., of a primary electric battery, invented by Mr. C. C. H. Rose, and offered for sale as an agent for electric illumination of all kinds. The two electrodes are zinc and copper; the former is surrounded by an acidulated solution of common salt, and the latter by a depolarising solution, the nature of which is kept secret. Each cell measures 15 in. by 12 in. by 4 in. outside, and contains three zinc and two carbon plates. These cells are coupled in series to obtain the necessary electromotive force for driving the lamps, according as they are designed to be fed with currents of 30, 45, 60, and 100 volts. The electromotive force of each cell is slightly under two volts, so that for 100 volt lamps there are required about 49 cells, so owing to their internal resistance, the difference of potential at the terminals falls below the theoretical amount. Of course the discharge of the battery vary with the number of lamps to be fed, as in the case of the arm mentioned above being capable of supplying about 20 lamps of 20-candle power. If the lamps be increased, larger cells must be used, or two cells be coupled parallel. It is stated that the Rose battery has a large working capacity, remaining constantly below the maximum for 12 hours, without sensible falling off in the intensity of the current, and then all that is required is that a small portion of the depolarising liquid should be added to the cells and the cells filled up with an equal quantity of fresh solution. Mechanical arrangements are provided whereby this can be done with ease and rapidity. The inventor affirms that the working expenses of his battery do not exceeds per electrical horse-power per hour, or rather less than one halfpenny per hour for 2 hours of lamps.

Hitherto the question of dealing with electric lighting matters in Glasgow by the public authorities has been left very much in the hands of the Corporation Gas Committee, but there are indications now that such matters will henceforth be relegated to the care of the Town Council proper, or to the care of that body in the capacity of Police Board. Referring to that subject at last week's meeting of the Town Council, Bailie Richmond remarked that the question of electric lighting for the city was a very important one, and one that would force itself upon them, whether they were willing to carry it out or not. His opinion was that they ought to have an independent committee of the Town Council. Mr. W. R. W. Smith said he would support Bailie Richmond in the remarks in that direction, as he was perfectly certain that the electric lighting question could not possibly be fairly considered in the Gas Committee. Electric lighting was a question by itself, and one requiring special knowledge. Bailie Richmond stated that he was quite prepared to move for a committee, but in the first place he wished to have an indication of the Lord Provost's opinion on that point. Dr. Marwick then spoke, replied by saying that the question to be decided there was whether they were to carry the matter to the hands of the Gas Committee, or whether it should be taken out of their hands and dealt with separately. He was to be taken out of the hands of the Gas Committee, it must be dealt with not by the Town Council, but by the Police Board, under the Act of Parliament. He would not like to say definitely what course should be adopted until he had had an opportunity of looking more fully into the matter, and therefore he suggested that it should be delayed in the mean time. Bailie Richmond then gave notice that he would bring up the matter again on the 7th proximo. Dr. Marwick had given his opinion.

An interesting action at law connected with electric lighting has lately been tried in the Court of Session at Edinburgh before Lord M'Laren, when a case was raised by Mr. A. H. Dodgson, London, against Mr. Wm. C. Main, of Inistrynich, Argyllshire, to recover payment of the sum of 2100, 10s. in respect of the Dodgson apparatus for lighting Inistrynich House by electricity. The pursuer had furnished defendant with an estimate for the apparatus and placed between the parties at a price not exceeding 2237. The pursuer supplied the apparatus and performed the necessary work, which, it was alleged, was completed by the 15th September 1882. The account amounting to 2100. 12s., payment of which was refused by the defender, and in consequence the action was raised. The defender averred that the work was not taken by the pursuer but not yet been completed; that the work hitherto executed by the pursuer had not effected the intended purpose; and that in point of fact his house was not yet lighted by means of electricity. The pursuer averred that if the apparatus was now lighted, the inefficiency was owing to the defender having discouraged the lighting, and interfered with and damaged a part of its work. Proof was led some time ago, and after judgment, Lord M'Laren decided against the defender for the sum sued for and expenses. His lordship said it was a matter of public notoriety, at the time when the contract was entered into, that the lighting by means of electricity was in an experimental stage. Mistakes in the execution of such a contract were almost unavoidable, and therefore excusable. The defender found fault with the lamps, but it had been proved that they had been obtained from the eminent firm of Siemens, and not procurred there, and it was difficult to see how the pursuer could fulfil his engagement, except by applying to the best manufacturers in the trade. The system would have worked well had it not been that the dynamo machine was, for some reason or other, not driven at a uniform rate of speed. He was of opinion that the pursuer's work was scientifically correct, and well executed.

Science N. Y. July 1883.

THE EDISON LIGHT.

A gas lighting and sanitary journal published in London asserts that Mr. Edison has thrown up his electric light researches, and left for California, and suggests that there is now a fair field to those disposed to try their hand in this direction.

Possible the *"wish"* was father to the *"thought"* with the promoters of this journal, when they printed this atrocious statement, which is not only false but malicious.

In this country a contradiction of such a *"canard"* is, of course, unnecessary. Mr. Edison has ceased to notice attacks of this nature, and possibly in his retirement at Menlo Park, and with every moment occupied on his important work, he may not even know of them. Warned by experience of the misinterpretation placed upon his willingness to permit the public to witness the gradual progress he was making with his carbon-electric lamp, he has of late discouraged the continued reporting of his movements, but within a very few weeks a whole section of Menlo Park will be illuminated by means of his carbon-electric light, equal in extent to one of those districts which will be afterwards established in New York City if success is achieved.

When the arrangements are completed the question of the success or non-success of Mr. Edison's system of electric lighting will be removed from the arena of experimental demonstrations. Here will be an exhibition on a full-sized scale, which must be decisive, as accurate calculations can be made, and every point determined down to the smallest detail.

This will be Edison's answer to all the unscrupulous arguments and scientific hair-splitting which has been of late, with such persistency, carefully disseminated to his disadvantage. Taking the view that it is a waste of time to argue theoretically, on that which can be demonstrated practically, Edison, through all this struggle has been silent, but not idle; while others *talked*, he has *worked*, and in a few short weeks all will be ready, when those who are competent can see and judge for themselves.

In the mean time, during this short interval, let slander be silent. The public is becoming nauseated with the worrying cry of *"new discoveries,"* and the real men of science in this country, appreciating the true scientific course Edison has followed to solve the question, are prepared to give his results a crucial but fair investigation.

The Lyell Mechanical Mews
Ohio, July 25, 1887.

THE MARCH OF THE ELECTRIC LIGHT.

DISAPPOINTMENT has sometimes been expressed by impatient or over-sanguine persons, at what appears to them the slow development of the new method of illumination. There are numbers of people who expected lone before this to see the gas-jet ignominiously turned off in every house, the street lamp-posts degraded to newspapers for loiter-boxes, and the gas companies overwhelmed with ruin, or proclaiming a miserable existence here and there on an unexpected and limited scale. So rapid is the spread of information in these days, so quickly is every new idea seized upon, analysed and applied by thousands of busy hands and brains, that no sooner is an improvement or discovery of any kind announced than we look at once for its perfect success and universal adoption. In former times people disbelieved and waited, and at last were slowly and reluctantly convinced. Now we have gone to the opposite extreme, and fallen into the habit, to use a commercial term, of discounting at once every promise of scientists and inventors. The wonderful facilities we enjoy have bred a corresponding impatience. Flying across the country at the rate of thirty miles an hour, we grumble because it is not forty or fifty. It is not very long since the telephone became a thing of daily use in our large towns, and we speak of it with the unfortunate instrument gets an exasperated twitch if the business which last year would have taken half a day can not be transacted in two minutes.

The electric light is surely coming; but Nature does not part with all the details of a valuable secret at once. There must be many trials, repeated experiments, modifications and adaptations before the new agent will be fully conformed to the necessities of the case. With certain uses of the new light the public is already familiar. Its power and effect in the illumination of large spaces are sufficiently proved, and have been witnessed by multitudes in London, New York and Cleveland, at Niagara Falls and many other places. The city of Akron, Ohio, has tried the experiment of lighting its whole area from lofty towers or "masts," and the result is reported as highly satisfactory. Many large breaches in different parts of the country, chiefly those of manufacturing establishments, have for some time been illuminated by electricity. Among the most recently recorded indications of progress is the introduction by Mr. Edison of his "tubular electric light," in a house on Fifth avenue, New York City. The experiment seems to have been a remarkable success. The New York Sun says that "a more brilliant and a steadier light could not be desired. There is none of the flicker so frequently observed in some of the electric lights, and which also characterizes gas-light; but the incandescent horse-shoes glow with a quiet and steady intensity. The electric current is turned on and off, like gas, and the instant pressure is put in upon the carbon it becomes brilliant. No more convenient light, therefore, could be had. No match is required to ignite it. It is clean, odorless and almost without heat. The hand may be pressed against the glass bulbs, inside of which the light glows, without discomfort."

Of the comparative merits of the several systems of electric illumination—notably the Brush, the Weston, the Edison and the Jablochoff methods, so named from their respective inventors—the world has yet to remain open to conviction. Three different systems were recently tried on a large scale in London, but the conclusions reached are not yet fully known, though the practical value of the light is said to have been clearly demonstrated. An objection which has often been made to it, namely, that its intense brilliancy is trying and hurtful to the eyes, is believed to have been removed by the latest modifications of the current, and the suggestion has been made, with much apparent reason, that if people were to gaze at any other light, whether at a gas-jet or a coal-oil lamp, with the same fixed stare which curiously leads them to direct at the electric light, they would find the effect scarcely less injurious.

We have abundant faith that the problem of the electric light, both for public and household use, will be worked out. The man who said a year ago, "The days of the gas companies are numbered," may have been prematurely wise. The first feeble attempt to operate a railroad did not at once bring all the owners of stage coach lines upon public charity, and we doubt not the holders of gas stock will find in some way an equally gradual and happy release. So great a blessing to mankind as a perfect illuminating agent can not be doomed to failure on the very eve of success. Not to reach the goal so nearly won would be as if Columbus, when in sight of land, had turned back unbelievingly from the New World, and no brother navigator had ever completed his work and redeemed his failure.

BLEACHING BY THE ELECTRIC LIGHT.

A process has been devised for bleaching blood albumen by means of the electric light. The albumen is taken after separation, and either before or after drying. It is then exposed to the light. The inventor arranged electric lights fitted with lenses or reflectors, so as to cast their light upon the albumen which is to be bleached. If it is still liquid the light is thrown upon the plates or trays which contain it in the drying stove. These plates may be made of glass, so as to let the rays pass through them. If the albumen is dry the light can be thrown upon layers of the article arranged upon the stage. In either case the process varies in duration, according as the albumen has been more or less completely separated from the clot. Under ordinary circumstances twenty-four hours will suffice to bring about a perfect decolorization. For more efficacy the electric light may be brought into action at the beginning of the process, when the clot and the albumen are being separated.

vested interests, the great railway companies, are required.

Last year there was some indication that Parliamentary Committees were inclined to view with approval the claims of independent companies to establish themselves in districts hitherto ruled over supremely by great companies, and in view of this these latter put forth all their strength, and much money in defense of their monopolistic rights, to crush the invaders of their monopolies. The Bill for the Barnsley Railway was enabled to triumph over the opposition, supported as it was by nearly all the eminent engineers of the day. In the same session, Newbury, and Southampton schemes was passed. This was, for the most part, only a revival of a railway the Act for which was obtained in 1873, with certain additions that converted it into a practical and valuable scheme, but which mixed up a determined opposition, led by Sir Edmund Beckett and supported by Mr. W. H. Barlow, then president of the Institution of Civil Engineers, on the part of the London and South-Western Railway Company, into whose domain it was supposed to intrude. Again, the Liverpool and Birkenhead Railway Company was enabled to obtain an Act for their incorporation in spite of the efforts of the Mersey Railway Company, which had been, during fifteen useless years, in Parliamentary progress of the locality.

When the results of similar applications in former sessions are recalled, this change in the views of Parliamentary Committees is brought into striking relief. For example, some twenty years ago an independent line, then called the Doncaster and Wakefield Railway, was promoted to supply an important link in the communication between Leeds, Bradford, and London. This was brought forwards for two or three sessions but finally was authorized under the name of the West Riding and Grimsby Railway in 1862. Five years later this line gave up its independence, and became the joint property of the Great Northern and Manchester, Sheffield, and Lincolnshire Railways.

Perhaps the last state of this line found some influence in the deliberations of committees, when in later years had to consider application for new lines of an aggressive character, for there were many notable instances of the success of schemes either starting under joint auspices or adopting a hybrid state in their course through Parliament.

Such was the case with the Manchester and Liverpool joint line of the Manchester and Sheffield and Lincolnshire, Midland, and Great Northern Railways, with the Leicestershire lines of the Great Northern and London and North-Western Railways which were granted in 1871, though the latter has since blended itself with that of a scheme by the Midland, rejected in the preceding session. The most notable instances, however, was probably that of the amalgamation of the rival schemes of the Great Northern and Great Eastern Companies in Lincolnshire in the session of 1873, as well as making Acts for long lengths of line at either end of those specially sanctioned in that session.

To return to the present session and its peculiar feature, the scores of Bills for railways indepen dently promoted.

The passing by the Commons' Committee of the independent line between Uxbridge and Rickmansworth, and the rejection of the Great Western scheme for the same route has been referred to already (see page 491). What the fate of the one survivor will be when it comes before the Lords, is of course uncertain, though the chances appear to be in favour. The Swindon and Cheltenham Railway, which was successfully and powerfully opposed by the Great Western Railway Company, has nevertheless gained a signal victory, and the future proceedings of this line will present an interesting study. It is a struggle for complete independence from an Act of Parliament to a completed line successful, it is to be hoped, in working and satisfactory in its accommodation. The two rival schemes for the accommodation of the district between Ballymena and Belfast, promoted, one by a narrow gauge independent company, and the other by the Belfast and Northern Counties Railway, have met with an uncommon reception in the Lords; the preambles of both Bills have been proved. Some modification will, of course, have to be made, as the construction of two lines to accommodate the same comparatively unimportant district is highly improbable. Belfast has been quite a centre of interest in a small way this session, for not only have the promoters been successful in the case of the Bills just mentioned, but the preambles of the Belfast Strand Town and Holywood Railway has been passed by the same committee. This line will provide accommodation for a large residential district on the south side of Belfast, at present only imperfectly served by the Belfast, Holywood, and Donager Railway, which pursues its course at a low level along the shore of Belfast Lough; it was constructed almost thirty years ago, and is alleged to be insufficient for the traffic and awkward of access. Application had been made unsuccessfully in previous sessions for powers to construct this line.

The Lords have also passed the preambles of the Seacombe, Hoylake, and Deeside Railway, a line which has for its object the conversion of the residential district served by the Hoylake Railway with Seacombe, and by means of the ferries from that point to join with Liverpool. The Hoylake Railway extends across the northern end of the peninsula between the Mersey and the Dee, from the western end of Wallasey Pool to Hoylake; from Wallasey Pool to Woodside there is a transway, but on account of the many breaks in the short journey between Liverpool and Hoylake via Woodside ferry, it has proved unsuccessful.

The great fight between the promoters of the Guildford, Kingston, and London and the London and South-Western Railways for power to make new lines in Surrey has ended in a compromise, under which the line from Fulham to Surbiton is to be joint property of the two companies, and the railways traversing the remainder of the county in dispute are to be in the hands of the South-Western Company. This will no doubt be satisfactory to the district Council, who are supporting the Bill for the Guildford, Kingston, and London line, over the proposed railways in the richest and probably the only part of the district it will open, and to many of the chief wants of the inhabitants of Surbiton, who are the most numerous and influential supporters of the Guildford line. On the other hand, the London and South-Western Railway Company may congratulate themselves upon having restricted their opponents to the confines of their territory and probably prevented in anticipation the success of any future schemes which may attempt to cross their lines into the heart of Surrey. The people of Guildford are hardly satisfied with this arrangement, however, which, though it gives them access to London in a certain quarter, hardly relieves them of the grievances they complained of.

The preamble of the Oxford and Greenbridge Railway was shorn of some of its importance in passing through the Commons' six running powers sought for to give access to London Bridge and Victoria Stations were denied, being only granted to Croydon and Tunbridge Wells; in other words, only restricted access has been given to the main lines of the London, Brighton, and South Coast system.

MAXIM'S ELECTRIC LIGHT.

THE incandescent system of electric lighting, invented by Mr. Hiram Maxim, of New York, has recently been introduced into London by Mr. N. de Kalinin, and is now being exhibited every evening at the Albany Works, 374, Euston-road. In point of steadiness and beauty it is one of the best incandescent lights yet made public.

The Maxim-Weston dynamo-electric generator resembles in external appearance, and somewhat in its internal construction, the distributor and the exciter. The exciter is a small machine for supplying the current to the electro-magnets of the distributor, and runs at about 800 revolutions per minute. The distributor which generates the working current is really a combination of two machines on the same base, and these can be joined up together so as to unite their currents in tension or in quantity. This machine runs at about 900 revolutions per minute, and many of its details are of a novel kind. This generator is known as Maxim's No. 20, and yields a single-arm light of 20,000 candles. Under the incandescent system, however, its total lighting power is considerably reduced. It is claimed to supply 85 Maxim lights of 25 candle power each, making an aggregate of 2125 candles, or 25 Maxim lights at 170 candle power each, amounting to

Of the smallness of the incandescent light over that of the arc has long been understood, but hitherto the cost of the one has been so great that practically it was out of the question for general use. This will account for the little progress made by the Werdermann light. The cost is due principally to the consumption of carbon. Again, it is well known that the consumption of carbon, in an atmosphere containing no oxygen, or in a vacuum, is reduced to a minimum. Many inventors have tried to reduce this to practice in order to produce a light which can be easily, and without much knowledge, used by surrounding the lamp with water Mr. Broughton has solved one of the problems of the incandescence lamp. The oxygen originally in the lamp globe is quickly exhausted, and then the atmosphere consists of gases which do not combine with carbon, and the result is very slow combustion or disintegration. The water-light joints have been obtained in the manner above indicated, the globe is partially filled with water, so that when placed over the lamp globe, the water is well over the cap. This water globe is fastened by means of clamps and screws. The inventor states that while the carbon burns away at the rate of six inches per hour in the open air, it burns only one-eighth of an inch per hour when in the water-covered globe. This shows an enormous saving in the cost of carbon, and if it can be shown that the saving thus obtained is greater than the cost of the extra power absorbed by the incandescent lamp over that of the arc, a decided step will have been made towards furnishing a light that can without difficulty be applied to ordinary street rooms. We have seen this lamp, and can testify as to its steady light.

So long as the liquid in the vessel is above the cap of the lamp the atmospheric air cannot enter the lamp globe, and the same atmosphere of gases is constantly carried off or dispersed and the light diffused. Provision is also made for the removal and revivifying of the liquid in or last causing it to circulate, but we are of the opinion that the preceding plan will prove more satisfactory as it is, than any addition to the apparatus can make it. We made inquiries as to the liability of the copper wedge to melt, but its size and its connection with so large and such good conductors removes all uneasiness in this direction.—*Electrician.*

A new form of electric lamp has been invented by Mr. Charles Stewart, M.A. It consists of a number of square carbon rods placed radially upon a disc of wood, or metal, in such a manner that the inner ends of the carbon rods form a complete circle. There is a circular opening in the wooden disc through which the electric light is seen from underneath. The carbons which are all forced toward the centre by a uniform pressure, move forward as they are consumed, and together form the positive electrode of the lamp. The negative electrode consists of a covered metallic physical cup of copper which before the current enters the lamp, rests upon the ring formed by the carbons. On the current entering the lamp an electro-magnet raises the negative electrode sufficiently to form a small arc between the circle of carbons and the metal electrode, the intervening space of water through the latter to keep it cool. The inventor claims for his lamp the following advantages. (1). It is automatic in its action. (2). Burns for a considerable period. (3). Throws no shadow. (4). Simple and inexpensive in structure. (5). The intensity of the light may be increased if desired.

ELECTRIC LIGHT.—The *Miller* has received from one of its correspondents particulars of the lighting of a flour-mill by electricity. The firm in question gave the order to put forty incandescent lights throughout their mills, and within three weeks from the date of order the lights were at work. The apparatus consists of a dynamo machine for working forty incandescent lamps of 16-candle power each, which are distributed about the various floors as required, and controlled with switches for turning them "on" and "off" at pleasure. From the start everything went on smoothly. During the first month a few lamps were broken, but since, on becoming more used to working the dynamo brushes, &c., the breakage is, on an average, two lamps per month. The lights have been now running for about 2,000 hours, and many of the lamps, which have been burning from the commencement, are apparently as good as ever. The dynamo, which requires about four-horse power, is driven from the mill engine, and needs scarcely any attention. The owners of the mill consider the electric light is much cheaper than gas, and certainly preferable as a means for lighting flour-mills. The lights are required for about 3,000 hours during the course of the year, and the following is an estimate of the relative cost of the two systems :—

ELECTRIC LIGHT.

The cost of fitting up the plant, about.....	£120 0 0
Five per cent. interest on outlay	£6 10 0
Ten per cent. depreciation of plant, &c.....	12 0 0
Renewal of lamps, 80 at 5s. each (much beyond what is actually required)	20 0 0
Oil, brushes, and sundries	3 0 0
	£43 0 0

GAS.

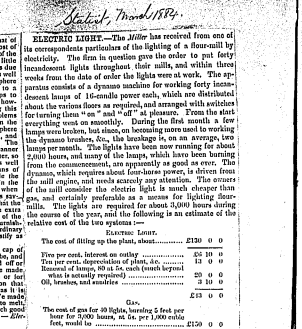
The cost of gas for 10 lights, burning 5 feet per hour for 3,000 hours, at 6s. per 1,000 cubic feet, would be £150 0 0

This leaves a balance of £107 to pay for the extra coals which may be required to generate the extra engine power necessary. It will be seen, writes the firm, that where the existing engine power can be used, the electric light is very much the cheapest method of lighting, and it has also many other advantages over gas—no heat or smell in the mill, no matches, and, as far as we can judge, perfect safety in its use and freedom from chance of fire.

THE GULCHER SYSTEM OF ELECTRIC LIGHTING.

Mr. J. G. Gulcher, of Blois, in Gallicia, is the author of a system of electric lighting, comprising a generator, a special form of lamp, and a mode of installation, which is being brought somewhat prominently under notice at the present time, and has been for some months past in actual use at the works of Messrs. A. Bateman and Co., King's-road, Chelsea. The dynamo-electric generator, illustrated by Fig. 1 on this page, is arranged with eight field magnets placed in two groups of four around a circle, four end of each being bolted to the frame, as shown, and the other ends established opposite each other. Each opposite pair of field magnets is provided with a wedge-shaped pole piece, the wider edge of which is curved, and the two are connected by a curved top plate, in the way the four pairs of magnets are coupled together, so that their pole pieces form four trough-like recesses or circle, within which the armature revolves. This is a flat ring made of iron wire, wound within the usual manner, and something like a Gramme armature, but they are not analogous, the core being separated between each coil. From the drawing it will be seen that the coils on the armature are brought within the magnetic field not only at their periphery but at its sides, so as to reduce the amount of idle coil as far as possible. A peculiar feature in the machine is that the field magnets are wound with a copper rope formed of a double strand of thick wire.

The Gülcher electric lamp, which possesses several ingenious and highly practical details, attracted much attention at the Paris Electrical Exhibition last year by the steadiness of its light. Although it does not belong to the class devoid of regulating mechanism, such as the Sedgfield, Werdermann, and others, it has no clockwork, and therefore may be used only to great advantage where necessary. It will be seen, writes the firm, that where the existing engine power can be used, the electric light is very much the cheapest method of lighting, and it has also many other advantages over gas—no heat or smell in the mill, no matches, and, as far as we can judge, perfect safety in its use and freedom from chance of fire.



thereby causing the electro-magnet to turn on the trunnions of the ring B. By this movement the lever-holder H is necessarily lifted because of the contact with the curved face of the armature A. This motion brings her smaller and more uniform than could be imparted by a rack and pinion; the two carbons are separated, and the voltaic arc produced. As the carbons burn away, and the distance between them becomes greater, the resistance increases, and consequently the strength of the current diminishes, and the piece J¹⁰ of the armature becomes further removed from the field magnets. As the carbon points approach each other, and the current continues to move on its course, the piece J¹⁰ of the armature J⁹ is arrested by the stop M, and the position of which has been carefully adjusted. As soon as this condition has been established, the magnet G has no further movement, the carbons continue to burn until they are at that distance apart corresponding to the greatest intensity of light. As soon however as further consumption increases the distance, the attracting power of the magnet G becomes too small to enable its armature to hold the bar C carrying the upper carbon, and this bar begins to slide down, until the carbons are brought nearer together, and the power of the magnet is increased so that it again holds the bar H and prevents it slipping further. If this bar continued to fall, the power of the magnet would increase until the armature J⁹ would be drawn down to the piece of iron M and the preliminary process of lighting would be repeated. In practice, however, it is found that after the lamp has been started it remains constantly stationary, the consumption of the carbons and the wear of the points being just sufficient through the intermittent motion of the magnet to secure the automatic working of the lamp. The fact of the armature J and the rod H are covered with thin tubes to diminish the retentive power of the magnet and to facilitate the sliding of the latter. The carbon-holder carrier is by a simple device that makes the action of the regulator much more sure and checks irregularity in the light. The block of iron L attached to the spring G, and acting as a stop to the armature, is covered with thin tubes as are also the armature J¹. This block serves as a brake and prevents the vibration of the electro-magnet when the lamp is started, and secures a soft and easy movement. As shown in the drawing, carbon-holders are made movable, so that the positive carbon may be kept unaltered. Another method of securing the necessary motion is shown in the drawing, where threads D, D¹—the former to the upper, and the latter to the lower carbon-holder—are wound round the drum N, both being actuated by the movement of the rod H.

Such is the construction of the Gülcher lamp; it now remains to be seen how the peculiarities of its arrangement render it suitable for being used in groups, in the same circuit, and how an economical distribution of the current is secured. The first and second of the regulator of the third, and so on. This regulating action depends on the positive motion of the electro-magnet G, upon the quantity of current passing through the circuit. To take first the simple case of two lamps put in parallel circuit with the generator. If a lamp be first lighted by connecting the branch wire from the terminal of the electro-magnet to the main conductor from the positive pole of the generator, the light will established itself as has been already described, then if the connection with lamp 2 be completed the current is divided, and lamp 2 is lighted. At first the part of the current which passes through lamp 2 is stronger than that passing through lamp 1, because the carbon points of the latter are in contact, and the resistance is less. The result of this inequality is that the electro-magnet of lamp 2 is set in motion, the carbons are separated, and the resistance is increased, at the same time that this takes place, the current passing through lamp 1 is strengthened, and the carbons are brought nearer together. A closer inquiry From this it will be seen that if in either lamp the carbons become too far separated, the increased strength of current in the other will tend through the action of the magnet to draw down its carbon-holder, increase the distance between the points, and so weaken the current in the first-named lamp, that the magnet will cease to maintain the carbon-holder, which will allow it to fall till equilibrium is established, or the same process is reversed, and so on, one lamp regulating the other, and consequently itself. With three lamps in parallel circuit as shown in Fig. 3, the same processes take place; when all three are lighted, lamp 1 regulates lamp 2 and 3, lamp 2 regulates 1 and 3, and lamp 3 regulates 1 and 2.

No. 3 regulates 1 and 2, and No. 3 regulates 1 and 2.

Mr. Gülcher claims in his patent specification that these lamps, when constructed of special mechanisms can be used for the division of the electric light by means of a single arrangement in parallel circuits. The advantages of a good arrangement of parallel circuits, and the application in connection with it of strong quantity regulators (in opposition to the division of the electric light hitherto attained by currents of high tension and differential lamps placed one after another) of great importance, and consist essentially in the following: That the electric light produced by this process is thoroughly white (without the violet or bluish tints in light produced by currents of high tension); that the number of lamps which can be fed by a single source of electricity is nearly unlimited; that the power used by the dynamo-electric machine is proportional to the number of lamps which are in use, thus are fed by it; that greater number) can be provided for by one and the same machine; and finally, the lamps can be attended to whilst at work without any danger, and even the current with recovered portions of the conducting wires by unprotected parts of the body is free from danger." It must be admitted that the experience gained at the Paris Electrical Exhibition, and recently at Messrs. Bateman and Co.'s, with the Gülcher lamp go far to sustain the greater portion of these claims.

The manner in which Mr. Gülcher arranges his conductors for working a number of lamps on the same circuit we reserve to the end of this article. Knowing the number of lamps to be fed and the distance of the furthest lamp from the source of power, he ascertains the cross section of the main conductor required to transmit the total current. He then constructs a cable having the same number of strands as there are lamps in the circuit, and each of such a diameter that the total cross section is equal to the required area of the principal conductor. This cable is then laid from the positive pole of the battery, one strand being branched off to the first lamp, another to the second, and so on for the whole number, till at the last lamp the final strand is connected. In the same manner the return conductor commences with one strand at the first lamp, and gradually becoming a strand at a time with each lamp returns to the negative pole of the generator with the same number of strands as left from the positive pole leaves it. Following Mr. Gülcher's explanation of the arrangement of the conductors it will be seen that each separate circuit to each lamp is of equal length, and the cross section of each conductor corresponds exactly with the strength of current flowing to it. If S be the area of the cable of conductors leaving the generator, s the area of each wire forming the cable, and n the number of lamps, as the total current is equal to the sum of the branch currents of equal strength, $S = ns$; consequently the current flowing to the $(n-1)^{th}$ lamp $= s(n-1)$, and so on. Thus in an installation of twelve lamps arranged in three rows of four, each row having $\frac{1}{3}$ branch current as $S = \frac{1}{3}s$ in this case $S = 12s$, and the cables leaving and returning to the generator are made up of twelve wires. Judging from the experience gained with the Gülcher system, it seems called upon to play an important part in electric illumination.

To conclude this notice we may give the summary of some recent trials made by Mr. Gülcher. They consist of a series of measurements of the electric current and resistance of the lamps and of the power they absorb. In these trials are also included some relating to the internal resistance and the electromotive force of the dynamo-electric generator of Mr. Gülcher which we have described above.

The first Table shows the lighting power obtained with a given intensity of current. The trials were made with a Gülcher generator feeding six large lamps on one circuit. The generator was driven at a speed of 640 revolutions a minute, and the intensity of the standard photometric lamp was exactly 1 carcel. The following ten measurements were taken, the photometric values being on the horizontal plane of the arc.

method of collecting and distributing election returns by mail gave way to the employment of special couriers; these in turn were superseded by the telegraph, and now the telephone is called into requisition to meet the demands of this fast age. Had any one asserted a few years ago, that a gubernatorial candidate could receive complete returns through the medium of the human voice, while seated in his own residence, and afterward receive the congratulation of his friends and supporters in distant sections of the State by personal conversation with them at their residence, he would have been regarded as a fit candidate for the lunatic asylum.

THE ELECTRIC LIGHT.

WORCESTER, MASS.—The electric light plant at Worcester will probably be completed by Nov. 15. When finished a local company will be organized to operate it.

PITTSBURGH, PA.—The Brush lamp has hitherto had a monopoly of electric lighting in Pittsburgh, but a movement is now on foot to organize an Edison electric light company in that city.

THE STEAMER WESTERNLAND.—The fine large, new Red Star steamer Westernland is now on her way from Antwerp to this port. The Siemens Brothers have fitted her up with their electric lights.

"FIRE RISKS IN ELECTRIC LIGHTING."—An electric light pole on Park avenue, Baltimore, took fire one day last week, it is supposed from one of the wires, and the fire department had to be called upon to extinguish the flame.

NEW CORPORATIONS.—New local electric light companies are reported as follows: The Circleville Edison Electric Illuminating Company, of Circleville, O.; capital, $25,000; and the Gem City Electric Lighting and Power Company, of Quincy, Ill.; capital, $40,000.

Overland Telephone Company was subscribed at a recen[t] meeting in that city, and the remaining $100,000 was ex[-]pected to be taken before night. The incorporators say that with the 20 per cent. to be paid in at once they wil[l] at once establish an exchange and give the public tele[-]phone service of equal if not superior value at half the charges made by the Bell Company. They say also that they have no fears of successful interference by the Bell Company, as they have already in working order, and with bona-fide subscribers, exchanges in Philadelphia, New York, Chicago, Jersey City, Richmond, Ind., and elsewhere, and a line, through which conversation is distinct, between Philadelphia and Chicago." If such exchanges are in operation in the cities named we have not heard of them.

TELEPHONE CABLES IN CLEVELAND, O.—The telephone wires in Cleveland, O., are rapidly being put into cables, and they are working well over short distances. The company is using about 4,000 feet of cable now; about 2,000 feet of that is out of the Central Exchange to the Cedar

factory had not been moved to the Relay House, and business will continue at that place until such time as Relay factory is rebuilt.

BALTIMORE, Md., Nov. 8, 1883. A. G. DAVIS, Presiden[t]

The Consolidated Electric Light Company.

To the Editor of The Electrical World:

SIR: At a meeting of the stockholders of this compa[ny] held on this day, the following gentlemen were elec[ted] trustees for the ensuing year: Edwin S. Thayer, H. Garden, Hon. William Windom, Hon. Preston B. Plu[mb], Judge James Keith, of Virginia, Albon Man, Henry D[...]ter, Horace Little, John J. Anderson, Amos Broadn[...], Jacob Hays, Hubert L. Judd and Henry T. Jenkins.

NEW YORK, Oct. 7, 1883. WILLIAM RICHARDSON, Secreta[ry]

THE TELEGRAPH.

A CONSTRUCTION MAN KILLED.—Charles Sheldon, f[or]merly of Elkton, Md., was killed in Pennsylvania a f[ew] days ago by a telegraph pole falling on him, while e[n]gaged in the construction of the Postal Telegraph Co[m]pany's line.

A BUSY RAILROAD LINE.—The main offices of the Phi[la]delphia & Reading Railroad Company are connected w[ith] its telegraph offices by pneumatic tubes. During busin[ess] hours one day recently 500 messages were passed throu[gh] these tubes.

W. U. IN THE NORTHWEST.—The Western Union Te[le]graph Company has nine gangs of men at work compl[et]ing the construction of lines along the Northern Paci[fic] from St. Paul to Portland and Puget Sound. An ad[di]tional duplex wire has been constructed from Bismar[ck] to Portland for through business. The company now h[as] two wires from Portland to Tacoma, and a second wire to be built to Seattle.

THE B. & O. WESTWARD CONNECTIONS.—On Novemb[er] 1 the Baltimore & Ohio Telegraph Company made dir[ect] connection from St. Louis to Kansas City over the lines [of] the Mutual Pacific Telegraph Company. The latter com[pany] was organized by Western business men after th[e] absorption of the Mutual Union by the Western Unio[n]. It proposes to extend its system in time west to th[e] Pacific coast. The Baltimore & Ohio has a close busine[ss] alliance with the Mutual Pacific.

"MISLAYING" MARK TWAIN'S MESSAGE.—On Saturd[ay] last Mr. S. L. Clemens (Mark Twain) expected an impo[r]tant telegram. He called for it several times at the Har[t]ford telegraph office on Saturday and also on Sunday, b[ut] received the answer each time that it had not come. O[n] Monday morning the missing dispatch turned up. It ha[d] been mislaid in the office on Saturday. ...

Chicago Morning News, June 21, 1882

GLEANINGS FROM LONDON.

The Old Town Wild Over Electric Lights—Edison's the Best Lamp—Edward Johnson—Ministerial Receptions—Garibaldi—Victoria's Daily Routine—Blanche Roosevelt—American Horses—Theatricals.

LONDON, June 8.—London has gone stark, staring mad on the subject of electric lights. Everywhere you turn there are new companies; lots of them. You can take your choice. So far as the new ones are concerned it doesn't make much difference which you pick out. Nearly all of them are frauds. The stock of the big ones was gobbled up before the ink of the officers' signatures was thoroughly dried. The greatest rush was for Edison shares. It will be pleasant to American readers to know that he stands at the head of all electricians in this country as well as at home. His company is the big thing here, at present, and its shares are so high that it isn't safe for anybody outside the Rothschild family to live on the same block with a man who holds any of 'em. Edison is going to capture some of the fattest prizes among the awards of the electrical exhibition that closed Saturday night at the crystal palace. His exhibit there was superb. Not only did he have the finest and most elaborate lamps, but his machinery for the production of electricity stood at the head. I have talked a good deal, off and on, with one of the members of the jury who are to deal out the prizes. It took a good deal of talking to get him to give away his opinions, because it would be divulging state secrets. But I have been a newspaper man long enough to talk a good deal when the subject requires conversation. So I got out of this juror a pretty fair notion of the position held in the minds of all the others by the various electric companies represented at the crystal palace. He told me that Edison and Swan had the best incandescent lamps, and that Edison's machinery was the best in the world.

EDISON'S LAMP.

The incandescent lamp, my unelectric friend, is the thing we are all going to have in our bedrooms by-and-by. It consists of a glass globe in the shape of a thimble, but larger. In this globe there is a little filament of carbon, which looks like a strand of black sewing-silk stiffly waxed, and shaped like a horse-shoe. There is nothing else in the globe. Not even air. When the electricity is turned on this little thread of carbon is intensely heated, and gives a steady yellow light. When the globe is smashed and the air gets in the carbon is consumed so quickly that it doesn't have time to set fire to anything. It could go off in a kerosene tank and do no damage. The difference between the Edison light and the Swan light is that the Edison carbon is horse-shoe shaped, and the Swan carbon is nearly round, with a loop in it. If you were to draw a heart pointing downward, with an inverted loop where the indentation occurs in the broad part of the figure, you would have the outline of a Swan carbon. This, they tell me, is inferior to the Edison pattern, because it concentrates the glitter of the light, and makes it harsher to the eye. My juror said, in talking of the different exhibits: "Swan has the delicate lamp, and Edison the durable and simple article. Any servant can handle the Edison light after two minutes' instruction. This is a quality which will help it immensely when it comes into general use." Edison has some fine ornamental chandeliers in the exhibition. One, in colors, represents a tremendous bunch of flowers, hanging from their stems. Another is a trailing vine, covered with blossoms in all colors. As the incandescent lamps burn quite as well bottom upward as any other way, and make no smoke, their utility for this kind of use will be seen at once. Edison claims that all other incandescent lamps are infringements upon his patent. There are to be some heavy lawsuits upon this point before long. If he can protect this invention in all its phases he will have a big thing, I can tell you. Maxim and Brush show together in the exhibition. That is because one has an incandescent lamp and the other an arc light, so they can utilize the same power without detriment to each other. Edison was so well equipped, however, that he needed no help. He had twelve [...] at work. They have not been equaled, I am quite sure, in perfect construction. Mr. Edward Johnson superintended their introduction. One of the advantages possessed by the Edison system of machinery is that it is possible to take out two or three, and the others will do all the work. I have known four to be removed from the lot and the other eight carried the load easily. It is this division of power which is particularly effective in the Edison system.

WHO IS EDWARD JOHNSON?

Well, ask any electrician in Europe. He's a Yankee, and the man who has charge of Edison's interests in London. He is the sharpest and most practical man who has thus far made his appearance in connection with the electric business in a capacity on this side of the water. You ought to know Johnson.

I suppose I ought. I have seen him, but not to speak. He seems to be a rustler. He came over here some time ago in Edison's interests. When he came, they did not like Edison, and they abhorred anything American. He went to work quietly and began establishing Edison's patents. He gradually got these all straightened out and impregnably intrenched. Then he began the formation of a company. That was before the boom began. But Mr. Johnson had a good thing and a terse, sharp, convincing way of making it known. He made good headway. His company was hardly formed before shares began to go up. And they have gone up ever since. He knows electricity from cellar to garret. He knows business, from the sub-cellar to the ridge-pole. I heard him testify before the electrical committee of the house of commons the other day. He was cross-examined by a man who was a good lawyer, and knew what he was talking about. The only difference between the lawyer and Mr. Johnson was that Mr. Johnson knew a good deal the most. He is a slight, agile young fellow, with blue eyes, light hair and mustache, and a quick, positive way of talking that "means business." I hear he is coming back to America shortly. And I *know* of one electric company that offered him $25,000 a year to stay here and attend to its affairs. But he is personally very deeply attached to Edison, and so he refused the offer. There is no doubt of two things: Out of over $100,000,000 worth of electric companies established in London during the past three or four months, the American (Edison's) stands highest by all odds. And the result is very largely due to the shrewdness and tact of Edward Johnson. I like to see an American get at 'em over here. If he's a good one, he does so everlastingly lay out these slow-coaches.

English Mechanic & World of Science, July 1883

DOMESTIC ELECTRIC LIGHTING.

THE following account of a complete system of domestic electric lighting is given in *Engineering*:—

Lauriston House, Bromley, the residence of Mr. Swan, is lighted throughout with electricity, and forms one of the most interesting private installations yet made. It is remarkable for its completeness, every room and closet being lighted by the current—even the coal cellars, and the gate lamps. The lights are all commanded by small switches suitably placed so that a person entering a room, say a bedroom or closet, can light it up before going, and darken it on leaving again. The switches for this purpose are placed near the doors either outside or just within. Again, if a light is wanted at the toilet table or the writing-desk it can be had in a moment by touching the proper switch. One of the beds has a reading lamp just over the pillows for an invalid who desires to read, and the switch is ready to his hand. The gate lamps are controlled by switches in the engine-house. The drawing-room is lighted by three very elegant chandeliers made by Faraday. They are of brasswork, and each holds six lamps shaded with blue glass cups. The lamps are controlled by switches, one for each chandelier, fitted into the wall. Besides this there are six wall bracket lamps with crystal reflectors behind. Both here and in the dining room, indeed throughout the whole house, the lamps are fitted up with great taste, and at the same time economy. In the dining room the chandeliers and brackets are by Elkington, the globes being of the new crinkled glass, which has a very pretty effect like rough ice. The filaments in all cases, except where naked lights are used in the cellars, are quite shaded from the eye by the ground glass or crinkled globes. In the drawing room this effect is produced by having the bulbs themselves of ground glass. The dining room table is further lighted by two brass standard lamps which are placed on it when required and connected by wires through the tablecloth, table, and floor. These connections are made by bodkins running through the tablecloth into the table. Moreover, a large Japanese calabash filled with roses and used as a centrepiece has several lamps hid amongst the flowers; and these are lighted up in the same way, producing a very pretty effect, the lamps resembling yellow roses. An artificial lemon tree has its fruit lighted internally in the same way. By means of a small Thompson motor Mr. Swan also employs the current from a lamp at will to drive a sewing machine or coffee mill. Light for candles, or fire for the cigar is also obtained from the lamp's current by means of a small device invented by Mr. J. E. H. Gordon. This consists of an ebonite handle, with a disc guard, like a dagger haft, and having in front of the disc, where the blade should be, a spiral of bare platinum wire surrounding a plug of fireclay. When the current from a lamp is sent through this wire by means of insulated wires running through the haft, the platinum gets heated up and light can be obtained from it. There are between sixty and seventy lights on Mr. Swan's premises, including two in the engine house. They are supplied by two Otto gas engines, each of ½ horse power nominal, but capable of developing two horse-power. Each drives a Siemens continuous current dynamo of the smallest size, and thirty Faure-Sellon-Volckmar accumulators are charged for an hour before the lighting begins. These accumulators serve to supply extra lamps when wanted, the two dynamos only supplying thirty lamps when running on them alone. The accumulators can be kept partially charged by a bye circuit while the machines are running. They maintain the extra lamps required on special occasions, and also yield occasional lights during day. The engines consume 75 cubic feet of gas per hour, and this expended in gas lighting would give 30 gas jets of 15 candle-power; but the electric lights are rather over 15 candles (they are 20 candle lamps), and the light is far more pure, agreeable, and healthy.

St. Louis, Dec. 1883.

AMERICAN TRADE JOURNAL.

Edison's Electric Light.—The Decline in His Company's Stock.

Among the unlisted securities, few are so little traded in now as the electric light stocks. This is doubtless almost wholly due to the unfortunate experience of those who bought these stocks at fabulous prices when they first came on the market, and have since seen them go comparatively speaking, almost out of sight. Of course the Edison companies, and their stock bonses, made the market for this class of securities—and ruined it again also. A one hundred dollar share of the Edison Electric Light Company once sold on the street at $4,000. The same stock can now be purchased for $170, and the well informed doubt if it is worth even the latter small sum. Were it not for the prestige of Edison's name, which gave the stock its first boom, but could not save it from its final collapse, the stock would probably have no regular market price. It has never paid a dividend, and were it not for the auxiliary companies, which are simply construction and manufacturing companies, we doubt if it could pay its expenses. The light furnished has fallen below the expectations of the company's partisans, and is regarded as a failure by the disinterested. An inspection of its light in many of the buildings where it has been introduced will satisfy any one that it is far inferior to the light supplied by two or three other companies whose names are not to be seen in the public. Less than 20 per cent of the tenants of the Mills Building are said to be using the Edison light, and from no lack of desire on their part for a superior light either. The other evening we were invited by a friend to view his handsomely appointed office into which he had just moved—the principal feature of which he hoped would be the electric lights. He must have been greatly disappointed, however, for although there were a half dozen illuminating wires in each cosy room, in our judgment a chandelier hung in the centre of each, with a similar number of jets, would have given a more satisfactory light. We do not believe that electric lighting generally is a failure. Indeed, we see ample evidences in various offices that it is being successfully used; but Mr. Edison must either perfect his system soon, or consumers will have to look to other companies for their light.—[*New York Daily Stockholder.*

SCIENCE:

A WEEKLY RECORD OF SCIENTIFIC PROGRESS.

JOHN MICHELS, Editor.

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CONCERNING ELECTRICITY.

An article in the *North American Review* over the signature of Edison, confirms our editorial remarks, made on the 10th of July last, respecting the true condition of his system of electric illumination.

The course of Edison has been consistent, and from first to last he has emphatically stated that the results arrived at last January practically demonstrated the success of his system for the ends in view, and that nothing remained to be done but to improve his lamp and generator, to bring both to as near a state of perfection as a long series of exhaustive experiments would permit.

Of course, Edison has also had to master the enormous mass of details incident to the practical working of his electric lamp on a large scale for general use, and that he has accomplished both tasks within a year must be a matter of astonishment to all who have any conception of the work done; but Edison seems born to overcome difficulties that appall other men, and the fertility of his mental resources appears unbounded.

In the discussion of scientific questions affecting vested interests, impartial treatment and justice to the innovator are lost sight of. Better things, however, might have been expected from some of those who have misled the public in regard to this matter. Under the belief that Edison's electric lamp was a failure, thousands of dollars have been lost by those who have invested their money in electric light companies which have tried to force systems of lighting, fundamentally wrong in principle, and ridiculously unfit for general illuminating purposes.

There is one fact which places the sincerity of Edison above reproach; he has the assurance of his system of electrical illumination to assert its own supremacy with the public, and has neither paraded his light in great cities, nor gone on a lecturing tour, as other eminent inventors have done; and lastly, he has spent thousands upon thousands of dollars in perfecting his system.

On his system of electric illumination Edison has staked his time, money, and reputation. He now states that he has succeeded. Let those who are wise accept the situation.

The series of equations afforded by XIV. and XV. will be employed in solutions of inscot supports and tunnel rings, when a similar course—acoplet or quadrangular in arrangement, that may hereafter be given.

LITERATURE.

Cotton Spinning: a Practical Treatise. By Hermann Ewerdan Tatlock. London: Simpkin, Marshall, and Co., and Sun. London: Simpkin, Marshall, and Co., 1883. This literature of the cotton trade has always been unsatisfactory. When the subject has been treated scientifically the result has seldom been of any use to the ordinary spinner, and when it has fallen into the hands of practical men, the information has usually been a set of empirical rules, which, although probably suitable enough for the conditions under which they were compiled, had no range of application, and gave no clue to the theory upon which they had their basis. Every few years an enterprising overlooker, with a taste for arithmetic, presents the public with a volume filled with problems worked at full length, relating to the calculation of twist wheels, counts, &c., and—no doubt such a book is useful to his fellow workmen in the same district, who from a limited education find it easier to follow a formal example than to apply the explanation of a principle to a particular case. But Mr. Watson's plan of something higher than this; at least, so we gather from his preface and his introduction, in both of which his remarks are addressed to those who aspire to the position of managers to cotton mills. To such he gives very good advice, urging them to be "acquainted perfectly with every detail of the whole business," and to devote their whole energy to the one object of learning the business thoroughly, both practically and theoretically." From the above recommendation we expect to find the subject treated in such a way that its underlying principles may be understood, while at the same time the practical details upon which those principles depend are kept prominently to the front. Instead of this, however, we find the first part devoted to short descriptions of machines, most of which would be satisfactory enough if addressed to a visitor going through a mill from curiosity, but of no value to the manufacturer; while, in cases where greater detail is entered into, the remarks apply only to the productions of Messrs. Platt Brothers, and consequently are meaningless in a mill furnished by another firm. The next chapter is devoted to "calculations" of the usual style, with simple propositions some within the capacity of "half-timers," given at full length. If this were the only charge to be made against these rules, it would be a very serious matter, but most of the rules lie under the further disadvantage of having to be learned by rote unless the reader is acquainted with the theories upon which they are based, in which case they are unnecessary. For instance, "To find the twist wheel in changing from one hank to another" we are told to "square the present twist wheel, then multiply result by present hank rove, divide by future hank rove, extract square root of quotient, and you get twist wheel required." This simply means that the number of teeth in the twist of change wheel must vary as the square root of the count or hank rove of the yarn being spun, the reason being that the number or counts of cotton yarn are not, like the wire gauge, a measure of the diameter, but of the cross section, and therefore, as the twists per inch vary as the diameter, they consequently vary as the square root of the counts. Half a dozen lines of explanation, such as this, would fix the matter in the mind of the reader in such a way that it would never be lost, while the rule by itself is sure to be forgotten. This is true of most of the directions given, but a good many are also incorrect, as well as insufficient. For instance, the speed of the throstle spindle can not be found by "multiplying the speed of the front rolls by its circumference and dividing the result by the diameter of the bobbin," while there is certainly something wrong about the following calculation. "A 20-in. bolt is moving at a rate of 2000 ft. per minute, with 0 ft. of its length in contact with the circumference of a 4-ft. wheel. What will be its horse-power? $20 \times 12 = 1440 \div 3 = 2000 = 1,440,000 \div 30,000$ worked = horse-power = 123 1.11." It would not be difficult to find a dozen glaring errors of the kind, but we must push on to the last portion of the book, of which we are pleased to be able to speak better. It is composed partly of workshop receipts and spinning-room dodges, and partly of specifications of machinery, apparently from Messrs. Platt's practice, and from the style in which it is written leads to the conclusion that the author is dealing with subjects with which he is familiar. A rather odd list of "Odlums counts" indeed the whole historical evidence of the book, especially the author's belief in the supporting influence of water in cotton yarn, points to its having been written in Odham. It is a pity that coming from a place where the cotton manufacture is carried on in the greatest perfection, this work should be so far behind the requirements of the times and the promises of its preface.

A Rudimentary Treatise on Clocks and Watches and Bells. By Sir Edmund Beckett, Bart., LL.D., Q.C., F.R.A.S., &c. Seventh Edition, revised and enlarged. London: Crosby Lockwood and Co., 1883.

This was one of the first of the rudimentary treatises undertaken by the late Mr. Weale, and the fact that it has run through six editions, and that a seventh is now issued, is evidence of the appreciation of the public, or at least of that portion of them that take an interest in clocks, watches, and bells. As regards clocks the work teaches the principles of horology, and as much practical knowledge as may be useful both to clockmakers and to amateurs. That part which deals with watchmaking, an art which depends greatly on handicraft skill, is confined to a consideration of principles only, while the chapter on bells is stated to be the only English treatise on their proper construction, their hanging, and the best method of hanging.

The work commences with an account of the various measures of time, explaining the difference between mean and apparent time, the equation of time, and the like. Then, after a brief historical portion, the next hundred pages are devoted to pendulums and escapements, after which three chapters are given to the going and striking parts of clocks. Church and turret clocks receive a great deal of attention, and are evidently a favourite subject with the author. He tells at considerable length the history of the Westminster clock, and of the disputes that were waged about it from 1846 to 1856.

Under the heading of watches and chronometers all the chief compensating balances and the various escapements are described, and some useful hints are to the subject of bells, in which he has had a great experience, having designed, in addition to the Westminster peal, many others for different parts of the country.

It is needless to add anything in way of commendation of this work, which has long stood as a standard authority. The genuine enthusiasm of the author for his subject, and his immense stock of information, are to be discerned on every page, and explains why he has taken interesting ranging even to those who have hitherto paid little regard to the exact measurement of time.

THE BRUSH INCANDESCENCE LAMP.

(*Concluded from page* 483).

The most important requisite in incandescence lighting is a good lamp, and at the same time it is the most difficult to obtain. This is evidenced by the fact, that while there are numerous reliable lamps known in the market, only one lamp (the Swan) has come into extensive use in this country. Even the Edison lamp, with all its good qualities, and the lavish expenditure that accompanied its introduction, has made but little progress here. A report issued by the French company, dated March, 1883, gives a list of all the installations of the English company, and the total number of lamps does not amount to 9000, a surprisingly small record. Hence news of the points claiming the most attention of the Brush Company was the recognition that they were working on the elaboration of a system that would produce lamps of regular and uniform quality, of great endurance, and endued with a capacity for sustaining a high degree of incandescence. Abandoning the loose-hoop, first advocated by Mr. Lane-Fox, they adopted prepared carbon thread as the material of their filaments, following in other respects the general lines of Mr. Fox's plan. But it is well known that the efficiency of an incandescence lamp depends to a great extent upon the extent to which it is made, than the skill and care expended upon its manufacture, and the perfection with which the air and occluded gases are removed from the globe and conductors. The general features of the Lane-Fox process of making incandescence lamps are now carried out as well understood and needs only brief mention. Cotton thread is wound upon a block of carbon of pear-shaped section, and after being packed with powdered graphite in a crucible is exposed to a red heat for a considerable time. After it has become cool the thread is broken into lengths at the point where it was bent over the sharp edge of the block, and each piece, after it has been cut to the desired dimensions, serves as the filament of a lamp. It is necessary first, however, to reject all those whose resistance exceeds certain limits of divergence from a given standard, and this is determined by sending a current through each while in circuit with a galvanometer. The mounting of the filaments upon the platinum conducting wires and the whole of the evaporatory work is done by gas, and it is only in the sealing, exhausting, and flashing processes that men are employed. The adjustment of the lamps to a standard resistance, so that all may give the same light under similar conditions, is done at two operations, the first bringing them nearly to the required point, and the second making the final reduction. Each filament is placed in a bottle through which a stream of hydro-carbon gas is passing and is connected to two leads maintained at a constant potential, while momentary currents are sent through it by means of a key, flashing it into incandescence and depositing the carbon of the gas upon it, particularly at the hottest points which attain the highest temperature. When the resistance is brought nearly to the standard, the filament is mounted in its globe, the conductors sealed into their places, and the necessary process of adjustment is repeated with a more delicate measuring apparatus until the exact required resistance is attained.

The exhaustion is effected by the Lane-Fox air pump, which is very simple and gives a high vacuum, but at the same time entails a good deal of manual labour, as the mercurial reservoir has to be raised another high at each stroke, and the escape valve opened and closed by hand. After the vacuum has been formed a current is sent through the lamp to drive out the occluded gases, and the pumping is renewed from time to time over a considerable period, until it is seen that there is no discharge whatever. The lamp is then sealed up at the exhaustion tube and separated. It remains, however, to provide terminals for the conducting wires, and for this purpose a screw cap is employed, the cover cut by a wooden plug, is slipped over the neck of the globe and secured by Portland cement. The ends of the conducting wires are brought through holes in the plug, and twisted round the terminal screws, which then are made to form contact-pieces to which the positive and negative mains must be connected.

As in the Swan and Edison systems, so in the Brush system, the act of fixing the lamp in its holder or socket establishes the necessary electrical connections. The socket is convolved in shape, and is designed to fit the cover of an ordinary gas bracket at its lower end, while at the top (Fig. 1) its points or pedals exert an elastic pressure upon the globe that prevents any vibration. The two leading wires are led up the centre of the holder and are secured to two separated pieces of metal fixed to a non-conducting plug in the body of the socket. When the lamp is dropped into position, and the bayonet joints of the bracket, and the bayonet joint (Fig. 1), the holder of the incandescent lamp, and lower (the above-mentioned curved springs, forcing them down towards the plug, by which they are attached at one end, and making a good contact, which is retained even after the time the lamp is removed or inserted. Figs. 2, 3, and 4 show the socket constructed in a more substantial manner for attachment to a wall or a piece of furniture. In Fig. 3 the lamp is replaced by a plug provided with flexible wires for connection to a portable bracket or counter, and fitted with terminals similar to those upon a lamp neck. Fig. 5 illustrates Grindle's ancient socket, which has been used by some of the Brush subsidiary companies. This has no bayonet joint, but is provided with a set screw to fix the lamp, while the contact springs are set in a vertical position instead of a horizontal one, the terminals of the lamp being correspondingly modified in accordance. By rotating the lamp 90 deg. the electrical connections are broken.

In Fig. 6 there is shown a Brush incandescence

THE MAXIM ELEC

(For Description, see

FIG. 1

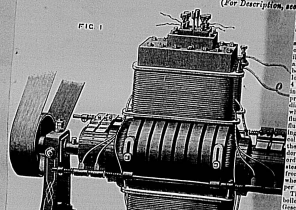
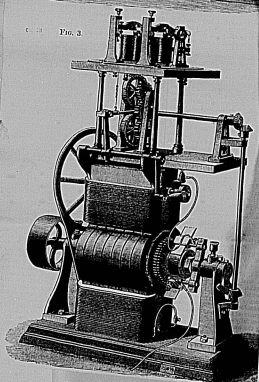


FIG. 3



...bers are fitted with Pitt's patent ... which Messrs. Schiele, Kessels, and Co. ... in Germany, and respectively which ... had in hand in favourable terms. ... our engravings have been copied ... the official report of the trial, and the exaggerated fuel amount of the corrug... plates, Mr. C. ... For generally adopting for t... a pitch of about 6 in. and a ... of which is shown by Figs. 1 to 3 is of ... as the Pinsbach boiler, and was made by ... Cockerill, although both it and ... illustrated were published by Messrs. ... Simonis, the Brush, and the Lontin, a complete ... system in itself, having its own special machines or ... generators, as well as lamps peculiar to itself, and ... it would be difficult to say whether the Maxim ... machine or the Maxim lamp is the more characteristic ... and original feature of the system. Of ... the two we are inclined to give to the generating ... apparatus the credit of the greater novelty on ... account of the arrangement by which the strength ... of the current is regulated to the work it has to do, ... this regulating apparatus being upon an altogether ... new and most ingenious automatic principle.

The generating apparatus of the Maxim system, like the Siemens and Gramme alternate current machines, as well as the dynamo-electric generators of M. Lontin, consists of two distinct machines (1) an electric generator whose magnetic field is produced by powerful electro-magnets, and whose current is utilised in the lamp circuit, and (2) a smaller machine on the dynamo-electric principle, the current from which is employed exclusively for exciting the field magnets of the large machine. The Maxim system has moreover, in addition to these, a third form of apparatus to which we have already briefly referred, viz., a current regulator by which the strength of the current in the lamp circuit is automatically controlled and adjusted to the number of lamps in action.

The Maxim machine which we illustrate by Fig. 4, p. 611, bears (on account of the disposition of its field magnets, and the arrangement of its magnetic field) a remarkable resemblance in general appearance to the small Siemens exciting machine used for the alternate current generators, or to one of the large Siemens machines set up on end so as to place its magnet helices in a vertical position. The machine, however, differs entirely from the Siemens machine in the construction of the rotating armature, which, instead of being in the form of a solid cylinder (as in the Siemens machine), is built up of a number of separate coils, each of which is wound upon a bobbin having its various wire sections arranged over its cylindrical ring or tube, like a ring wound either in the form of a series of longitudinally inside but outside the ring as in the Gramme armature, of which the Maxim armature is in fact a modification, but it differs from the Gramme armature in the fact that the length is considerably greater than its diameter, in other words, that it is rather in the form of a tube than of a ring. It also differs from the ordinary Gramme armature in having two of the coils and the armature are connected alternately to the commutators, that is to say, as the wire sections were numbered consecutively 1, 2, 3, 4, &c., all the even numbers are connected with one commutator and the odd numbers with the other. The Maxim armature is in physical principle a combination of the Gramme and Siemens machines, and may, in that sense, be described generally as a Gramme armature working in a Siemens magnetic field, but it has, in constructive detail so many points of originality, as to give to it a separate and distinct position among electric generators.

Referring to the engraving, Fig. 1—which represents the principal machine connected up as a dynamo-electrical machine, exciting its own magnets, and requiring, therefore, no separate exciting machine—it will be seen that the field magnets consist of two sets of iron bars of rectangular cross section, surrounded at the upper and lower ends by rectangular coils of insulated wire, which are so connected together that the currents traverse them in series, and in such directions as to produce a line of North polarity along the middle of one set of curved iron bars, and a similar line of South polarity along the corresponding middle line of the opposite set of bars, thus producing an intense magnetic field between them, within which the armature cylinder is rotated at a speed of about 900 revolutions per minute. This armature consists of a quantity of soft iron wire coiled into the form of a cylindrical tube about 16 in. long and about 12 in. in diameter, and wound after the fashion of a Gramme ring with a set of sixteen sections or helices of insulated copper wire, each helix consisting of four wires, the ends of which are connected to the sixty-four sections of the commutator. The system of winding, as well as the disposition of the electro-magnets, is best shown in the illustration of the smaller machine, Figs. 3 and 4, the ring and those of the large machine, but the armature of the large machine differs from that of the exciter in the fact that its contiguous coils are connected to different commutators, eight coils being attached to the commutator at one end of the shaft and the eight alternate and remaining coils being coupled to the other, so that the ring may be regarded as two armatures in one, each producing a distinct set of currents, which by a very ingenious contrivance of switching arrangements, as will be seen in Fig. 7, can be united either in parallel

FIG. 2

circuit or in series. Referring to the latter figure this switching apparatus consists of four pieces of copper, differing entirely from the Siemens machine in the figure, while at M, N, and P are represented insulated pieces of ebonite, into which conducting pegs can be inserted when required. On each of the brass pieces A, B, C, and D is a binding screw, which can be connected by conducting pegs in P, B is connected to the machine's own parallel circuit, can be arranged to supply a dynamo machine for a single-are light, the

for continuation see next page

	Part Boiler.	Fig. 5.
	sq. ft.	sq. ft.
Heating surface, total	1,166	1,166
In contact with water	1028	1028
Grate area, total	19	19
... ... between bars ...	6	6
Water surface	19	19
Contents of Boiler:	cub.	cub.
Water space	274·4	274·4
Steam	...	...

THE MAXIM SYSTEM OF ELECTRIC ILLUMINATION BY INCANDESCENCE.

A most interesting system of lighting by electricity, the invention of Mr. Hiram S. Maxim, is at the present moment being introduced into this country by Mr. J. D. Eckhardt, the financial representative of the United States Electric Lighting Company at New York, the scientific management being entrusted to Mr. Joseph Lockwood, one of the electrical staff of the Weston Electric Light Company, assisted by Mr. Charles W. Farquhar.

The Maxim system, the various apparatus of which we illustrate in the present article, is, like the Siemens, the Brush, and the Lontin, a complete system in itself, having its own special machines or generators, as well as lamps peculiar to itself, and it would be difficult to say whether the Maxim machine or the Maxim lamp is the more characteristic and original feature of the system. Of the two we are inclined to give to the generating apparatus the credit of the greater novelty on account of the arrangement by which the strength of the current is regulated to the work it has to do, this regulating apparatus being upon an altogether new and most ingenious automatic principle.

whole of the current being caused to traverse the coils of the field magnets; but, for incandescence lamps, or for circuits in which the work is at all varied, the current from the machine flows direct into the external circuit, and the magnets are excited by the current from a second machine and exciter, which we illustrate in Figs. 3 and 4, the former being a general perspective view and the latter an end elevation. This apparatus, which, with its regulator, more than anything else, is the characteristic feature of the Maxim system of generating current as his incandescent electric lamp is the distinguishing characteristic of his system of utilising the current, consists of a small dynamo-electric machine, very similar in construction to the larger machine just described, but fitted with but one commutator and a single pair of brushes, and having its armature cylinders wound with a single set of coils; in all other respects, except in size, the exciting machine is similar in principle and general construction to the lighting machine.

The method by which the current from the machine, and therefore the intensity of the magnetic field of the large machine, is adapted to the work on the lighting circuit, is most interesting and highly ingenious. On referring to Fig. 3 it will be seen that the collecting "brushes," which consist of a bundle of fine copper springs or plates, are mounted upon a rocking frame, which is capable of being rotated through a certain angular distance upon the armature spindle by means of a lever, which is geared into by a bevel pinion on a vertical shaft shown on the right of the figure, and this shaft is actuated by a horizontal shaft through the intervention of a pair of bevel pinions. At the upper end of the horizontal shaft is a sprocket gearing into two others, which are mechanically coupled to two ratchet wheels, shown in Fig. 3, but more clearly in the elevation, Fig. 4, which forms the framework being cut away to show the position of an oscillating pawl between the two wheels, by which a reciprocating motion is communicated by means of a rocking lever worked by a connecting rod and crank, clearly shown in Fig. 4. Above this ratchet gearing is a small table carried on four pillars, and to the top of this is attached two electro-magnets, the coils of one of which are considerably higher resistance than those of the other, but it is with the coils of higher resistance that we have to do at present. Above the upper pole of this magnet is a soft iron armature, mounted on a lever, which, by means of an adjustable tension spring shown on the left of the figure, can be balanced, not only against the weight of the lever, to which its opposite end is attached, but also against any required magnetic attraction of the electro-magnet. The mechanical action of the apparatus is as follows: during the working of the machine a reciprocating motion is, by means of a small crank and connecting rod, communicated to the pawl, and is thus carried from position to which the upper lever is adjusted, slightly more than a tooth and forwards into one the ratchet wheels without touching either. If, however, the magnetic intensity of the electro-magnet increases, its attractive force is overpowered by the tension of the adjustment spring, the lever rises, and the pawl is lifted so as to gear into the upper ratchet wheel, and the whole train of counter-shafts will be set into motion in one direction, the following strokes moving around the commutator towards the point of a maximum efficiency; the current sent into the low-resistance coils of the large machine will, therefore, be weaker, thus diminishing the intensity of the magnetic field, and therefore of the current induced in the armature revolving within it. If, on the contrary, the magnetic intensity of the electro-magnet of the regulator decreases, the reverse operation will take place, the pawl will engage in the teeth of the lower ratchet wheel, and the brushes will be moved towards the point of maximum efficiency, and the magnetic field of the large machine will, therefore, be intensified. The mechanical details are so proportioned and arranged that the brushes can be moved through a range which is limited on one side by the zero of efficiency, that is to say, the neutral plane of the magnetic field, and on the other by the point at which the maximum current is collected by the brushes, and between those two extremes the efficiency of the machine can be varied by simply corresponding to the motion of the brushes caused by the rotation of ratchet wheels through an angular distance equal to the pitch of their teeth.

In order to make the work on the lighting circuit constant the smaller machine, and therefore the strength of its own current, the regulator for the large magnet is placed in a shunt circuit derived from the lighting circuit of the large machine. This arrangement will be readily understood by reference to the diagram, Fig. 5, in which M represents

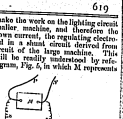


FIG. 5.

the large machine, and R the regulating portion of the smaller machine, P and N are the wires leading from and to the lamp circuit, and x and y are fine wires forming, with the electro-magnet to which they lead, a shunt circuit of comparatively high resistance to the main circuit of the large machine; and, as the current from one terminal of the large through the lamps and the other through the regulating magnet of the smaller machine, it follows that the strength of the current flowing through the latter depends upon the relative resistances of the two circuits; and, as the resistance of the magnet circuit is fixed, while that of the lighting circuit is variable according to the number of lights in action, it further follows that the addition or subtraction of one or more lights from the circuit immediately affects the strength of the derived or magnet circuit, and so adjusts the brushes to collect a sufficient current to give to the magnetic field of the large machine an intensity which is neither more nor less than sufficient for its work.

From the above description the arrangement of circuits is obvious that should a large number of lamps be suddenly cut out of circuit, through the sudden interruption of one of the branch circuits by the accidental rupture of the wire or from any other cause, there would be great danger of the current of full power being diverted by the whole of the current being divided over a smaller number, and, consequently, there would be a great risk in such a case of the machine itself being injured. To protect the system against any either of such results is the object of the second magnet, which is shown at the top of Fig. 3, and which, while being of lower resistance than the regulating magnet, which actuates the pawl, is included in the same circuit. This second or guard magnet is provided with a soft iron armature attached to that of the regulator, but its lever, instead of actuating a pawl, is fitted with a trip or switch, forming, when the current is at its normal strength, a part of the circuit of the helices of the field magnets of the small machine. The moment that the strength of the magnet circuit increases beyond that to which the spring armature is adjusted, the armature of the guard magnet is attracted and the field magnets of the small machine are thereby immediately cut out of the circuit, the exciting current ceases, the intensity of the magnetic field of the large machine is thereby reduced to zero, and the main current is thus momentarily suspended, causing a momentary extinction of the lights but saving them from destruction and the machines from injury.

The lamps employed by Mr. Maxim are in general appearance very similar to those devised by Mr. Swan, of Newcastle,* and like it, consist of a fine filament of prepared carbon in the form of a loop enclosed in a glass globe from which the air has been exhausted, and becoming incandescent under the influence of a current of electricity flowing through it, produces a light of any required power between 20 and 60 candles. Mr. Maxim has given the carbon filaments various forms such as simple loops, Maltese crosses, and other shapes, but the form which appears to have produced the most satisfactory results, and which is adopted at the present time, is a double loop of the form shown in the lamp illustrated in Fig. 6, and which then forms a sort of gridiron grating, having four intermediate vertical filaments. The points which distinguish Mr. Maxim's incandescence lamp from that of Mr. Swan's are the method of preparation of the carbon filaments, and the fact that while Mr. Swan's carbon loops are enclosed in an attenuated residual atmo-

* See ENGINEERING, vol. xxxv., page 377.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT. [April 1, 1884.

ELECTRIC LIGHTING MEMORANDA.

The Englishmen of the Metropolitan Brush Company offer for sale by private contract the complete stock-in-trade and plant of the defunct concern; and their advertisement of the fact is couched in language which unintentionally supplies the bitterest comment upon the position of Brush lighting in London, and indeed in England. Here is a store of dynamos, of recent manufacture and in good order, Brush and Lane-Fox lamps, steam and gas engines, miles of cable, instruments, &c., "all available for immediate use, and ample to provide every requisite for fitting up a number of considerable installations;" and to be sold at a reduction on cost. So this is the end of all the cramp-ring of the Metropolitan Brush Company, who a year ago vainly aimed at dividing London as a spoil. How many times has the world been assured, through the medium of complaisant daily newspapers, that nothing, now or to come, could supersede the Brush system! Alas! for those who trusted in these professions; their ideal has fallen, not through the rumour of the enemies of the new faith, but because of its own congenital rottenness. Reading this advertisement it might almost be thought a dream that a few months ago the simple permission to buy Brush machines for use in the Metropolitan area alone cost somewhere about a quarter or a million of money. A little while, and the debt and costs of the valid portion of the discredited property will be satisfied to the auctioneer's hammer; and the chief popular record of the brief and troubled existence of the Metropolitan Brush Company will be a number of entries on the wrong side of some hundreds of pass-books.

The South-Eastern Brush Electric Light Company have held an extraordinary meeting, against the wish of the Directors, at which the resolutions to which a previous general meeting were rescinded, and practically reversed. It appears that when, as usual, the cost of running the Board had intended to make a call of 10s. per share; but the proprietors set to work, and, before the call could be paid, they demanded that the capital of the Company should be reduced by the amount unexpended, in order to prevent any further waste of money. This the Company who are endeavouring to carry out an installation at Colchester under the Act; and which was confessed by the Directors to be now the only practical fruit of this notorious concern. With reference to the Colchester experiment, several suggestive observations were made by one of the liquidators of the Metropolitan Brush Company, and by the Chairman of the Great Western Brush Company. The former said that it at present impossible to make electric lighting pay in any district; and the latter observed that, if the Company were to put £10,000 into an installation in a provincial town, they should "expect to lose from £2000 to £3000 a year upon it." Against this, of course, the South-Eastern Directors contended that, on the £10,000 to be spent at Colchester in supplying 2200 lamps, there would be a profit of 12½ per cent. Time will show.

The Gilleder Company have succeeded in completing their reorganisation upon a complete basis in respect of capital, upwards of £50,000 having been given up by promoters and founders, and the unnecessary leaving hence streak off. The Company require money, in order to carry on their business at the Crystal Palace and elsewhere; and this is to be raised by the issue of debentures to the value of £12,000, of which the Directors will themselves subscribe £4000. The looks more like business, and should go a long way towards guaranteeing the sum that is so urgently required. It remains to be seen, however, whether this rally of "All" hands to the pumps!" will keep the leaky ship afloat until she enters a safe port. It is a long step down from the high ground taken at first by these Electric Lighting Companies, when they thought they were going to conquer the world, to the quiet unpretentious level of working economy on the scale on which a reasonable profit might yet with due care and diligence be realised. The Gilleder people seem determined to take the step; and nobody will grudge them the small trading profit which is all they hope for now.

Distant Force Acc. March 11, 84.

[illegible]

ELECTRIC LIGHTING MEMORANDA.

It is difficult to see any hope for the Faure Electric Accumulator Company, now that M. Philippart, the manipulator of the English and French undertakings, has become insolvent. When last mentioning the melancholy history of this concern, we stated that the English Company had only two Directors, both Frenchmen, and resident in France. Even these have now resigned; and so the English shareholders are left to look to the—the last men for directors—for help. However, being wholly short of recovering their squandered money. M. Philippart declares that the cause of the ruin of the Faure Companies was the refusal of the English Directors, to prosecute the Electrical Power Storage Company, who, he contends, pirated the Faure patents. He alludes in this to the Sellon-Volckmar combination, which, after all, does not appear to be much worse for supplying that was taken from the owners of the older secondary battery. As for claiming anything from their rivals, the Faure Company probably realize the truth of the old proverb about shearing pigs for wool. Electrical storage is in a bad way just now; and we look in vain for the prosperity that, according to M. Philippart, has been taken from his Companies by the so-called "pirates." The English Company have done all that is possible in the circumstances; they have treated M. Philippart's communications as waste paper, and have appointed a Committee of Shareholders to investigate the affairs of the Company. When this Committee have reported, one more extraordinary chapter will be added to the history of joint-stock enterprise in this country.

The Hammond Electric Light Company have held their meeting, prefaced by a lecture delivered by Mr. Robert Hammond, in St. James's Hall, when he told the audience —which was entirely "paper"—one—that electric lighting could be supplied, on as large a scale as gas, at the equivalent of 3s. per thousand cubic feet. Next day, at the meeting of the Company, the speaker had to confess to a considerable deficiency in the working accounts, and to make other admissions, which show clearly enough that it will never be the lot of the Hammond Company to sell electricity at anything like the rate stated by himself a few hours before. The loss on the Brighton working has been £20,797; to which must be added £7,000 for the loss up to date. For carrying on this ruinous business Messrs. Hammond are paid £1000 a year; Mr. Hammond himself getting £1000 a year, of course, his expenses as a travelling lecturer. This gentleman seems to possess the gift of managing shareholders: for they still go on paying solid cash in return for his oratory, and, at the same time, found it necessary to rearrange their capital, by cutting down the nominal value to rearrange from £5 to £1 10s. Of course the Directors want money to carry on their contracts; but hope to raise this by the issue of new shares. Naturally, the subject of Chesterfield was not mentioned at the meeting. That ugly blunder in the management of the Company admitted by the Chairman was "that they had not started with a far larger subscribed capital." Considering the ability of the Board to go through what money they had, this observation is decidedly refreshing.

A great fuss has been made about the electric lighting of a new municipal building in East London; much ill-blood having apparently been generated in the Town Council by the peculiar way in which the whole affair has been managed. Answer: the only apartments where gas is not laid on as well being some rooms of the library, which will probably therefore be shut at dusk at different periods of the year. The 19-horse power gas-engines being employed for driving the dynamos. In reading the account of the new buildings in the *Lewis Mercury*, we were struck by a mention of one room in "the basement" where—the head-for-the-business department, "medical." *Presumably the Council chamber and Committee rooms do not require special lighting; the necessary "fittings" being supplied by the councillors themselves.*

It is announced that the public electric lighting of Godalming is about to be abandoned and the use of gas resumed for the streets. This is the place which was advertised so loudly a year or two ago, by the *Daily Telegraph* and other London newspapers, as the favoured spot where electricity was soon abandoned, and a portable engine introduced; but now the miserable *farce* is to be dropped, as it ought to have been months ago. It is not to be expected that the daily newspapers will take any notice of this anti-climax to their vapourings of the speculation era.

El Terrocarril

SANTIAGO, VIERNES 14 DE MARZO DE 1884

LUZ ELECTRICA.—Como el alumbrado eléctrico sistema Edison, cuya cesion negoció el Gobierno con Mr. Mackenzie, ha despertado ya con justicia resultados en Berlin, Milan y demas capitales europeas, nos parece oportuno dar algunos datos que hemos recojido en diversas publicaciones especiales y por informes particulares. Desde luego anunciaremos en los diarios de Berlin que la Corte, Reparticion de Alemania ha faltado al precioso juicio inventado de la luz eléctrica incandescente, declarando: en Edison como un mero inventor. Esta decision ha sido sin duda mayor impulso á esta clase de alumbrado, no solo en Berlin, sino en Paris y Londres. Ahora Mr. Edison ha comunicado un nuevo sistema de iluminacion que disminuye considerablemente el costo de la luz eléctrica. En Santiago, donde se ha implantado el antiguo sistema, los conductores cuestan mas de cinco pesos por cada luz, con el nuevo sistema no importa mas de un peso cuarenta centavos, lo que hace con el negocio en mas que lucrativo para los empresarios. Por el sistema antiguo un caballo de fuerza equivalia á 1125 velas; por el nuevo llega á 1450, esto es: beneficio de 25 por ciento, siendo el mismo el gasto del motor. Ademas, por un ingeniosa invencion en el arreglo y funcionamiento de la maquinaria, se obtiene una economia mensual de un 50 por ciento sobre el empleado. Y todavia, las maquinas que hasta ahora valen 90 centavos, se obtendrán á 40. Todas estas economias y ventajas seguramente, mas la estabilidad del alumbrado bajo el sistema Edison que, segun el mismo inventor, presenta la fal petición de los ensayos para entrar en el dia la aplicacion. En Nueva York, la primera estacion central es por el sistema antiguo, y cuesta en conductores, cana, cajabocks, empalmes, etc., un millon de pesos oro, alimentando 12,000 focos. Asi, los accionistas han recibido un dividendo de 6 p. Con el nuevo sistema, un gasto se reduciria á 300,000 pesos; de manera que la utilidad de la empresa va á ser inmensamente. En la estacion habia mas maquinas eléctricas, y mientras en Inglaterra se instalaban otras mas, una de 60,000 focos y la otra de 90,000 en la parte mas central de aquella ciudad. Existen actualmente en Estados Unidos 10 establecimientos centrales, y hai un contrato para establecer dos en cada semana durante el presente año; y en cinco de los estaciones existentes se han aumentado 5,000 focos cada una. Mañana, el decreto en la solicitud presentada por don Carlos Bellet, representante de don Tomas A. Edison, de los Estados Unidos, concediendo que establezca, para la distribucion de luz eléctrica, el sistema Edison.

LITERATURE.

Lectures on Architecture delivered at the Royal Academy by the late EDWARD M. BARRY, R.A. Edited, with Introductory Memoir, by ALTRED BARRY. London: Longmans, Green, & Co. 1881.

That book-making there latures is divided into three heads: a memoir of 70 pages; a series of lectures and notes extending over many pages; general principles, consisting of 385 pages; and a second series of lectures, treating on the historic architecture of days long past, or as it should be termed archæology from an analytical point of view; these last comprising 250 pages, and thus taking up a considerable portion of the book.

Any memoir of those whose works and doings are familiar to us, is necessarily interesting; but when such an account throws light on the circumstances under which an eminent worker out of high and artistic principles has achieved his results, and explains hitherto obscure difficulties that have surrounded his path, it becomes valuable in proportion as it affords a key to the explanation of matters often incomprehensible from the surface, and frequently misjudged.

Among the principal works of Edward Barry were, the additions to the Westminster Palace, the Cannon-street and Charing Cross Hotels, the Ellesmer Cross, the Opera House at Malta, Covent Garden Opera House, the New Temple Buildings, the rebuilding of Crews Hall, Halifax Town Hall, and the Birmingham Institute; his bitter experience in connection with the Royal Exchange Competition, resulted in the 2nd prize being awarded to a Frenchman, and his own design was placed 3rd. Again, his design for the Law Courts was selected in lieu of his own, and the first premium awarded to Mr. Street, who, after the Government had abandoned its intention of carrying out anything further. These prizes were awarded before the Government remembered him in any way. These with other troubles told on a constitution not robust, wore him out, and shortened his existence; he died in January, 1880; and thus passed away a man that gained the highest distinction in competition for architectural employment, as one of the most important public buildings in England. The lectures on architecture proper, that is of the first series before mentioned, are admirable; they show the results of deep thought, close examination, both from an artistic and from a fitting utilitarian point of view, ensuring a right and good judgment. General principles are laid down with breadth and vigour while the "striving as" so frequently translated in every branch of the art, and aided by suggestions in every direction, show the tendencies of a practical enthusiast having "a mind to work" with the whole problem before him. Technical details, artistic improvement, details of practice, progress, retrogressions, and the smoke difficulty are all fully dealt with.

It could be of little use to quote any passages from these lectures: they should be read as a whole by every professional architect and student; and it would be well if even the whole profession were not up to the principles explained. Apart from that, the perusal of these lectures at an interesting moment cannot but aid in producing a greater appreciation of true architectural merit and an intolerance of taste. Some of the phrases of the lecturer indicate his ideas of the habits between architects and the general public as well as with the critics. He says: "Architecture is an art which does not work in seclusion for the benefit of the few, but appeals openly to the many, and I believe is valued by the few who are qualified by study and knowledge to speak authoritatively on its principles, because the broader characteristics must always be those that will interest the intelligent observer. Those also who to see properly will ever require education, and the power of criticism is not an instinct, although the power of grumbling may be so. Knowledge, then, is required in the critic as well as in the artist, and where it abounds, a genuine criticism is of the highest value. It professes to aid the younger aspirants the way of progress, and satisfactory conclusion that accompanies true knowledge."

Also: "I am convinced that there is no reform of more pressing importance in our day than the improvement of the houses of the million; and this is a question in the solution of which architecture should have her share. The living of the many should be as much under the control of the architect as the worship of the few."

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and powerful country will be able to rid herself of the reproach that a majority of her area are unable to house themselves with comfort, or even with decency. Such views are better than those of most professional architects. The first series of lectures is followed by a short, but interesting Lecture X., "On Town Architecture and Modern Improvements," and the concluding one of the series. The utilisation of London squares in the way proposed is not perhaps after the best mode of very desirable in any way, but may aid greatly in leading the way to more unique designs in that direction.

The second series of lectures is interesting to the professional student, and shows the manner in which the European architectures of the past, from the Norman castles down to the palaces and buildings of the Third Renaissance period, should be studied; that is, in accordance with the local and temporal circumstances, and with the objects with which such constructions, with their modes of communication, were adopted; this series also explains the principles of architectural development in the past, and so far may be of assistance to those practically interested in producing that which is suitable, artistic, and useful in the future. The more general heading, however, already been more thoroughly gone over by Ferguson in his well-known and much more complete in this respect. Such omissions and shortcomings, after which in local interest, justify the value of the lectures, which will, probably, form a standard volume in every English architect's library.

Pocket Logarithms and other Tables for Ordinary Calculations. By CHARLES HOARE, Architect and Surveyor. Lewes: Now. 18mo. London: Allen, 1881. [Price 6s.]

This very small volume is designed for the use of those who are to perform ordinary, and more than ordinary calculations with exactitude. Common four-figure logarithms are proved by a series of examples to yield very incorrect results, and this error frequently occur in a very large proportion of cases. The tables are simplified to mostly full defect, and yet keep the calculations short. The author justly states that if it were not for the necessity of using four figures in the numbers of a result, it is also stated by suggestions in every direction, show the tendencies of a practical enthusiast having "a mind to work" with the whole problem before him. Technical details, artistic improvement, details of practice, progress, retrogressions, and the smoke difficulty are all fully dealt with.

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Templeton's Tuschenbuch for Practische Mechaniker. By ERNST TEMPLETON and JOHN GEORGE BRIGHT. Halle: Winkler.

This book forms a text-book for a class of mechanics not educated up to a high standard, unacquainted with higher mathematics, yet possessing a sound middle-class education, and of that kind, very often, with special reference and particularly for the colour working engineers, foremen and workmen of the ordinary stamp, are not nearly so numerous as those for the upper class, and if well carried out, should have a very large circulation. The one before us, with the name of Templeton's Pocket-Book, bears but little or no resemblance to the original work of this title; it is an engineer's hand or reference book with the usual arrangement of contents, commencing with mathematics, a third part consisting of a mechanical section, a third part containing formulæ, rules, and skeletons for designing; and a fourth treating on technological subjects. The book, although of but small proportions, contains an abundance of useful information in over 600 pages, and more than 400 small sketches distributed throughout the volume, add materially to its value. The entire absence of higher mathematics will no doubt be an important feature for all those for whom the book is specially intended, and a series of tables, including trigonometrical tables and logarithms, render it more than usually comprehensive.

That so large a variety of information cannot be very completely given, and be translated as much as possible, is only natural, and the book will, therefore, be more suited for study than for reference, but the general treatment of the different subjects is so complete that it is commonly found in a so-called pocket-books. The title, "Pocket-book for Practical Mechanics," is somewhat misleading, since a great part of the contents would never enter into the sphere of a practical mechanic's occupation, and is really intended for the designing office; but there is, of course, no reason why mechanics should not be acquainted with the principles of design; experience, however, teaches that generally they are not, and very frequently even more complete than the drawing office have but a limited knowledge of what they should know, and that special and of a very practical mechanic. If it succeeds in spreading the information it contains, it will be doing good service.

THE JASPAR SYSTEM OF ELECTRIC LIGHTING.

The system of electric lighting, devised by M. Jaspar, of Liège, which was illustrated at the Paris International Exhibition of 1878 by the jury, who awarded him a medal, attracted much attention among electricians at the recent Exhibition in the Palais de l'Industrie, on account of the simplicity of the lamp, its efficiency in working, the softness of the light produced, and the ingenuity of the whole system. We have referred several times to the Jaspar lamp in these columns, and have also noticed the special arrangement that M. Jaspar adopted for lighting No. 16 at the Palais de l'Industrie, and also the one he has in the cellars of the Paris Opera. The arrangement consists, it will be remembered, in placing the carbon rods, conducting the light at the bottom of a cylinder with opaque sides, which conceal it from view. The luminous rays escape from the upper and open end of the cylinder, and are thus thrown upwards in large white umbrella-like reflector, which diffuses them, and distributes a general diffused, very soft and pleasant to the eye. We shall find in this arrangement the solution of an idea which we have mainly preconceived M. Jaspar. He is not of course in perfect a convenient and simple a regulator, but goes further, to find the means of more effectually distributing the light, as will be also endeavoured to produce, not only light of useful illuminating power, but of light more entirely distinct, although in popular language they are considered as synonymous. We will first divide our into two parts our notice of the Jaspar system, describing first the regulator, and then the lamp in the manner in which he employs it. The Jaspar lamp belongs to the numerous category of apparatus in which the weight of the positive carbon-holder acts as the motive power of the system, and the object of that is to say, it is not adapted to the divisibility of the volts are, and only one lamp can be placed in an electric circuit. Fig. 1 is a side view of the regulator, from which a part of the outer casing has been removed in order to show the mechanism. Figs. 2, 3, 4, and 5 are respectively two vertical and a lower plan. This lower portion of the regulator is shown in Fig. 1 formed of a hollow cylinder be carbon-holder A formed of a hollow cylinder be A, set on. In the middle, the tube C is

The Times, Chicago, Saturday, May 17, 1884.

ELECTRICITY

And the Wonderful Development.

The Telegraph from the Building of the First Line to the Present Day.

The Invention of the Telephone and Its Almost Universal Adoption.

The Electric Light and Its Importance as an Artificial Illuminant—The Many Minor Applications of Electricity.

The Recently Rapid Extension of Electrical Apparatus Manufacturing Plants.

History of the Western Electric Company, the Foremost Manufacturers of Electrical Apparatus.

Description of Their New Building and of the Company's Manufactures.

In 1837 Morse invented the electric telegraph, and in 1843 he built the first telegraph line, a short strip line between New York and Washington. At this time the application of electricity were few, and Morse's invention was considered a most remarkable one, as indeed it was. Even after the line between New York and Washington was erected only a single wire, adopted of the most primitive and desired whether it would ever be available for commercial uses, improved apparatus and methods, however, soon made the line an entire success. The growth and success of telegraph lines since the time of Morse's early experiments have been truly marvelous. They have been extended and multiplied until they now form a network of wires over the whole land, which are reached by the electric signal. The Western Union company alone claims over fourteen thousand offices, and the continental lines of the country are connected by nearly two hundred thousand miles of connecting links, thousands of miles in length, forming a great intercommunication system, with the entire globe as its territory, and over which is carried the world's business for the existing twenty-four hours.

When Alexander Graham Bell brought out his telephone, less than a decade ago, the public attitude at the time was prepared for a certain class of the startling developments in the electrical field, were limited, nevertheless, to look upon his invention as an ingenious and wonderful toy simply, and not as the first of a series of inventions that were the parent Bell Telephone company, as it is reported to its stockholders, has increased in a term of 40,000 with which to develop its business, in spite of great difficulty in getting its wires, and, in fact, full-sized, which is the standard in use in all the principal cities of the country, and larger areas are required in the business districts of the large cities.

In 1877 a New York inventor, Mr. Edison, built what is known as the "phonograph," which was a machine for recording the human voice and reproducing it at will. This machine was considered a most wonderful invention, and was exhibited in all the principal cities of the country. Mr. Edison, however, was not satisfied with this invention, and in 1878 he began experiments in the direction of electric lighting, which resulted in the production of the incandescent light, which is now in such general use. Mr. Edison's first lamp was exhibited in Menlo Park, New Jersey, in December, 1879, and was the wonder of the day. Crowds visited the place to see the new light, which was then considered a most wonderful invention, and its brilliancy and steadiness were the subject of universal comment. Mr. Edison has since perfected his lamp, and it is now in general use throughout the country. Its use is rapidly increasing, and it has come to be looked upon as a necessity in many households.

The parts are fifteen inches long and one inch wide, and consist of a strip of boxwood, with a groove in each one framed in the bottom of the frame is rediscovered by the inventor of the telephone.

Each frame contains two hundred annunciators, and the building is arranged in eight stories, and each one contains one frame is required. The entire number of annunciators contained in the building would give of these.

Each frame contains at each end a spring-jack, to which are attached the cables, as shown in the illustration, so that each frame is connected with the electric current for the non-breaking of the circuit. The front of each frame also contains the annunciator drops, the light and spacing department is mainly devoted to the manufacture of the Gray annunciator drops, which are the latest and most improved. The cutting, punching, testing, and arranging machines and screw-making machinery are also in the establishment, which is now in full operation, and is turning out a large number of drops daily.

The end of the building is devoted to the wood-working department, in the basement of which is the boiler and engine room, with the necessary machinery for the company by Messrs. Fuller & Warren, of Stamford, Conn., and is of the latest and most approved pattern. The engine is a splendid piece of work, and is a model of neatness and finish.

The machine-shop contains the second and third floors of the building, and is filled with the latest and most approved machines, such as lathes, drills, presses, milling machines, and machinery, in which are to be found all the tools necessary for the fitting up of the work of the establishment of the kind in the world.

The basement is devoted to the manufacture of work in which they are engaged in the manufacture of, and which has been with the exception of the cabinet work, which is done in the city of Cicero. The main facilities in the way of tools for this work are in the basement, and it is here that the heavy work is done. Electric motors are used for driving the machinery in this department, and the work of a large standard of the cabinets, which are made in the city of Cicero.

The first floor of the building is entirely occupied by the offices of the various departments of the business. The main office, adjoining the private office of the president, is a model of neatness and convenience, and is admirably adapted to the purposes for which it is used. The offices of the various departments are all conveniently arranged, and are provided with the latest and most approved appliances for the transaction of business.

The second floor of the building is entirely occupied by the offices of the shipping department, which is a model of neatness and convenience, and is admirably adapted to the purposes for which it is used. The offices of the various departments are all conveniently arranged, and are provided with the latest and most approved appliances for the transaction of business.

The third floor of the building is entirely occupied by the offices of the shipping department, which is a model of neatness and convenience, and is admirably adapted to the purposes for which it is used. The offices of the various departments are all conveniently arranged, and are provided with the latest and most approved appliances for the transaction of business.

The fourth floor of the building is entirely occupied by the offices of the shipping department, which is a model of neatness and convenience, and is admirably adapted to the purposes for which it is used. The offices of the various departments are all conveniently arranged, and are provided with the latest and most approved appliances for the transaction of business.

The fifth floor of the building is entirely occupied by the offices of the shipping department, which is a model of neatness and convenience, and is admirably adapted to the purposes for which it is used. The offices of the various departments are all conveniently arranged, and are provided with the latest and most approved appliances for the transaction of business.

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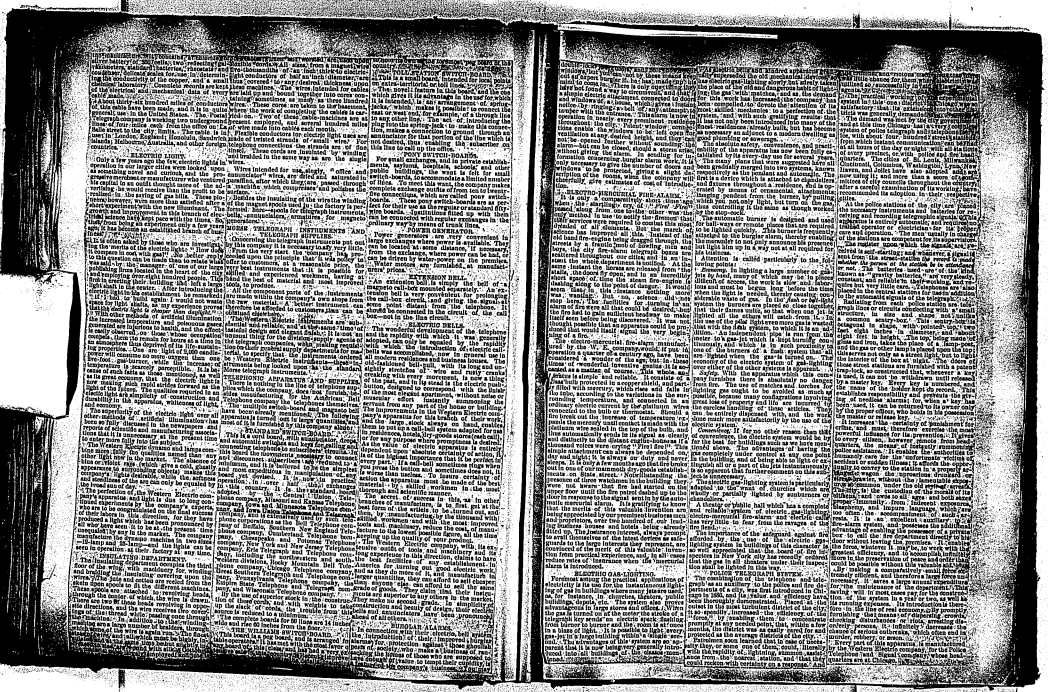

ELECTRO-MEDICAL APPARATUS.

The company manufactures quite a variety of electro-medical apparatus, and in connection with this section with the other manufactures. Some of their medical batteries are in high repute among physicians, notably the Mendel galvanic battery, which is conceded to be the very best galvanic battery made. The company has taken pains to consult the taste of the purchaser in making these instruments to order; and every battery is carefully tested before leaving the shop. Full directions are furnished with every instrument sold.

The company has been a seriously illustrated catalogue of this kind of material, in which are shown and priced all kinds of batteries, their appurtenances, and electrodes. This catalogue the company sends free on application.

AMERICAN DISTRICT TELEGRAPH APPARATUS.

A few years ago the most promising field for the social and business usefulness of electricity in cities and towns was the district telegraph. The apparatus for calling messenger, doctor, police, or fire-engine, and the wires for transmitting the call, or the alarm of fire, brought well before the public what its utility was even when confined to the mere extended use of the telephone.

The district telegraph has its peculiar adaptations, and it is well that it is so; that is, that the field is small, and that it is coming to be perceived more and more, that the telephone and district telegraph systems are not conflicting in their services, where they render the community, but that they supplement each other.

The Gray district telegraph system, which has so far been made for district telegraph purposes is the Field, A. Firman, eleven-call box with answer-back signal.

One and four-call boxes are considerably used, but the eleven-call box is preferred, as it is adapted to a line with a large number of calls (the language resulting from their use is much more extended), and it is generally found to be advisable to equip a system with the more costly but more flexible instrument.

The advantage of the answer-back signal, by means of which a customer is notified that his call is received and will have attention, is of reality and

The apparatus required for a district telegraph system is not complicated or expensive. The one essential in this apparatus, as in all electrical apparatus, is that it shall be perfectly constructed and thoroughly reliable. Those are the qualities of the instruments made by the Western Electric Company, and which have so far in business are well known, and which have secured to it the pre-eminence in this field.

MULTIPLEX TELEGRAPH APPARATUS.

In the general office of the Western Union Telegraph Company, in New York is a case containing the multiplex telegraph instruments of the immediately next.

They appear clumsy and rude even to the casual observer, but it is only when a visit in the operating-room has shown the beauty and delicacy of the mechanism that one is able to appreciate the vast progress that has been made in the art of telegraphy since its early days. Operations no longer require the register to write out their messages in dots and dashes, but take them from the tape by sound, thereby avoiding the risk of the accident, and accommodating means transmit and receive messages at a speed which the quickest writer of several operators can not emulate.

The Quadruplex and Duplex instruments also are marvels both in their construction and in what they accomplish. By the quadruplex two messages can be sent each way over the same wire, making four messages which are simultaneously transmitted over one wire.

The duplex system is accomplished by the Gray harmonic system, by which two messages are simultaneously transmitted over one wire.

All this improvement over the first device has not accomplished without great expense of time and money, and much of it that properly in the art are marked by many a dial, papers, manual rolls on the shelves of factory storeroom and inventor's laboratory.

Volumnious as are the records of the patent office of the United States, the entries of this great body of work, which has been carried on and noted, be fully seconded by the skillful and faithful carrying out of his designs in the construction of instruments.

Among the latest instruments in use for translating telegraphic signals is the stock of the Western Electric Company, which is in use in the stock exchanges in New York, Chicago, Boston, and Philadelphia, the Gray harmonic, the Miller, and the Edison, with Pender

THE ELECTRIC PEN

of Edison's invention is manufactured by the Western Electric Co., and very largely in demand by those who appreciate the advantages of the duplicating process.

APPARATUS FOR ELECTRICAL MEASUREMENTS.

The practical electrician needs to measure the insulation resistance of circuits, strength of current, internal resistance and electro-motive force of batteries, and to test out the different forms of apparatus and circuits. In telegraph work, and in telephone work, being a new thing, there are new problems connected with it which require to be solved, and the solution of which will, in time, save immense sums of money, which would otherwise be unwisely expended.

The following list of electrical measurement apparatus manufactured by the company (Western Electric Co.) and very largely in demand by those who appreciate the advantages of the duplicating process.

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The Wheatstone bridge and rheostat is modified after the English pattern or Silvertown standard, and is made by the company with the greatest care, and compares with the original standards in use at the great utility.

The Bradley rheostat and galvanometer, made under the patents of Dr. L. Bradley, has for many years met with great favor, large numbers of which are in use, complete with entire confidence in the great utility.

The Silvertown galvanometer is a new pattern, is neat and compact, and meets with favor.

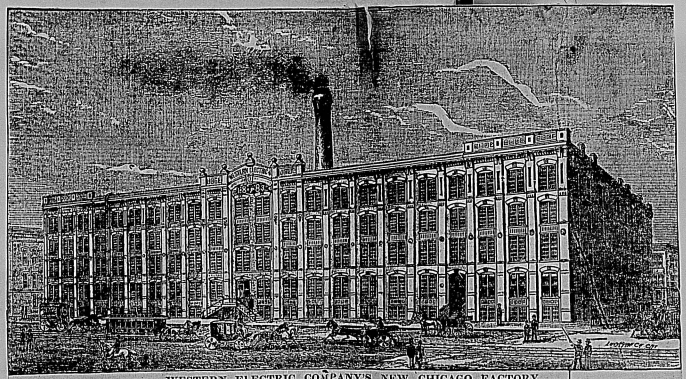
GENERAL SUPPLIES.

In connection with the manufacturing carried on by the Western Electric Company, they have found it advisable to carry a large stock of general supplies, which are found to be called for by their customers. Thus, a purchaser for a telegraph line may require wire, and will take certain insulators and batteries which he requires, and will look to the Western Electric Company for wire, which has been for constructing the line.

This stock is true of all branches of their trade, so that, besides the large variety of goods included in the regular catalogue, the extensive facilities to which they have become the distributing dealers for the supply of telegraph companies, has led to the adding of many articles which have secured the confidence of purchasers, many of which are not found in the catalogue, and which are only to be had of them.

The stock of these goods, in the line of telegraph supplies, from a pole-step to what is required for the equipment of a complete telegraph system, that this company is not prepared to sell them, in format at the lowest cash prices.

The warehouses at Chicago, New York, and Boston are always full, in anticipation of this class of goods, ready to be shipped out without delay on mail or telegraphic orders.



WESTERN ELECTRIC COMPANY'S NEW CHICAGO FACTORY.

See previous Article for description

See picture factory on other page

The Evening Sun
NEW EDITION AT 4 P.M.
THURSDAY EVENING APRIL 5, 1883

ELECTRICAL REVIEW

April 7, 1883

The Electric Light Companies.

In the following résumé of the market for electric light shares, the figures given are of the sales that have been made during each week; but higher prices may have been obtained at private sales.

The Edison Electric Light Company, the parent company and pioneer in the field, was originally organized with a capital of $600,000. This was increased to $800,000, and then to $1,200,000. The company owns about 61 per cent. of the stock of the Edison Illuminating Company, which was organized to use the Edison invention in this city, and of the stock of the Edison Company for Isolated Lighting. The value of these holdings is taken into consideration in estimating the value of the shares of the parent company. When its capital was $800,000, its $100 shares sold as high as $2,700. These shares sold at that price. The purchaser of those shares is reported to have sold them at private sale on this same day for $3,000 a share. This original seller paid $2,000 a share. His investment was $1,600, and the second seller made $2,000. All of these transactions, it is said, took place in one day. One of the first transactions in this stock was the sale of five shares for $1,000, or $200 a share. On the day after this sale, the purchaser sold two of the shares for $500 a share, thus recovering the amount of his purchase money for the lot. He afterward sold the three remaining shares for about $8,000, which was his profit on the venture. At times the price jumped up $100 a share in an hour. The son of the president of one of the largest corporations in the country sold 20 shares that cost him $2,000—that is to say, $100 a share—for $20,000, or $1,175 a share. The purchaser sold the stock shortly afterward for $1,870 a share. The stock is now selling at the lowest figure it has touched since it came upon the market recently, $700 a share. A sale was made at that figure not long ago. The price has twice been affected by the increase of the company's capital, as the increase in capital has been offered to the stockholders at par. At the present market value of the shares of the Edison Illuminating and of the Edison Isolated companies, it is estimated that the stock of the parent company is worth about $100 a share, merely as representing the interest of each share in the aggregate market value of the stocks held by the company.

The capital of the Edison Illuminating Company is $1,000,000, and the par value of its shares is $100. Fifty-one per cent. of its stock was given to the parent company for the Edison patents, which it is entitled to use exclusively in New York City. The company proposes to light the city by electricity. Its first district is bounded by Spruce street, Park row and Broadway, and the East River. It has equipped an engine-house in Pearl street, and laid wires and put in fixtures extensively through this district, but has not yet succeeded in furnishing any light to speak of, though it has about 6,000 lamps, which have been lighted at times. The stock of this company has sold as high as $125 a share, and as low as $80. The former price is the one which was reached before the company had put much of its plant, and the latter a few months ago. The last sale is reported to have been at $99 a share, and it is now offered at $90, $40 a share being bid for it.

The Edison Company for Isolated Lighting was organized with a capital of $500,000, which was subsequently increased to $1,000,000. The par value of the shares is $100. The object of the company is to furnish light by the Edison system, and patents to single buildings or establishments. Fifty-one per cent. of its stock is owned by the parent company, having been issued to it for the patents and privileges. When the capital of the company was $500,000, its stock first sold up to $315 a share, and then as low as $175 a share. The stock now brings $150 per share. It is offered at $155, and $150 is bid. The price at present, however, depends to an extent upon the number of shares offered or bid for. This is the only Edison company that has paid a dividend. One of one per cent. and the operations of the last year are recently been declared. Though the parent company has never paid a dividend, large profits have accrued to its stockholders by two awards of new stock at par at times when the premium was very great.

The Edison Electric Light Company of Europe was organized about two years ago, simultaneously with the other offshoots of the original company. Its capital is $2,000,000, and the par value of its shares $100. It has a monopoly of the Edison system in Europe. Its stock sold soon after it came on the market at $165 a share, and has declined to $40. The present quotation is $40 bid, $45 asked.

The capital of the United States Electric Lighting Company is $1,000,000. Its shares, of the par value of $100 each, sold about three years ago at $300 per share. During extreme depression in this class of stocks about six or seven months ago its shares sold at $68.50 a share. The last reported sale was at $125, and at present $110 is bid and $120 is asked. The company has just declared a first dividend. It is five per cent. in cash, but whether it is to be considered as an annual, a semi-annual or a quarterly dividend cannot be learned.

The patents of the United States Company are used extensively in this city by the United States Illuminating Company, which has a capital of $1,000,000, only one-half of which has been issued. The transactions in its stock have been large. The last was at $188 per share.

The Brush Electric Company of Cleveland sustains practically the same relation as the Edison to several minor companies. It has a capital of $2,000,000 in 40,000 shares. The stock sold recently at $110, and it is said that it can be bought at that price now. The present bid price is $100. It has never sold below its par value. The company has paid quarterly dividends of two per cent. for three years.

The Brush Illuminating Company of New York owns most of the stock of the Brush Electric Light Company of New England, which uses the Brush system throughout the Eastern States. This stock is not much in demand, but is supposed to be worth about $600 or more a share. The company has just declared an extra cash dividend of 20 per cent., making a total for the year of 30 per cent., that it has paid within a year. The report is current that the New York and New England companies contemplate a consolidation.

The Fuller Electric Company manufactures electrical machines. It has a capital of $600,000, of which $400,000 is common stock and $200,000 preferred. The par value of both classes of stock is $100. The company has sold from $53 to $62 a share, and the preferred from $66 to $75 a share. Present nominal quotations are 50@55, for the former, offered at $58, and 67@70 bid and $100 asked for the preferred.

The American Electric Light Company has been distinguished chiefly for the economy of its plant, and from the sums of its officers exchanged a few months ago. The company has a capital of $600,000 in $50 shares. Some of these shares have sold at $35. They are now offered at $4.75.

The Brush-Swan Electric Light Company is the last organized enterprise of this class. It combines all the Brush and Swan patents, and is now electrically promoted by the Brush process in the Swan incandescent lamp. The capital of the company is $500,000, and the par value of its shares is $100. Sales have been made at $180 a share, and it is now quoted at $105, and $150 asked.

For the business, protection of their patents, all of the leading electric light companies formed, some two years ago, the Gramme Electrical Company. The shareholders are the American Electric Company, of New Britain, Conn.; the Brush Electric Company, the Edison Electric Lighting Company, the Fuller Electrical Company, the Maxim Electric Lighting Company, the United States Electric Lighting Company, and the Weston Electric Light Company. The stock has no marketable value.

While the prices that now prevail for the shares of most of the electric light companies are the lowest that have ruled, it will be observed that there has been a considerable recovery in the case of those companies which have demonstrated that selling to make returns upon the money invested in them. Those, however, are few in number.

The Electric Light in the Magasins du Louvre, Paris.

Our esteemed contemporary, *Engineering*, in speaking of a previous article published on this above installation, says that we explained that this installation, very carefully arranged in a practical point of view, is directed with great care, and that a very detailed account is kept of the expenditure involved. The figures we shall now give, and which we owe to the kindness of M. Honoré, are therefore absolutely exact; they are deduced from a careful examination of the official accounts, and refer to the year 1882, during which the electric lighting of the Louvre was conducted under normal conditions, without any change or interruption.

As we stated in our previous article, the lighting of the Louvre is effected by five Gramme machines with independent exciters; each of these supply eight circuits of three Jablochkoff candles, or 120 in all. There are two Méritens machines, each of five circuits, feeding thirty candles in all, or a total of 150; there are, besides, four other dynamos, each working as an arc lamp, and one Edison machine, type Z, supplying sixty incandescence lamps.

The expenses relative to this installation have been separated from the general accounts, and divide themselves into three distinct classes, as follows:

1. Those of first cost.
2. The running cost of the lamps.
3. The cost of maintenance and working.

In any ordinary installation the first costs are generally easy to arrive at; the second are usually calculated more or less approximately; as regards the third, it is rarely that running and maintenance charges are recorded with accuracy; these, however, are the most important of all.

During 1882 the Jablochkoff candles, many of which it will be remembered were burning the day as well as at night, gave a total of 204,672 hours; the four arc lamps furnished each 730 hours, or a total of 2,920 hours; as they are each equivalent to five candles per circuit, as far as mechanical work is concerned, their proportional part corresponds to 5,032 × 5 = 14,600 hours. The sixty Edison lamps more recently placed, furnished during the months of November and December last, 720,200 hours of light, but each of them absorbed only 0.3 of the power taken by a candle, so that the proportion of power absorbed was 0.3 × 20,203 = 6,061 hours. We have thus a total of 204,672 light hours of equal intensity. The foregoing is the data from which the distribution of expenses (management, fuel, sinking fund, &c.) has been arrived at for each of the different systems.

Of the 204,672 hours of lighting supplied by the Jablochkoff candles corresponded a total of 2,108,340 candles consumed; hence the average duration of each candle was about 1½ hours. While part of the expenditure works out at a trifling price as which the candles are used in the Magasins du Louvre, it will be found that the cost of working (1.10) per hour; the cost of working and maintenance corresponds precisely with the same figure; as to the allowance for sinking fund, calculated at 10 per cent. for interest and amortization of all the capital invested, in the installation—for boilers, steam power, material of all kinds, conductors, lamp brackets, &c.—it corresponds to a total of 0.145 francs (1.20d.).

The whole of the expenses, therefore amount to 0.393 francs (3.70d.) per hour, divided as follows:

	FRANCS.
Candles	0.134
Motive power and main'ce.	0.124
Sinking fund and interest..	0.140
Total	0.393 (3.70d.)

The cost of the arc lamps is made up as follows:

	FRANCS.
1. Of the cartons consumed, which, divided by the 2,920 hours of lighting, cost per hour more	0.221
2. Of the maintenance as before	0.620
3. Of amortization charges	1.001
Total	1.843 (17.68d.)

Lastly, the account for the Edison lamps stands as follows, allowing a service of 800 hours per lamp:

	FRANCS.
First cost 7.5 francs (6s.)	0.0094
Maintenance	0.0248
Amortization	0.0191
Total	0.0533 (.51d.)

It should be observed here that the general expenses connected with the production of motive power are, in the original accounts, grouped together, and that the distribution made has been arranged proportionally among the different systems, whilst the expenses special to each system, are in all cases kept separate.

An observation should here be made on the hourly consumption of the Jablochoff candles. Until the year 1882 the lighting of the candles was carried out in multiple chandeliers at the Magasins du Louvre, and with hand commutators manipulated by an attendant, when it was necessary to substitute a new candle for one that was burning out. In consequence of this, in order to avoid accidents, it was necessary to be always a little in advance, and consequently to sacrifice a certain amount of the candle which was not yet burnt. Moreover, when the candles in the first chandeliers of a circuit were lighted simultaneously, it was necessary to regulate the change either by the candle which had burnt the quickest, or by the shortest one of the group. From this it followed that none of the candles were entirely consumed, and a considerable waste was entailed. The suppression of this loss was a problem which long occupied the attention of those using the Jablochkoff candle, and many special devices have been achieved for the automatic lighting of the candles. Unfortunately, all these arrangements, more or less complicated, have failed to answer in practice, although great ingenuity has been exercised on the subject. At the Magasins du Louvre, the practical management of the electric lighting is placed, under the superior direction of M. Honoré, in the hands of a chief electrician, M. Clariot, for a long time in the employment of the Jablochkoff Company. This gentleman has carried out an idea at once very original and very practical, by which, at an increased cost of something less than one centime per candle, the relighting can be effected automatically and without any failure, and to secure an economy of twenty per cent. on the consumption of the candles, by avoiding the constant loss of unburnt ends of candles. This arrangement of M. Clariot, the description of which we mean reserving for the present, thus prevents large losses without any delicate mechanism, and with a certainty that has never failed. Thus manifested, the cost of the Jablochkoff candle per hour is

	FRANCS.
Candle	.101
Maintenance	.124
Sinking fund	.146
	.373

In order to afford a means of calculating in what proportion the various systems of electric lighting which have replaced gas are more economical than the latter, we may add that the Magasins du Louvre pay at present for gas .30 franc per cubic meter (6s. 8d. per 1000 feet), which is equivalent to a cost of .054 franc per burner of 180 liters per hour (6 cubic feet). The maintenance would cause to .003 franc, and the amortization of the installation, calculated on the same basis as for electricity, to .014, or a total of .072 franc (1.60d.) per hour and per burner of 6 feet of gas. The total cost of gas lighting is thus raised to about 8c. 6d. per 1000 cubic feet. We have already seen in the previous article that there has been established at the Louvre one Edison lamp for one gas burner of 6 feet, and one Jablochkoff candle for about ten such burners, while more lately five candles in one circuit of a De Méritens machine have replaced a Bengrot arc lamp.*

Consequently, if we compare the cost of lighting by each system, with 1c. light furnished by one cubic meter (28.3 feet) of gas, we shall have the following values:

	FRANCS.
Cost of gas per meter	.300
Edison lamps .0533	.266
.186	
Jablochkoff candles without the	
Clariot device .393	.918

Or calling the cost of gas 1, that of the Edison and Jablochkoff lights are .76 and .332 respectively. By comparing M. Clariot's arrangement for relighting the candles, the cost is reduced to .307, and that for the arc lamp to $\frac{1.819}{1.650}$ = .195; these compared with gas taken as unity, stand at .22 and .495 respectively. The cost of lighting the gas at the burners, and that of the electric lights, is not included in the comparison, which supposes that in either case this work is done by the staff of firemen retained permanently by the establishment. If, however, this item was estimated, it would increase the cost of the gas lighting and of the Jablochkoff candles without the Clariot apparatus, and would not affect the other systems.

We may now examine a little more closely the cost of lighting by the Jablochkoff system, which has been most elaborated in this installation. We see that is the cost per hour (.373) franc the cost of the candle itself is only a small item, and is one that will be still further reduced, to a certain extent, by further developments to be made in manufacture. Consumption and maintenance correspond to .124 franc hourly. But little saving can be looked for in this direction, because the steam engines employed at the Louvre are of a very economical type, and consume a minimum quantity of coal per hour. With extravagant engines, the element of cost would run up very rapidly, which shows that the selection of a good motor is of primary importance in obtaining economical conditions in electric lighting. The sinking fund for plant and material forms a heavy item. The cost of electric machines and conductors is a large proportion of the whole cost, and which it may be fairly hoped will in time be reduced. The principal attention of many electrical engineers is directed now, and towards new inventions, but to cheap production, and advance is made in two different ways by improvement in construction, and by making larger and more powerful machines. Thus, of the three elements of cost,

* Photometrically, five Jablochkoff candles approximate very closely to one Bengrot lamp; actually, however, the luminous value is higher, on account of the greater facilities for distributing the light.

the first will be gradually reduced to a small extent by improvements in the production of carbons; the second must remain nearly constant, as but little economy can be made by motive power. Thanks to the employment of more powerful electric generators the latter source of expense may be considerably diminished, since the current can be produced more cheaply on a large scale, and the first cost of installation can be reduced.

But little remains to be added to complete this description of the electric installation at the Magasins du Louvre. Reference has been made to one of the generators employed for the transmission of power to a distance. The current produced by this machine flows through a circuit of insulated wire which crosses the Rue St. Honoré and goes to one of the smaller buildings belonging to the establishment. Here the wires are connected to a second Gramme machine, which drives an air pump by means of which the small balloons that are given away are inflated.

At one time this work was done by two men driving a hand-pump, who were occupied the whole day. The transmitting and receiving Gramme machines do this work in six hours, during which time they fill from 800 to 1,000 balloons. There is in addition a second and more important installation, but not yet completed, so that its description must be deferred for the present; this is in a large building erected near the Change de Paris, where, amongst other things, furniture covered with stuffs, such as sofas, chairs, &c., are made; this workshop contains a number of sewing-machines which will be driven by the current. When the installation is complete we shall describe it in detail.

Engineering, March 17, 1882.

ELECTRICITY.

C. Holden, Mass., will extend its fire-alarm telegraph to Brookside.

All the necessary apparatus has been fixed up in the Parliament House, Quebec, for lighting the Council Chamber with the electric light. It is intended to make a trial in a few days.

The Cincinnati & Hamilton Telegraph Company has completed a line to Hamilton in that city, has erected a wire to Hamilton, Ohio, and will open communication between the two places for business, both for the purpose of transmission of various and special messages.

Electrician Sawyer has discovered a cement which he claims will not be affected by change of temperature, and by which telegraph insulators will be cemented to the pin, and which will not adhere to the glass and metal so closely that it will be impossible to remove them. It will not melt under 500 degrees Fahrenheit. Sawyer thinks it cannot be analyzed, and consequently will not patent it.

Mr. Edison determined about two weeks ago to have the entire plan for electric lighting conducted by experts, owing to unfavorable criticisms that have been made. Accordingly Prof. Barker, of the University of Pennsylvania, and President of the American Association for Advancement of Science, Prof. Rowland and other eminent scientific have had free access to the laboratory and machine shop. The report will be made in a few days. It is understood that it will be favorable. Meanwhile Mr. Edison has sold his patent on electro-autograph to the Western Union Telegraph Company for $500,000.

Pierre Valvour, of Lockport, N. Y., has invented a telephone cable. A metallic, elastic, steel vessel, about thirty feet long, contains the conductors and wire. This vessel about 100 feet in the wake of the vessel. When cables have been accomplished, an automatic connection is made with the cable on board the vessel. By this, as the vessel goes on, finds its way to the bed of the ocean. At the point where the sinker is attached the wire is much heavier for a distance of 2000 feet. This at every 200 miles, this shell, which is full of electrical apparatus, is attached. It releases a sinker, thus bring a telegraph wire on the bed of the ocean. The object of the shell is that the wire shall not be at the mercy of the rolling and pitching of the ship.

COMPARATIVE COST OF GAS AND ELECTRIC LIGHT.

TO THE EDITOR OF THE MANUFACTURER AND BUILDER:

In the April number of your journal, I read an article entitled "Comparative Economy of Gas and Electric Lighting," a subject of such importance and universal interest that I am tempted to ask you for a little fuller information regarding the manner of arriving at some of the figures that appear in your treatment of it.

Taking, for example, your calculations on the cost of lighting the Riverside Mills with Edison's appliances. You estimate the cost of the necessary plant, including a 500 horse power engine, with its machines and boilers, at $15,000. This, you say, means an interest of $1.50 per hour for fighting ("including 8 per cent interest on investment"). I cannot make it mean that way, and would ask you to correct my figures. In the first place, the year, I take 6 per cent for simple interest. But how many of the 8,760 hours in the year is the depreciation by final destruction that the engine is subject to? I should think, from my limited knowledge of such matters, at least fifty per month of 6—and how long will this proportion of it last? In other words, what is the life of this class of machinery? If we reserve 50 years, that would necessitate charging 1 per cent per annum for a sinking fund to replace the loss of $15,000 of investment in 50 years. Then, taking the salary of a competent engineer at $60, I have

6 per cent on $15,000 = $900, simple interest.
1 per cent on 15,000 = 150, sinking fund.
Engineer's wages..... 60

Interest and attendance, $1,100 per annum.

Again, I believe the estimate can be reached, it must be known how many hours a day this engine, with its 1,000 lights, would be started up and run. For all the year round, long hours and short days, I think it would be fair to fix Mr. Edison by his hours a day for 300 working days. This gives 600 hours a year on the machine, useful time of the engine and the rest of the investment in 50 years. Then, taking the salary of a competent engineer at $60, I have

6 per cent on $15,000 = $900, simple interest.
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$900, annual interest on $15,000.
150, annual cost of repairs, etc.
60, fuel.

$1,050, for say 1,000 hours, or $1.05 per hour as above.

In this estimate, which, as above stated, we give purely as a guess, it is stated in the article that no allowance is made for depreciation by use of machinery, and it is evidently meant to include the wages of an engineer for attendance, and also for repairs.

Now, I have already been assured that the additional power and attention required when the lights are turned on is looked after and supplied by those already employed about the mill, without demanding a specially chosen attendant. When the machinery is conducted on as large a scale as here, however, it is to the least very questionable whether special services could be dispensed with, and the expenses of the service would necessarily go to swell the cost of the light.

Taking even this as the basis for the economy of Mr. Edison's lighting system—say 105 candle lights per hour—there would still be a very wide gap between the cost of such a project which has so many warm friends and advocates, and the comparatively cheap cost of gas, which we have seen before the electric light will be able to compete with in any but exceptional purposes. One great advantage of gas-light lies in the simplicity of the arrangements for its distribution, and the facility for measurement and sale, while the machinery of any electric lighting system that aims necessarily to secure the electric current for domestic use, is so very complex if highly refined and delicate, as to call for the employment of the most expert talent to attend to the cost of actual service. At Mr. Edison's laboratory things may work smoothly enough, but Messrs. Brush and Harvey could, going to down their hill gloves every time they went a light.

Taking the above estimate of relative economy of gas and electric light, which we should have no fair figures of several gentlemen who have examined and expressed their opinions of the Edison system, will, we think, be far nearer the truth than those which "Piscean" calls into question. In his estimate of the cost of the electric light he has evidently taken the price of 28 candles (which is the usual duty assumed for a 5 foot burner, and also the average rate of one candle per hour per hour, based on the practice of first-class shops, to be 4 mills, which includes fuel, attendance, repairs, and rent, as follows:

Authority.	Light in One Hour per Candle.	Comparative Cost of Illuminating Gas per M. Feet.
Edison, annual cost.....	1-4	$2.80
Sawyer & Man, "	1-4	2.80
Elv., "	1-5	3.50
Thurston.....	1-3	1.05
Sawyer and Man.....	1-3	1.05
Martin.....	1-2	1.40

Taking the best of these figures, we are safe in saying that if coal gas can be put in the holder at a cost of 85 cents, or less, the economy and simplicity of lighting by gas-light will still continue to give it the preference over the electric light with its costly plant and very delicate appurtenances, even supposing the cost of the plant to the case of the electric system would not exceed that of the other, which is certainly not the case. But the figures we are posted, know full well that illuminating gas can be had, and that at a profit, for even less than 85 cents per 1,000 feet, and the local competition between gas and electricity for some years to come will be eagerly watched by the admirers of the latter.

From the previous statements made, the calculation of cost would be for 1,000 hours of service for 105 home-power engines, or above assumptions of 4 cts. per hour per horse-power:

6 per cent interest on $15,000 per hour.....	9
Fuel.....	2
	$11

This result, we think, will be a much closer approximation to the truth than $1.05.

Successful Electric Lighting.

Of the older electric light companies much has been written and said in our columns during the past year or more. Their success as pursuit, local or general, has been canvassed and been circulated in the daily and weekly press all over the land, and especially when over a local organization had been started. Their system was thoroughly and colefully expounded by them, and sought to be, in an unctious public, only too willing to take any light from a tallow candle to the electric fluid-smelling gas. From a sanitary point of view, nothing has yet been written upon this important subject, that does full justice to the case. Whether we shall continue, so to speak, electricity in furnishing a healthful light, or have a poor illuminating, nauseating, smelling gas consume us, is a question of vital importance to ourselves and our posterity, and one that will sooner or later command the attention of the thinking public, as it deserves. Important beyond comprehension at the present day is this one question, and when public sentiment is well aroused it will be sensibly apparent that the future of all electric lighting is solved without regard to cost. The people have progressed in the latter respect very materially since the first introduction of gas-light, and will take a broader and more liberal view than they did in the beginning, and as a natural consequence more willingly pay a fair price than to-day than ever before. The progress has not been slow, but the public is not posted on the question. The patient work of the inventor's brain has discovered new methods of overcoming difficulties; and the practical energy of many men in properly introducing these various appliances to the public would ultimate in giving it the preference over the electric light with its costly plant and very delicate appurtenances, even supposing the cost of the plant to the case of the electric system would not exceed that of the other, which is certainly not the case. But the figures we are posted, know full well that illuminating gas can be had, and that at a profit, for even less than 85 cents per 1,000 feet, and the local competition between gas and electricity for some years to come will be eagerly watched by the admirers of the latter.

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ELECTRICAL REVIEW.

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Fuel.....	2
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Which everyone would like to know. Edward H. Johnson, president, it has made phenomenal progress during that short period. Many people, during that time, they said thorough investigation into the many theories, and investigation into the many theories, and the most advanced and most common sense the best, and has been using the Thomson and Houston systems, but now the Edison system has come out as a part of a parent company, but as they progressed in the character of a construction company, which is, of course, the most successful company, difficulties and difficulties of labor presented, but step after step overcame in the public. Mr. Johnson has given the directors and every member attending a great deal of time and attention to the business, and while the machine or article will be detailed. The Edison system, under which the Edison Electric Light Company—and with this company, Mr. Edison, the inventor of the system, has been associated from the first—has been the most successful of all the companies, and the natural result of the superior merit of the system. The Edison Electric Light Company has been the most successful of all the companies, and the natural result of the superior merit of the system. The Edison Electric Light Company has been the most successful of all the companies, and the natural result of the superior merit of the system.

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Engineering News
March 25, 1882

COST OF ELECTRIC LIGHTING AS COMPARED WITH GAS.

An American paper states that the Brush Electric Light Company receives $7,400 per annum for lighting Fourteenth street, New York, from Fourth to Fifth avenue, Fifth avenue, and Broadway to Fifty-seventh street, and the latter street from Fifth avenue to Broadway. In addition, the company, under its contract, also furnishes two lamps, six lights each, in Union and Madison squares respectively. The street lamps have been lighted for several months; those in the squares have been in operation for a shorter period. The illumination is said to be fully satisfactory. The tower lights, however, are effective only upon a small area, and it is also thought that their effect will be still further impaired by the heavy foliage in summer. The total number of gas lamps which it has been possible to extinguish by the substitution of electric lamps is 450. The municipality of New York formerly paid $17.50 per lamp per annum, which is estimated to have been at the rate of about $1 per thousand cubic feet net; but it is stated that that rate was so low that the gas companies did not care about lighting the streets, the gas lights, therefore, cost the city (and probably the producer) $7.50 per annum. The cost, as reduced by the electric light at a cost of $7,400, is a substantial point, however, and under the Brush Company, as in London, more or less money at this time. The advertisement alone, in either city, is worth something, and it is just possible that this company may succeed in making the contract, at all events, on terms as to be very little margin of difference where gas is supplied at $1 per thousand cubic feet. This, however, it should be clearly understood, is much less than the charge made to private consumers of gas in New York.—*London Architect.*

LA LOMBARDIA 30 Giugno 1882 N. 178

La luce elettrica al Teatro della Scala. — La luce elettrica secondo il sistema Edison farà conoscere ricreerà dal nostro egregio amico ingegnere James Shepherd, sarà quella ventura stagione di carnovale applicata all'illuminazione del palcoscenico del Teatro della Scala.

Dopo gli splendidi esperimenti fatti al Ristorante della Scala e al Caffè Biffi, e l'applicazione negli Stabilimenti di Benigno Crespi e del sig. Andrea Ponti, ora tempo che la si adottasse stabilmente anche nella nostra Milano.

Engineering News
June 3, 1882

ELECTRICITY.

Thereare now 97,000 miles of submarine telegraph cable in use the world over.

The French Atlantic Cable Co. charges fifty cents per word from New York to Great Britain or France.

The Pacific Coast Wire Company connecting Arcata with Eureka, Cal., is still lacking to complete the telegraph circle about the earth.

Altoona's City Council having refused to go to the expense of a telephone for the Mayor, he has connected with the police and will have one erected anyhow.

The electric lights on the City of Berlin has given such general satisfaction that it has been permanently adopted for lighting the saloon, steerage and engine rooms, and will soon be supplied to the other vessels of that line.

H. C. Spaulding and Oliver Harmer, of Topeka, have been trying to arrange with the water-power company in that city to furnish power to run a dynamo for lighting the city by electricity. The proposition is to place lights on high towers at the intersection of principal streets, and they want to run the apparatus with water-power.

An interesting experiment with an electric head-light for sea-going vessels was tried in this city on the evening of the 25th. The air was impregnated with sufficient salt to bring into full relief the beam of light, which was about eight inches in diameter at the reflector, and could be seen for a distance of about a mile. Objects on the other side of the river, the colors in which they were painted and in many instances the letters of their inscriptions. The danger attributed to such lights hereafter has been that the reflection was thrown back into the eyes of the pilot and helmsman, blinding them to all distant objects. But with this present one there is no disadvantage. The reflection is cut off by the smoke-stack, and the only consequence is the fade away in the spar only objects remote from the ship are made plainly visible. As long as the result of dust is more clearly outlined, though some of it is reflected back; in a thick fog it appears to be a bright, white spot. In the Scientific Review, let in the densest fog it will penetrate a distance of 1,000 feet. The light is to be tried on the steamer Scotland at the first favorable weather that lends to the mind of an intensely illuminated fog, and knowing at once the snow would obviate the danger of collision. Such an illuminator would have prevented the recent disaster on the Seine of the collision at sea.

The Electric Light.

"ECONOMY, PURITY, HEALTHFULNESS."

Items of a General Nature pertaining to Electric Lighting, and Especially Devoted to the System of the Fuller Electrical Co., of New York.

VOL. I. ROCHESTER, N. Y., AUGUST, 1882. NUMBER 6.

THE ELECTRIC LIGHT,

A BI-MONTHLY JOURNAL.

GEO. R. MORSE, - - PUBLISHER.

THE ELECTRIC LIGHT will be sent to any address free of charge. While especially devoted to the interests of the Fuller Company's system, it will aim to notice the progress of electric lighting in general, and such other of the manifold applications of Electricity as may be of interest to the business public.

Previous issues, containing much interesting information, may be had by applying to the Fuller Electrical Co., No. 44 East 14th St., New York, or Box 512, Rochester, N. Y. Address,

THE ELECTRIC LIGHT.

DIVIDEND NOTICE.

THE FULLER ELECTRICAL COMPANY.

New York, June 31, 1882.

The Board of Trustees of this Company have this day declared a dividend at the rate of 12 per cent. per annum on the preferred capital stock, out of net earnings for the first five months of 1882, payable on Monday, July 2, 1883, at the office of the Company, 44 East 14th St., New York City, to stockholders of record, June 20, 1883.

The transfer books of the Company will be closed on Wednesday, June 30, and will be reopened on the morning of Sunday, July 2, 1883.

H. SEMOUR GRAVY, Treasurer.

EDITORIAL NOTES.

The new semi-incandescent lamp of the Fuller Company is a great success.

"Our lights run uniform and steady." D. W. Powers, Rochester, N. Y., using 45 Fuller lights.

"I am saving twenty-five dollars a day." Wm. Gleason, Rochester, N. Y., using 10 Fuller lights.

"One of my best investments," says Gen. S. McConkey, Toronto, Canada, using Fuller lights in his refreshment parlors.

The people of an Austrian village recently broke all their kerosene lamps, because they caused most of the fires in the village. The electric light will satisfy them.

Besides the electric light, two or three new processes for producing gas cheaply without coal or petroleum are designed to make gas tyrants tremble.

The Fuller Company is now manufacturing the largest dynamos ever made in the United States for standard lighting, in which they are applying their current regulator with the best results.

In our own country, where a factious opposition exists, on the part of many, to everything that savors of privilege, it is a matter of congratulation that inventors and promoters of electric lighting ought to be given to any corporation whatever.

A correspondent of the Rochester Post Express, writing recently on the subject of street lighting, condemned the clear glass globes ordinarily used, as being productive of dark shadows and unpleasant contrasts. He commends the electric light of London and Paris, "where," he says, "the electric light is seen in its perfection." He continues, "As an illustration of all this, one has but to observe the light used by D.W. Powers in front of his building. These are the only lamps in the city that approach the perfection of the London and Paris lamps." We merely add, for the benefit of those not acquainted with Rochester and its far-famed "Powers' Block," that those lamps are furnished by the Fuller Company.

The electric is much richer than the solar light which reaches us, especially in what has been called the chemical and violet rays. What light is omitted from the carbons and bluish, purple from the arc. The combination of the two gives a characteristic tinge of bluish white.

The secret of the Fuller Company's success may be found in addition to its excellent apparatus, long since proven by undeniable testimony, in strict attention to the wants of its patrons, and care in looking after all the minute details of its business. These principles always secure the favor of a discriminating public.

We regret our inability to notice, as we had hoped to, the electric light display at the Chicago Exposition of Railway Appliances. The lights of all companies aggregated several hundred and lighted the immense structure and grounds as they could not have been illuminated under any other system. The Exhibition closed so suddenly, it was not practicable to have the tests of the several systems made, but the tests would have been of the illuminating and motive power required and other possibilities of the respective machines and lamps.

The Marenge, Trident, Ocean, Redoubtable and Hercules, ironclads of the French fleet, have recently been equipped with Gramme generators and Mangin projectors, furnishing 10-0 lights. The combined effect, at a recent naval illumination at Cannes, was said to be very splendid.

The Philadelphia Times thinks that the underground electric schemes were talked to death in the contest in the council having been between rival speculative enterprises. It is the opinion that no [illegible] privileges should be conferred on [illegible] ought to be given to any corporation whatever.

The keel is very much produced forwards, where, at its lower apex, it has a rough surface of some extent, against which the united clavicles abut. Sufficient material is not at hand for me to say whether xenicyanis ever takes place at this point or not: it may do so, because we find in Aluco these bones usually unite at this point; but yet we come across specimens of this owl where the union is no more perfect than it is here. The hypocleidium of the clavicles, and the manubrium of the sternum, are both about equally feebly developed. The upper extremity of each clavicle has a very broad abutment for the head of the corresponding coracoid, to the inside of which expansion these clavicular bones throw backwards a scapular process; but they fail to reach those elements of the shoulder-girdle, as we find them

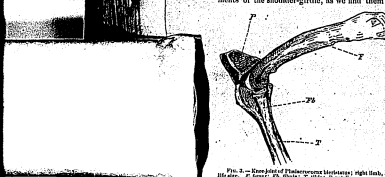

FIG. 3.—Knee-joint of Plusiocrocus bicetaceus; right limb, fifth size. *F*, femur; *Fb*, fibula; *T*, tibia; *Pt*, patella.

in others of the class. All of the bones of the pectoral extremity, or the arm, are completely non-pneumatic, but otherwise well developed. Faint papillæ for the quill-knobs of the secondaries are found along the entire length of the outer aspect of the ulna. The manus is composed of the usual number of bones,—one pisiform for index digit, two for the next, and one for the last.

In the lower extremity we find a femur of 6¾ centimetres in length; a tibia of 11¾; a metatarsus of 6; and the outer toe with five *foleata*, measuring in all 10.7 centimetres. This limb is likewise non-pneumatic, in so far as its osseous structure is concerned. The fibula is carried unusually far down the side of its companion bone, to within 1.3 centimetres of the lower periphery of the outer tibial condyle.

The greatest interest, so far as the bones of the leg of this cormorant are concerned, centres about the knee-joint. Here we find a condition of affairs which is presented in my drawing. The femur, which is much roughened above for the attachment of muscles, articulates about equally with the leg-bones. In front of this joint is placed a very large and massive patella, of a pyramidal form, articulating with more than half its lower surface with the anterior and lower fifth of the femur, its inferior and anterior margin articulating at the same time with the upper border of the cranial crest of the tibia. In front, we find that the groove that exists between the pro- and ecto-cnemial ridges of the tibia is produced on the entire anterior face of this patella, and, no doubt, the muscles of the leg are thereto inserted, as in many divers. Such examples as this throw some light on such birds as Colymbus and Podiceps, where this bone becomes anchylosed with the tibia in the adult. I have not the skeleton of a loon at hand, to examine the process spoken of by Professor Owen (‘Comp. anat. phys. vert.,’ ii. 83), and followed by Dr. Coues in his osteology of the same bird (‘Mem. Nost. soc. nat. hist.,’ i. pt. ii.), as the analogue of the patella. The skeleton I have of Podiceps to examine does not show it; but it is one that has been in my collection for several years, and may have been lost. Penguins have a very large patella, that articulates with the tibia much in the same manner as it does here in Phalacrocorax. Professor Marsh describes a very large, free patella for Hesperornis regalis, and remarks that it bears a general resemblance to that bone in Podiceps (‘Odontornithes,’ p. 30). In examining this bone in the young of our cormorant, it seems to ossify from one centre. The ossification at the summit of the tarso-metatarsus includes the prominent process at the upper and posterior aspect of that bone.

Many other points of interest are to be found in the skeleton of the adult, as well as of the young of Phalacrocorax idiersitatus, which space will not allow me to enter upon here: the leading points, however, I have endeavored to give, and these are always valuable when we wish to have them to compare with kindred forms.

R. W. Shufeldt.

THE ELECTRIC LIGHT ON THE U. S. FISH-COMMISSION STEAMER ALBATROSS.—I.

In pursuit of the hidden treasures of the deep, the work of the Albatross keeps her at sea many days at a time; and the operation

of dredging in great depths often carries the day's labor past midnight. To provide for these emergencies, which are frequent, and to afford ample illumination for the naturalists, not only in assorting the contents of the dredge as it is delivered on deck, but to illuminate their microscopes, delicate balances, etc., in the laboratory, the commissioner of fish and fisheries determined to employ the best artificial illumination the country afforded. As the vessel is essentially a steamer, using steam for every labor where it is practicable, the idea of electrical lighting from a dynamo-electric machine, driven by a steam-engine, was readily conceived, and an examination of the different systems was at once entered into. The Edison company for isolated lighting, we found, was prepared to enter into a contract for a complete plant, including the engine and the wiring; and being able to divide the light into eight-candle power lamps, besides giving guaranties, their bid was accepted.

The arc-lamp, though admirable for our deck, where a great quantity of light in a limited space is necessary, can never, from its great brilliancy, be utilized for twelve or fifteen naturalists, each at a special work, in the laboratory. It also occurred to the commissioner, that a lamp which could be lowered into the sea, to attract fishes, would be useful, thus affording another reason for preferring the incandescent light.

Fig. 1 shows the way in which the arc-lights are placed in circuit. And as each arc offers a considerable opposing electromotive force, it is necessary, in order to get light in a number of such lamps placed in series, to use currents of high tension.

Fig. 2 shows the incandescent lamps in multiple arc. The main wires, *a* and *b*, are tapped at pleasure, and the lamps are hung in the short circuits. The carbon threads in the lamps (described beyond) offer so much resistance that the current heats them to incandescence. The electromotive force in the circuit is low, which renders shocks impossible.

The plant on board the Albatross consists of an eight and a half hp. Ericsson and Sims engine, an Edison *Z* dynamo having its field-magnets vertical, a resistance-box in the circuit of the magnetic field, the main and branch wires, lamp-fixtures, safety-catches, and lamps.

The steadiness and uniformity of brightness of the lamps depend largely on the engine driving the dynamo; and the success of the system lies more in the attention paid to the engine, when the plant is correctly installed, than in any thing else. Uniformity of speed is the great object sought; and, to secure this, Mr. Edison has wisely adopted a high-speed engine with a sensitive governor, which is found in the Armington and Sims engine, represented in fig. 3.

The superiority of this engine lies in its well-

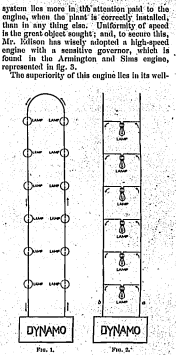

FIG. 1. FIG. 2.

balanced working-parts, its relatively large bearing-surfaces, its sensitive automatic governor, and in its simple and well-balanced valves.

To secure high speed without the noise of ‘thumping,’ great lap has been applied to the exhaust side of the valve, whereby ‘cushioning’ is effected. This cushioning, or early exhaust closure, also effects a saving by retaining, in the clearance spaces, steam which would otherwise have been exhausted and wasted. To prevent an unequal expansion between the piston-valve and its chest, the castings are so made as to allow live steam to surround that part of the chest which surrounds

the working-faces of the valve, as shown in fig. 4, in which S shows the steam space, and E the exhaust space. By this arrangement

FIG. 3.

the valve-stem is packed against the exhaust instead of the steam pressure. The valve is ground to a sliding-fit, and, so far as I can ascertain, there has not been a particle of wear or leak during the ten months the engine has been in operation.

The governor of the engine, that part which makes it especially valuable for the purpose of electric lighting, is represented in fig. 5.

This automatic device is fixed in the fly-wheel, which is keyed to the shaft. There are two eccentrics, E and F, the one within the other, and both free to move on the axis. There are two weights, with their centres of motion opposite, and fixed in arms of the wheel. These

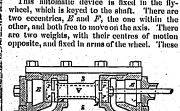

FIG. 4.

weights, W, W, are connected, each to an eccentric, and are connected together by an arm or rod. Springs are provided, to resist the centrifugal force of the weights. The system is so constructed that any centrifugal motion of the weights will throw one eccentric ahead and the other back, thus diminishing the throw of the eccentrics, and effecting a shorter cut-off without altering (within working limits) the lead of the valve. The engine used on board the Albatross has eight inches and a half diameter of cylinder, and ten inches stroke of piston: it runs without noise, three hundred revolutions per minute, requiring no more attention than the oiler can give it in addition to his other duties. When the main engines of the Albatross are in motion, a boiler-pressure of sixty-five pounds is often used, and twenty-six inches of vacuum is scarcely above the average. Lying in port, the boiler-pressure is kept at about twenty-five pounds; and, notwithstanding this great range of pressure, the governor regulates the dynamo to three hundred revolutions per minute, as closely as I can measure it.

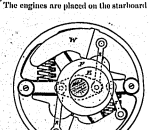

FIG. 5.

In selecting a good engine, Edison has, to my mind, displayed as much genius as in using the Siemens form of armature for his dynamo.

The engines are placed on the starboard side of the main engine-room, the engine taking steam from the main boilers, and exhausting into the main condenser.

The dynamo used on board the Albatross is

known as the Z dynamo, and is installed for what is called a 'tt circuit. It has its field-

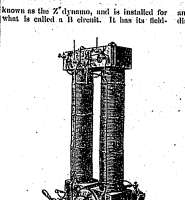

FIG. 6.

magnets vertical (fig. 6), and its armature revolves on a horizontal axis in the magnetic field. The field-magnets are arranged on what is called a 'derivation' from the commutator, placing it in the circuit, as in the Siemens system. In adopting and utilizing known principles and devices, Edison has worked out the details to a state of perfection simply admirable. Wherever the eye rests, it is pleased by correct proportions, sound mechanical ideas, and agreeable outlines.

The armature, on Siemens's principle, is mounted on a wrought-iron shaft. About the shaft, and concentric with it, are circular cylinders of wood, separating copper plates, as shown in fig. 7. Between the plates a and b, and also between a and d, there are annular disks of copper, insulated from each other. Between the plates b and c are similar but very thin annular disks of iron, separated from each other by tissue-paper. This built-up cylinder is then bolted together longitudinally; the bolts passing through the thin iron and copper disks without touching them, but clamping them between the thick plates. Wire bundles or bars are placed equidistant from each other longitudinally, around the cylinder, connecting each a pair of the copper disks, i.e., one at each end; and these bars or bundles generate the current.

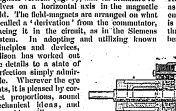

FIG. 7.

Bars of brass or copper, separated by thin sheets of mica, e,e, are dovetailed into the projecting end of the cylinder, which forms the commutator. The resistance of the generator is thus small, and allows great subdivision of the current in multiple arc.

To preserve the uniformity of the current, an adjustable resistance-box is placed in the circuit of the field-magnets; and, when a number of lamps are extinguished, additional resistance may be added to the field by a switch on this resistance-box, whereby the internal and external resistances are balanced, preserving not only the uniform brightness of the lamps, but also the economy of the machine. A test-lamp is suspended on the dynamo; and the fireman, who oils the engine, regulates the resistance according to the brightness of this lamp. Automatic regulators have been devised; but as it is necessary to employ a man to run the engine and dynamo, and as the incandescence is more frequently altered by slipping of belts than by the sudden turning-out of a large number of lamps, the same man can attend both to

consequently the simple resistance-box answers every purpose on board ship.

(To be continued.)

Globe (London) May 22, 1882

ELECTRIC LIGHTING.

The most cursory reader of last week's newspapers could not but be struck with the prominent place taken by electric lighting. If he glanced at the City articles, he read day after day of new companies formed for the acquisition of one patent right or another, and could not fail to note the eagerness with which the public rushed forward in response to the appeals made to them to take up shares in these several undertakings. Or, if, he confined himself to the general intelligence columns, it was equally impossible not to encounter the ubiquitous topic. At one time it presented itself in the form of a scientific lecture, at another in the more attractive guise of a narrative of wonderful results attained in the illumination of great engineering works, the lighting of a city, or, it might be, of a private house. That the subject has come within the sphere of practical questions, and very practical questions indeed, is abundantly evident. A Select Committee has been sitting for several days to take evidence bearing on the proposed enactments of several bills which are before the House of Commons, and though very different opinions have been expressed by the numerous witnesses examined as to points of detail, there is a practical consensus of opinion that we are on the eve of a change in our appliances for the production of artificial light as great as that which occurred more than half a century ago, when gas was beginning to take the place of oil and candles. There is this difference, however, between the past revolution and the coming one—that, whereas that was exceedingly gradual, this threatens to be very rapid in its progress. The use of new inventions extends in these days with a celerity which was inconceivable even a very few years since. The telegraph came into general use but slowly; the telephone has become a necessity of life over half the world within half a dozen years of its invention. There are at the present time 17,000 Brush lights in America, to speak but of one system—1,000 in the New York Central Station—and there is hardly a city in Western Europe or in the United States where one system or another has not been tried. In some instances, the experiment has been held to have failed, but the proportion of cases in which a considerable degree of success has been obtained is so large that no doubt can be entertained even by the most sceptical that lighting by electricity will before long be very generally adopted. It is another question—and one we are not now going to enter upon—whether gas is destined to be superseded. As far as experiments have yet gone, the probability seems rather to be that there are special uses for each of the two illuminating agents, and that while gas will undoubtedly be dispensed with for many purposes, there are others to which the new mode of lighting will prove less applicable, or for which it may be found too costly.

It is safer, however, as Mr. W. Spottiswoode remarked at the meeting at the United Service Institution the other day, to prophesy what electricity can do than what it cannot. A Committee of the House of Commons, not many years ago, ventured on the prediction that the subdivision of electrical force was not to be hoped for. Both subdivision and conservation have now become familiar processes, and it may be that before long means will be discovered of adapting the force which already accomplishes such miracles at our bidding, in other directions to the achievement of results in the way of illumination as yet undreamed of. Mr. Spottiswoode is himself among the most sanguine. He told the Select Committee the other day that he considered the experimental stage to have been passed, and that the adaptability of electric lighting to all purposes had been established. [illegible] Society uses the light himself throughout his house and gardens. The incandescent lamp he regards as the best for the interior of a house, but prefers the arc system for use in the open air. Mr. Spottiswoode's evidence is, in fact, all on one side. With regard to public buildings, he defends it on the grounds that it does not heat the room, and does not vitiate the atmosphere, while its colour is agreeable to the eye. On both these latter points there is room for difference of opinion. Some of the people who read at the British Museum undoubtedly complain of headache, and say that the dazzling brilliancy of the light is hurtful to the eyes. It must be admitted, we suppose, that the complainants are in a minority; for the trustees of the Museum, in their reply to the memorial lately presented to them by 200 members of Parliament, praying that the whole Museum may be electrically lighted, so as to be opened at night, say that the three years' trial in the Reading Room has been attended with "very satisfactory results." The trustees do not see their way at present to applying the electric light to the Museum generally, but we suspect they regard the application as only a question of time. They remark that, where the electric light has been introduced in other similar buildings, gas has been available either as an auxiliary or a substitute, but there are no arrangements for gas-lighting in the Museum, and its use would be injurious to many objects in the collections. "The time has not arrived," therefore, they think, "when the galleries in Bloomsbury can be safely opened to the public at night." The meaning of this would seem to be that when the trustees have satisfied themselves by further experiment that such absolute reliance may be placed on electric lighting that gas may be safely dispensed with, either as an aid or substitute, they will consider the question again. In the meantime, they have had an estimate made of the expense of plant for lighting the whole building, and find it will amount to a little more than £14,000. The Museum of Natural History at South Kensington might, the trustees think, be more safely experimented upon, and no doubt a little gentle pressure exercised upon them would lead to a trial being made in that building. The use of the electric light in dwelling-houses has other advocates than the President of the Royal Society. Sir William Armstrong has tried it for nearly a year, and has lately published an interesting account of his success. Sir William obtains his power from a waterfall nearly a mile from his house, and his only outlay, except on machinery, is the pay of the labourer who attends his machine. His lamp is the Swan Incandescent, which he finds by experience preferable to the arc system, therein agreeing with Mr. Spottiswoode. Sir William has thirty pairs of lamps, the light of each single lamp being equal to about 25 candles, and he praises the system alike for its efficiency and its economy. On the latter point the testimony given by Mr. George Lane-Fox, in his lecture at the United Service Institution last other week, was not a little remarkable. Speaking of the Incandescent Lamp, used alike by the President of the Royal Society and by Sir William Armstrong, he expressed his conviction that a light equal to 150 candles could be produced by it at the same cost as a gaslight of 12 candles—namely, a farthing an hour. This calculation, it may be observed, suggests one of the difficulties which occur to less sanguine people than Mr. Lane-Fox. A light of 150 candles is not wanted in any ordinary dwelling-house. Such difficulties will doubtless be overcome, but so far the experiments tried within doors have been either in public buildings or in large establishments like Mr. Spottiswoode's or Sir William Armstrong's.

There is no doubt of the success of electric lighting in its application to the interior of [illegible] great manufacturing works of various kinds. But there is one special way in which it has been utilised that deserves particular notice. In certain manufactures a great loss of time, and consequent waste of money, is occasioned by the interruption of work on the approach of night. No form of artificial light has heretofore been found powerful enough for the purpose. A striking example of what can be done by electric lighting to meet this difficulty was mentioned by Mr. Hammond at the recent meeting of the Hammond Electric Light and Power Supply Company. It was taken from the process of rolling iron and steel rails as it goes on at such great works as those of the Ebbw Vale Steel and Iron Company, or Messrs. Bolckow, Vaughan, and Co.'s. The process is a very rapid one. The ironstone is taken out of the mine in the morning, and before night it has passed through the various stages incident to its conversion. The rails emerge from the rolling machinery bent and crooked, and economy of manufacture demands that they should at once be straightened. But by this time darkness has come on, and it has been found impossible hitherto to proceed with the straightening operations till the return of daylight. The introduction of the electric light has done away with this difficulty, and the manufacture now goes on without any breach of continuity. Not only, however, is work made practicable when it would be otherwise impracticable, but we are assured that the superiority of the electric light over gas improves the quality of certain work which has to be performed by artificial light to an extent which would be hardly credible. In proof of this it is stated that a new fitting shop, lately opened at Messrs. Palmer's ship-building works at Jarrow-on-Tyne, was supplied with the Brush Light, and the results obtained were compared with those in an adjoining shop lighted by gas. In the opinion of Mr. Gibbs, lately deceased, the manager of the works, the difference was equal to 25 per cent. in favour of the electric light. It is clear, of course, that if such results as these are to be obtained, the question of the alleged greater cost of electric lighting as compared with gas lighting can hardly come into consideration. So of the dangers which may be—and no doubt are—incident to the new system. In great works such as those just referred to we may expect that every needful care will be taken to obviate the possibility of accident by fire or by contact with conducting wires. The popular notion that there is but small danger of fire has been thoroughly exploded, but it is probably safe to say that the danger is not greater than the use of gas involves, and may very likely prove to be less. It has been found, however, to be sufficiently serious in America to lead to concerted action on the part of the insurance companies, and it is likely that a similar course will be taken in this country. Mr. Lane-Fox rather pooh-poohs the danger to life in a dwelling-house from contact with the wires. The supply of light for domestic purposes will require, he says, but a low tension, which cannot affect life—only give the unsuspecting person a good shock, perhaps. That accidents will occur if electric lighting becomes general is certain, because it is admitted by its warmest advocates that it does involve danger, only to be guarded against by well-directed care. That of course is no argument against its adoption, if it can be shown that the care which is needful is such as people of ordinary intelligence, once told what to do, can be reasonably expected to exercise. A good many accidents have occurred in the use of gas, and probably will still occur, though almost every child is now familiar with its dangers, and the way to obviate them. But it will be a long while before we shall be equally familiar with electricity.

[illegible] NEWS — N.Y. Times Sept. [illegible] 1882

EDISON'S ELECTRIC LIGHT.

"THE TIMES" BUILDING ILLUMINATED BY ELECTRICITY.

Edison's central station, at No. 257 Pearl-street, was yesterday one of the busiest places down town, and Mr. Edison was by far the busiest man in the station. The giant dynamos were started up at 3 o'clock in the afternoon, and, according to Mr. Edison, they will go on forever, unless stopped by an earthquake. One-third of the lower district was lighted up, the territory being within the boundaries of Nassau and Pearl streets and Spruce and Wall streets. During the past few weeks the Edison Electric Illuminating Company has been engaged in completing the installations in the premises of its customers by the insertion of meters and lamps, and in procuring inspection of such premises by the Fire Underwriters. As the Board of Underwriters has but one expert, Mr. Osborne, the progress has been necessarily slow, but such portion as has been inspected was supplied last night. Mr. Edison said that the work will be pushed as rapidly as possible, so, that the rest of the district—that lying between Pearl-street and the East River and Spruce and Wall streets, will soon be lighted. The laying of the steam-heating pipes, Mr. Edison added, had interfered with some of the pipes of his company, and it might be necessary to-day to shut off the current in that portion of the district wherein THE TIMES office is situated. The current would be shut off until his pipes could be shored up in that neighborhood.

Yesterday for the first time THE TIMES Building was illuminated by electricity. Mr. Edison had at last perfected his incandescent light, had put his machinery in order, and had started up his engines, and last evening his company lighted up about one-third of the lower City district in which THE TIMES Building stands. The light came in in sections. First there came in a series of holes in the floors and walls, then several miles of protected wires, then a transparent little egg-shaped glass globe, and, last of all, the fixtures and ground glass shades that made everything complete. They were temporary fixtures to give the light a trial, and so were put in with as little tearing and cutting as possible. To each of the gas fixtures in the establishment a bronze arm was attached, and the electric lamps were suspended from the ends of these arms. The lamp is simplicity itself. At the top is a brass circle, from which are suspended the shade and the lamp proper. The latter is a glass globe about four inches long, and the shape of a dropping tear, broad at the bottom, narrow in the neck, in which is inclosed the carbon horseshoe that gives the light. The globe is air-tight, and the air has been exhausted, leaving the carbon horseshoe in a perfect vacuum. When the thumbscrew is turned, and the connection with the electric wires is thus formed, the electric current makes this carbon so brilliant that it would be unpleasant to look at. It is not intended to be looked at, however, being entirely hidden by the ground glass shade. The whole lamp looks so much like a gas-burner surmounted by a shade that nine people out of ten would not have known the rooms were lighted by electricity, except that the light was more brilliant than gas and a hundred times steadier. To turn on the light nothing is required but to turn the thumbscrew; no matches are needed, no patent appliances. As soon as it is dark enough to need artificial light, you turn the thumbscrew and the light is there, with no nauseous smell, no flicker and no glare.

It was about 5 o'clock yesterday afternoon when the lights were put in operation. It was then broad daylight, and the light looked dim. It was not till about 7 o'clock, when it began to grow dark, that the electric light really made itself known and showed how bright and steady it is. Then the 27 electric lamps in the editorial rooms and the 25 lamps in the counting-rooms made those departments as bright as day, but without any unpleasant glare. It was a light that a man could sit down under and write for hours without the consciousness of having any artificial light about him. There was a very slight amount of heat from each lamp, but not nearly as much as from a gas-burner—one-fifteenth as much as from gas, the inventor says. The light was soft, mellow, and grateful to the eye, and it seemed almost like writing by daylight to have a light without a particle of flicker and with scarcely any heat to make the head ache. The electric lamps in THE TIMES Building were as thoroughly tested last evening as any light could be tested in a single evening, and tested by men who have battered their eyes sufficiently by years of night work to know the good and bad points of a lamp, and the decision was unanimously in favor of the Edison electric lamp as against gas. One night is a brief period in which to judge of the merits or demerits of a new system of lighting, but so far as it has been tested in THE TIMES office the Edison electric light has proved in every way satisfactory. When the composing-rooms, the press-rooms, and the other parts of THE TIMES Building are provided with these lamps there will be from 300 to 400 of them in operation in the building—enough to make every corner of it as bright as day. [illegible]

OLD ORCHARD ILLUMINED.

THE FAVORITE RESORT UNDER THE ELECTRIC LIGHT.

A Happy Party Goes Down to Participate in the Festivity.

The train which rolled out of the Boston & Maine depot at 6 o'clock last Monday, at half an hour past noon, had on it a special car which had been furnished by General-Superintendent James T. Furber, for the accommodation of some forty gentlemen, who had accepted an invitation to be present at the first illumination of that popular Summer resort, Old Orchard Beach, by the Pool Electric Light.

The invitations were issued by Mr. Edward H. Goff, President of the Pool Electric Light and Illuminating Company, whose plant less has been established at Old Orchard, making it the first beach in the country to be thoroughly illumined by the electric light. The company consisted of many well-known business men of this and other cities, and representatives of the press, and included, besides Mr. Goff and Superintendent Furber, Dr. William A. Hovey, second vice-president of the company; Col. Fred Mason, treasurer, and F. B. Stanley, general agent of the Bridgport Brass Company of Bridgeport, Conn.; Alderman George W. Fifield, Lynn; Mr. Henry Causey of the Cheshire Mills, Harmer, N. H.; Messrs. Martin V. Brady, B. F. Stevens and Benjamin A. Bilven of Thirteen Falls, Me.; Charles H. Cutler of Brewer, Me., dealers in mill supplies of that city; Mr. M. P. Curren, chairman of the Board of Selectmen of Scarboro; Messrs. Dr. J. G. Owens of Nashua, N. H.; Messrs. Dr. Charles H. Bean, C. B. Bean of the firm of Charles A. Smith & Co., merchants below, at Portland, Me.; A. Upton, general manager of the Jarvis Engineering Company of Lowell, Mass.; Messrs. Dr. Ellis Ames and Col. J. E. Bickford of the United States Electric Lighting Co. of Boston; Mr. A. A. Knowles of the Pennsylvania Railroad; Mr. Wm. H. Brown of the Baltimore & Ohio Railroad; Mr. W. G. Tallman of the Grand Trunk Railway; Mr. J. Tyson of the celebrated Armington & Sims Engine Company of Providence, R. I., who furnish the power to operate the works; Mr. H. E. Irving, manager of the Bridgport Electric factory, Mr. E. J. Welch, electrician, and Mr. C. D. Smith, the superintendent and engineer of construction of the American Electric and Illuminating Company; Mr. Joseph Wheeler of Lowell, Mr. W. G. Hassell of the Boston Evening Star, Mr. J. A. Sears of the Boston Daily Advertiser, Mr. J. Tyson of the Boston Herald, Mr. Henry O'Meara of the Boston Journal, Mr. L. H. Allen of the Boston Post, Mr. James S. Measham of the Boston Traveller, Mr. John H. Bradley of the Boston Newspaper Union, Col. Albert Clarke of the Boston Globe, Mr. Daniel O. Gray, G. P. Howell of the Boston Record.

The ride to the objective point was a most enjoyable one. The car was a new one, tastefully finished in cherry, carpeted with moquette and furnished with elegant cane arm-chairs with spring seats. Fruit and refreshments were furnished during the journey, and at Exeter, the "half-way" house of the journey, the minutes was made and refreshments furnished to those who had not partaken of them before.

Old Orchard was soon reached, shortly after 4.30 P. M., and the party proceeded to the Old Orchard House, where, after a brief rest, luncheon was served. To visit the lighting station is located near the beach, about half a mile west of the depot. Little more than three weeks ago this station was a plain, unfinished wooden building, 40 feet square, with its sills resting upon the sand. The company bought it, converted a basement for its boiler and furnaces, built solid brick foundations and piers for the support of its engines and dynamos, and in the interior placed and appliances of the plant, and finished the wood work outside and inside, making it complete. When the party visited it the mechanics were still at work and the merchant said: "You won't be able to get into this running order to-night, Mr. Goff." "Yes," replied that gentleman, "everything will be ready to turn on the lights at seven o'clock," and the result showed that he was right. After fully examining the station and its machinery the party was treated to a ride along the beach, which was one of delightful. Old Orchard is undoubtedly the finest beach on the Atlantic coast, at least north of Cape May. The breakers, noteworthy standing the calm sea, broke majestically, wave following wave with its white cap, rushing up the beach and, beneath the feet of the horses and the carriage wheels, and then receding to its own domain. Along the beach, as far as the eye could reach, were the people, and the beach lights, forty in number, and placed 4,000 feet apart, were in readiness to be lighted, making altogether a system of one hundred lights.

The plant consists of a steel boiler from the Charles River Works of Messrs. Kendall & Roberts of Cambridgeport, Mass., with the Avis furnace settings, supplying power for three Lawrence engines of fifty-horse power each (two of which are set and running), manufactured by the Armington & Sims Engine Company of Providence, R. I. These engines drive four dynamos of the American or Thomson-Houston system. The furnace consumes one and one-half tons of coal nightly to keep the 100 lights burning from seven to twelve o'clock, the hours during which they are in operation. This is the first time that coal has been thoroughly utilized as fuel by electricity. We read in the society reports of the weekly papers of bonfires by electric light—at this or that watering place; we have isolated lamps here and there. The Old Orchard system thoroughly illumines the whole place within an object measuring more than a mile long and half a mile wide.

The drive along the beach having been thoroughly enjoyed, the party returned to the Old Orchard House for supper, with appetites whetted to the keenest edge, the hour of departure from Boston having followed so closely upon the heels of business engagements as to prevent many from partaking of their usual mid-day lunch. That the supper was an excellent one goes without saying to all who know anything of this excellent hostelry that starred it.

As the sun sank to rest in the western horizon, evidences of festive preparation began to be manifest. Excursion trains from Portland, Saco, Biddeford, Salmon Falls, Dover and adjacent towns began to pour their crowded freights upon the platforms of Old Orchard station. Pyrotechnists were busy arranging their pastime of the festivity on the spacious lawn in front of the Old Orchard House, a lawn that slopes from the broad piazza down to the street and even to the beach, the breakers and the open sea. At about quarter past seven, when the shades of night began to settle down, the electric current was turned on and one and all started, the pioneer in this respect, was lighted as was anything else that was once lighted before.

Meantime the guests of Mr. Goff and his associates, who had accidentally arrived at the latter men and had strolled about the piazzas or the lawn for a short time, were again called together to take carriages for a drive along the beach. But the long trains conveying their throngs of people upon the scene somewhat impeded the way and it was decided to wait until later. The guests therefore took their positions upon the piazza of the hotel and witnessed the finest display of fireworks ever given in the State of Maine. They were from the laboratory of Messrs. Mason & Wells of Boston, and consisted of flights of rockets discharged from mortar points, fire balls of different hues, gold and silver rain, and amber streamers, showers of blue lances and balls of dragon and gold bombs, gold and red streamer balls. There were several set pieces, including stars and crosses. One device was that of two stick skaters, life size, on skates, and the display closed with the set piece, "American System of Electric Lighting," in varied and beautiful colors. To Gods what a sight it was. Probably 20,000 people witnessed it. The grounds of the hotel were crowded, the stairway and platform leading to the railroad depot were crowded, the lawn in front was crowded and the roads were filled with teams and pedestrians.

The magnificent skating rink was like a vision of fairyland, the walls inside literally covered with Chinese lanterns in brilliant hues and gorgeous fluorescence, while the excellent band furnished music for the merry skaters. Fully fifty people were turned away from the rink during the evening, unable to gain admission on account of the crowd. Chandler's Band of Portland furnished the music on the lawn previous to, and during, the fireworks. And away beyond was the magnificent beach, its broad and shining sands stretching down to the glorious breakers, all as plain in the electric brightness of the electric light, at a distance of nearly half a mile, as it had been at noonday. The weather was all that the most exacting could have desired. Even the moon seemed to respect the occasion, and kept herself veiled behind a cloud until after the fireworks were finished.

Among the guests present were Governor Hobbs of Maine, and several members of his staff, the mayors of Portland, Saco and Biddeford, with their respective boards of city government; City-Marshal Andrews of Portland, and many prominent officials and citizens from that and other cities. Notwithstanding the immense throng, there was no disorder and no disorder. Everything was as peaceful as could be wished.

After the fireworks, the party of which it was the GAZETTE'S good fortune to be a member took to the carriages once more, and visited the lighting station to see the working of its practical operation. And what a sight it was! Everything, though started then for the first time, was in as perfect running order as if the plant had been in operation for years. Not a jar or a slip occurred. "There was Mr. Ellis, the builder; of the engines, in his shirt sleeves, personally superintending the work, and examining with the eye of a master every detail of their operation. He found no "screw loose," of course, as any one familiar with his work can readily believe. The wheels of the engines were running at the rate of 300 revolutions per minute, and the dynamo machines 850 per minute, but so smoothly did the engines work that there was no noise, and scarcely may be in the door. The term "illuminated lightning" will apply literally to the production of these engines, for it is but a step from one such as order to create the power which makes the electricity and sends it over the copper grasses over the four corresponding circuits.

After a full inspection of the practical working of the enterprises another drive over the beach under the light of the forty lamps was enjoyed, and it was the sensation of a lifetime. Words cannot describe the beauty of the scene—it must be left to the imagination. The sea lashed, and the sand glorious light, rivalling even that of the sun, in the distance, and the road, with its majestic breakers, rising, falling and shedding their silvery spray. Between, the magnificent beach, broad, smooth and glorious—a very abreast upon which could have almost driven four horses.

But nature will assert itself, and man must eat. So the party returned, almost reluctantly, to the hotel. Now it was with the others was seated, but we do know that the GAZETTE retired, and slept the sleep of the unbelievers, and have by a single exception, who was speedily discovered and knocked out.

In the morning a hearty breakfast with trimmings from the farms of the Messrs. Hanson, on account of the crowded condition of the hotels, being distributed among different ones for the night), and to the train for Boston at 9.30. The same car that brought the party down was boarded and the ride was a repetition of that of the day before. At Dover the Boston train was boarded, aboard and were eagerly scanned, to see what had happened in the night in the glorious town.

A portion of the party, inspired by the irrepressible Furber, of the Baltimore & Ohio, made merry music at one end, gilded by Jim Pinafore, at the other end of the car, and sliding into jubilee melodies with perfect recklessness.

Boston was reached at about 2 P. M., but before a benevolent dispensation of Dr. Goff had been drawn up and signed by every member of the party. Following is a copy:

We, the undersigned, members of the excursion party to Old Orchard Beach, Me., Monday, Aug. 15, to witness the opening and putting into practical operation at that place of the new electric light system of the American Electric and Illuminating Company of Boston, desirous of showing our appreciation of the courtesies extended on that occasion by the genial and hospitable president of the company, Mr. Edward H. Goff, hereby tender our individual and collective thanks to that gentleman, and earnestly hope that the great success of our success that has attended him in this vast undertaking may be but the earnest of success through life. That merit will always come uppermost. We, one and all, vote Edward H. Goff a "prince of good fellows," an efficient officer, and identified with an enterprise that will prove to the future to be a blessing to his whole human family.

Mr. Goff was indefatigable throughout the day in his duties, and he made the party happy, and he was ably assisted by other officers of the company. More than word of thanks is due, however, to Superintendent Furber of the Boston & Maine Railroad for the splendid accommodations his facilities, but then, that is what might have been expected of him. He has a head in it. The company separated, after many handshakings and good-byes, hoping that the chance for a repetition might, in the course of human events, present itself ere long.

The success which has attended the lighting of Old Orchard will doubtless lead to the illumination of other resorts by the American Electric system. It is an electric avenue, and it is a strong one, and the thin end of it is very thick.

THE BRIGHTNESS OF LIGHT IN THE CITY.

To the Editor of the Manufacturers' Gazette.

SIR,—In the report of the proceedings of the Commissioners of Sewers, which appeared in your issue of Wednesday, June 23rd, the minimum charge for electric light per hour for the month of May is stated to be 2.0357c., and the maximum 1.2667c. Now, sir, I am a subscriber to the Incandescent Company's system, and this is upon a wrong basis, perhaps analysis of the figures will show that I am the highest contract tenders received for the three sets, and the lowest tenders received for the principal reason being that I myself as follows: Each set of lamps is supplied with a switch, by which the current can be turned on or off at pleasure, and the consumption of electricity is registered by a meter. Now, sir, I do not object to anyone knowing my business, but I do object to the unnecessary comments. For obvious reasons I will not state the name of the firm which I supply, but will number and mention them in sequence according to their tenders.

THOMSON-HOUSTON OR COMPARATIVE COST OF ELECTRIC LIGHTING PER ONE YEAR.

Schedule No. 1, comprising Norman-street, Gilbert-street, Hill-street, Dundas-street, Clarence-street (from Hill-street) and Clarence-street (from Dundas-street to St. Martin's-le-Grand), Queen-street (from Cheapside to Bucklersbury), and Queen-street (from Bucklersbury to Dowgate-hill).—Estimated annual cost of present gas lighting, about £311; the Jablochkoff system, £1,000; the Brockie-Pell system, £1,000; the Siemens system, £1,000; the Thomson-Houston system, £1,000; the Swan system, £1,000; the Edison system, £1,000; the Crompton system, £1,000; the Lane-Fox system, £1,000; the Gramme system, £1,000; the Brush system, £1,000; the Wallace-Farmer system, £1,000; the Weston system, £1,000; the Maxim system, £1,000; the Ferranti system, £1,000; the Hopkinson

discovery. First, it is a continuous line adjacent to one already lighted by the Anglo-American Brush Company, all the cables from premises or station permanently established for the manufacturing of the Brush machines, the pavements and carriage-ways not presenting any considerable difficulties encountered in No. 3 District; the width of the streets not being so great, nor with any of the obstacles as found by Messrs. Siemens. Another point in No. 1 District is that the gas lamp posts were used, therefore another great saving in the first outlay. With respect to the illuminating power I believe that there is a difference of opinion among the scientists themselves with respect candle power. Messrs. Siemens stated that they gave sufficient light to their district; whilst if more was given by the others it was wasted.

As to the Brush Company "deliberately refusing to tender" for other districts, the answer is they could not, having sold or granted concessions to other companies; with respect to No. 2 District, the same arguments apply as to No. 1 and 3, only in a less degree.

Now, sir, as regards the great difference of price in each district. It is like making a mile of railway through a hill, and one through open meadows. As regards the future cost of maintenance and production of the electric light, eminent electricians say that it will be far cheaper than gas. That is a question I am not able to speak on, but this I would venture to say, that if the local authorities would but lay down the "permanent ways" for the electric light, giving to all private houses and establishments on the route every facility to have their premises lighted, so that electric companies contracting would only have to thread their cables through, and lay down their own machines and at the end of their term they could take up their machines and take out the cables, the less would then be titling monopoly.

The local authorities and their officers would be by far the best persons to carry out the laying of pipes, being accustomed to, and fully aware of every difficulty that is likely to arise, and they would keep a bold open the light of the future such as they ought now to have on the water supply of the metropolis.—I am, &c.,

ONE WHO KNOWS.

TO THE EDITOR OF THE CITY PRESS.

SIR,—My attention has been drawn to a short report of a meeting contained in your issue of June 14th respecting an opposition of Mr. Siemens's system of electric lighting. In the condensed form of your report when I actually stated less to some extent becomes inaccurate. I said that I had been associated in duties with Mr. Peter McKillop, of the Royal Arsenal, some 20 years ago, in connexion with the production of electricity for the purpose of firing guns at proof, and that the present form of incandescent lamp was identical with that introduced so long ago for artillery purposes. Further, that Mr. McKillop invented, and that I myself had worked at proof of guns, exactly the same form of switch as those now in use for electric connexion and disconnexion, for lighting and other purposes, therefore I could claim to know something about electricity for many years, particularly as it was a subject which I had ardently studied and switched in all its aspects since the period in which I had been gained an insight into it.

I write this note to you because your condensed report has caused somebody to take undue upon him by the *Electrical Review*, which paper, in a sneer, wants to know what connexion there is between firing guns and electric lighting. Perhaps you will allow me, through your paper, to say that I think there is some connexion between the two, since the same generators and currents for firing guns on board our ironclads that you have that which is now and is destined to be so very useful, safe, and economical on all our men-of-war. The *Electrical Review* does not seem to be aware that the generators which gives that powerful light for the discovery of the advance of the torpedo-boat at night, fires the gun with which this is swept of naval warfare. There is the cadet who passes out of the Royal Military Academy at Woolwich for the Royal Artillery or Royal Engineers, that is "not well instructed in all the principles of electricity, including lighting, and who is well able to take charge of any service or otherwise, whenever the opportunity arises."—I am, &c.

Journal of Gas Lighting, Water & Sanitary Article, June 16, 1882

ELECTRIC LIGHTING MEMORANDA.

THE anticipations of those who looked upon the Electric Lighting Act of 1882 as premature will probably be regarded by them as justified by the fact that only four applications for the present year, involving a total capital expenditure of £200,000, have been received by the Board of Trade for Provisional Orders under the Act. Last year there were 100 applications, the great majority of which were rejected or allowed to drop; and not one of those that were finally granted has been put in force. There are spasmodic displays of scanty electric lamps in districts for which statutory powers were obtained; but as not one of them is on a scale that could not have been attempted without formal permission of the kind, the utility of the Act may well be called in question. The very fact that a law ushered in with such a flourish of trumpets should, in the second year of its existence, so invoked by four applicants only—and half of these asking merely for the transfer of Orders previously granted to others—is a luminous illustration of the extent of the need for it. Although in the positive sense of facilitating or fostering a business in electric lighting the Act is a failure—simply because the business which it was intended to regulate has no existence—it has been successful in preventing a great waste of money in the attempt to force electric lighting into unnatural favour. There can be no doubt that but for the fear of the Board of Trade, and the question of coal deposits, bubble Companies into existence, and have struggled on for a year or two, not without causing trouble and entailing expense on the ratepayers and residents of the places favoured by them. Instead of this, the Act has confined the game to Local Authorities with more ambition than wisdom, and the Companies who could show that they at least had some money to spend. How many of the latter will survive to make use of their shadowlly defined charters, or how many of the former will grow tired of their useless privileges before these become duties, remains to be shown.

A very neatly worded account of the electric lighting of the libraries and dining-rooms of the House of Commons with Edison lamps appeared in *The Times* of the 14th inst. The engines and boilers, connections and fittings, are described with great care, and the impression evidently intended to be conveyed by the paragraph is that no expense has been spared in making the installation complete in every respect. The notice contains this sentence: "Ample provision has been made against any failure of the light, from accident to the engines or machines." This is what *The Times* says; hence it is only natural that inquiry should reveal the fact that on Saturday, the 9th inst., the *Pall Mall Gazette* contained the following paragraph:—

> The occupants of the reading-room of the House of Commons had a very exciting evening adventure on the occasion of the electric light going out, without the slightest warning. The whole place was thrown into total darkness, the honourable members are said to have "rushed from the room under the impression that something dreadful was about to happen."

Comment is superfluous.

At last a decision has been arrived at in the case of the Metropolitan Brush Company. The proprietors have determined to wind up the concern, and to try how much money they can recover from the promoters. The Shareholders' Committee have carried everything against the Directors; and, among other things, the Holborn Provisional Order will be thrown overboard. The Directors clung desperately to this Order, as well they might, for it is the only thing they could show for the quarter of a million sterling or thereabouts that has passed through their hands. They obtained, at the Annual Meeting, a resolution declaring that, to carry out the Order

and provide lighting at the cost of gas would result in a profit of 8½ per cent. On the other hand, Mr. Robert Hammond (who, of course, had a finger in the pie) told the shareholders that the Order could only be carried out at a loss of more than £9000 per annum. If anything done by the fact that, after stating this opinion, Mr. Hammond offered to buy up the whole concern, for the Company that bears his name, for £80,000 in 6 per cent. debentures, and £30,000 in 5 per cent. deferred shares, or instead thereof the round sum of £80,000 in cash. Considering that Mr. Hammond's own connection with the promotion of the £30,000 a concern which a few months ago paid £286,000 for patent licences alone, was rejected with contumely in favour of the resolution to voluntarily wind up the Company,

ELECTRIC LIGHTING MEMORANDA.

The time has come for the deposits of capital to be made with the Board of Trade in respect of the Electric Lighting Orders granted last year. Within six months from the date of confirmation is the time appointed under the Act; and this period having nearly expired, the various Companies are now casting about for excuses to obtain an extension of time. Among others, the South Staffordshire Electric Lighting Company—one of the Brush swarm—have an Order for lighting Wolverhampton; but, of course, they are not ready to begin, and so they ingeniously ask the Board of Trade to give them other six months' grace, while they can watch how the Consolidated Electric Lighting Company (another set of the Females) get on at Colchester. Considering how many times the world has been assured that electric lighting —and especially the Brush system—has passed the experimental stage, it is odd that the Wolverhampton speculators still find it advisable to wait upon Colchester. Of course the Town Council of Wolverhampton are assured by the local speculators that there is not the least doubt of the result, but still it will be better to wait and see. Strongly enough, the Town Council do not appear to understand the position; and therefore they have successfully opposed the petition for an extension of time, with the probable result that the Wolverhampton Order will be revoked void six months earlier than it would otherwise have been. There is some show of indignation in the district in connection with this matter, now directed against the Town Council; but this feeling will probably turn against the real culprits when the true state of affairs is better appreciated. It remains to be seen, in the other cases of application for extension of time for deposits, whether the Board of Trade will prolong the agony, or make a clean sweep of the original Companies by demanding the prompt fulfilment of their financial engagements. It is idle to pretend that the cause of electric lighting will be served in the long run by continuing the existing Provisional Orders in the hands of those who have neither present means nor prospects of doing anything.

An extraordinary general meeting of the Gilcher Electric Light Company was held on Wednesday last, when the proceedings deserved the publication of "extraordinary" in the limited to the meeting was for the purpose of authorizing the Directors to accept surrenders of shares, and to make other arrangements which will eventually reduce the capital of the Company from £106,000 to £90,000. It was stated that the Independent Committee have been at work during the past three months upon the arduous task of reorganizing the Company's affairs. The work has been so successful that one may picture the hardly-used shareholders of the Metropolitan Brush Company, who are just beginning a similar enterprise, blinding themselves by solemn oaths not to stop until they have attained equal fortune. Briefly, the promoters of the Gilcher Company have redeemed £70,000 of the £100,000 paid for the patents, and the original patentees have also given £80,000 of the purchase-money. Besides this, a saving of £200 a year has been effected in the item of rent; the Consulting Electrician has deferred for five years the annual fee of £1000 a year, have been arranged. It will now only require a clear profit of £6000 to pay a 5 per cent. dividend on the reduced capital, instead of £12,000 as formerly. Whether there is really any better prospect of earning the one than the other is very certain. The Directors announce that they are doing a considerable amount of lighting in different parts of the world—one installation being at Lyttelton Harbour, New Zealand, in succession to the Brush Company. The most important installation, however, is that at the Crystal Palace, where 72 arc lamps are to be maintained at a price which the Gilcher Board describe as directly profitable, but which the *Electrical Review* has stated to be "considerably lower than many well-informed engineers consider a remunerative one." This Gilcher lighting prospers.

The petition of Messrs. Peebles, Sir Edward Ingledeu, and Co., for winding up the Metropolitan Brush Company is fixed for hearing on the 7th inst. by Justice Kay. This is more than the "beginning of the end" of the largest of the concessionary Brush Companies; it is the end itself. The Board of Directors ceased to act at the termination of the last shareholders' meeting; and therefore the Company, as a going concern, became extinct at the same time. It has been repeatedly urged on the part of the Board that the Provisional Order for lighting Holborn should be proceeded with, on the ground that it would be so profitable that it would pay to keep the whole machine going for this particular purpose alone. The Shareholders' Investigation Committee did not take this view; but—apparently in order to test the good faith of the Board—they offered to take up the work on behalf of the proprietors, or to try and dispose of the Order, for which they had been assessed "money had been offered." The proposal was declined; from which it appeared that the real object of the Directors, in putting forward the imaginary advantage to be derived from this Holborn Order, was not so much a desire to do the work as to keep the game up a little while longer in their own hands, by making this their excuse. If they were not allowed to carry out the Holborn Order themselves, the Shareholders' Committee should not do so, however profitable it might appear. Hence it is not to be wondered at that the proprietors—to whom this little plot was exposed by one of their own Committee—declined to allow such a Board to continue in office any longer, especially as the cost of maintaining the Directors and staff amounts to £8000 a year, which, if allowed to run on, would soon eat up the present dispondent cash balance of £30,000.

ENGLISH MECHANIC AND WORLD OF SCIENCE.

THE ELECTRIC LIGHT IN THE CITY.

WE gave on p. 289 of Vol. XXXII. a somewhat lengthy account of the experiment to of the alternating machines are also excited light in fog; the effects, if any, of lightning short account of the experiment to of the alternating machines are also excited light in fog; the effects, if any, of lightning be made in the City of London with the concessionary Brush Company's machines, and also of the current from a small dynamo will be witnessed; and lastly but not least, we electric light—an experiment which it is considered will have a most important effect on the progress of the "new" system of lighting. It will be remembered that one of the streets were excepted from the compulsory taking over by the Brush Company, and that though Crompton's is not adopted, we may be satisfied that there will be no needless trial of an already well-tried system. The Brush system extends from the Surrey end of Blackfriars Bridge, along the north side of Bankside, Southwark Bridge along Queen Victoria-street to Blackfriars Bridge is to be 22,000 feet for the 250 days during which the experiment is to last. The machine-house, with engine groups, each with its separate steam-engine, and a third engine in reserve. The machinery supplies current for six powerful lights, varying light about, at night, 4000 candles; for the larger as much as 6,000 candle-power. Each of these lamps has its own dynamo machine, while the 28 smaller lights are worked by two alternate-current machines each having 14 lamps. The lamps have double carbons and, in two groups of seven, are so arranged that, if either one of them should be burning too brightly, the other will be shaded from the full power of the current, so as, above this point, to reduce the light. The carbons in all the lamps are placed with copper, there is the largest lights being 2½in. long and ⅞in. in diameter, the negative or lower carbon being smaller. The other lights being worked by alternating currents, the carbons are both of the same size, being 1⅝in. long by nearly ½in. (0·5in.) in diameter. As to the photometric value, the estimate is that the small lights, 2

THE EDISON ELECTRIC LIGHT INSTALLATION IN NEW YORK.

WE have previously mentioned that the Edison Company were laying down mains and fitting up wires for an installation of the electric system of lighting over about one square mile of the business section of New York. The district includes 950 subscribing consumers whose premises are already wired, the number of lamps in which is nearly 14,000. About one-third of the whole area has now been working for some days; but before all the subscribers in the square mile can be accommodated, the plant must be nearly doubled, as each generator is equal (in practical working) to only about 1,200 lamps (nominally 1,800), and at present six dynamos only are ready. About fourteen miles of street mains have been laid; and the experiment, so far as more than yet reached this country, is a success, about 7,000 lamps being steadily supplied, including those at some of the newspaper offices. The central station is situated in Pearl-street, a short walk from Fulton Ferry, the building itself being merely a shell inclosing the platforms by means of which the apparatus is placed. The building is about 50ft. by 100ft., and is divided by a middle wall into two equal portions, one only of which is at present occupied by plant. Originally erected for commercial purposes, it was quite inadequate to support the great weight of the machinery, and as it now forms merely a shell, the new interior which is composed of iron pillars and girders resting on a substantial base of concrete. The boilers in the section at present working are four in number, of the Babcock and Wilcox type, each being of 250 horse-power. These boilers are of the water-tube class, having long inclined tubes set between external walls, and each with a shell reservoir, the bottom of which is exposed to the direct rising heat of the tubes. The fronts are completely finished in white enamelled brick, the footwork is used as the doors for coaling, and engine of about 20 horse-power is placed there for working a fan to supply air to the furnaces, and keep up a draught. Coal, which, at the same time, by means of screw conveyors, it keeps up a constant supply of coal to, and removes the ashes from, the stokeholds. The boilers being arranged on opposite sides, the firemen have only a short distance to walk to reach the coals, and the place is kept as clean and tidy as possible. Each boiler has an injector, and one large steam-pump is so fitted that it can supply any or all of the boilers. The feed-water is heated as far as possible, by being forced through a feed-heater which receives the exhaust of all the engines. The object is not merely to secure the greatest degree of economy of heat, but also as far as possible of the impurity of the water before it reaches the waterbottom of the boilers. The steam is taken by an 8in. pipe, from which 3in. pipes rise vertically to the engines on the floor above. Each dynamo has its own engine on the same base-plate, the combined set weighing nearly 20 tons. The engines are of the Porter-Allen type, with cylinders 16in. diameter, 24in. stroke 160n. The cut-off is regulated by the governor, the engines being set to run at 350 revolutions, with a pressure of 120lb. per square inch. The connecting-rods dive direct on to comparatively small disc flywheels carried on shafts coupled directly with the armature shafts of the machines. Some idea of the enormous dimensions of the dynamo may be gleaned from the following figures:—Length of armature, 5ft. 10in.; diameter 2ft. 2in.; weight 9,000lb. The field-magnets, of the horizontal pattern, weigh nearly 15 tons, and the height of the machine from floor is 6ft. 5in. The resistance of the armature is .0028 ohm., and the current of so low an intensity that it can cause no injury to anyone inadvertently handling or touching the wires. The six dynamos are arranged in a line on one side of the room, and are alternately connected to the heavy copper bars forming the main leads on opposite walls, the bars of like sign being connected together at the front of the building, where the entire the current is collected into two large horizontal copper bars with which the leads laid under the streets are coupled. These street-mains vary in size, some of them being equal to a copper rod of about half-inch sectional area, while others are equivalent to about ten wires of No. 10 gauge, and others again so relatively small as to equal only about two No. 10 wires. The leads, except where they diminish to the size of wires, are of nearly semi-cylindrical section, and are placed in iron tubes which are filled in with insulating material. Here and there are service-boxes, in which the leads are so shaped that they serve the double purpose of taking up expansion, and allowing for contraction, while affording a ready means of making connection with the wires which convey the current to the wires which supply the consumers. The regulating apparatus consists of a circular switch and a number of resistance coils, and is so arranged that the attendant to judge of the strength of any dynamo has the field-magnets, it should be mentioned, are in shunt with the armature, and which can be increased from a function of an ohm to seven and a half ohms, which is the greatest resistance necessary to control the current used for excite the field-magnets. The circular switch is operated by a horizontal shaft through sets of mitre gearing, and the indicator is an ingenious arrangement by which unskilled labour can be utilised for regulating the current. When the indicator consists of a couple of lamps, one of blue, the other of red glass, neither of which is illuminated when the current is normal. The electrical arrangements are so made that when the resistance of the shunt circuit is too small, the blue lamp is illuminated, and the attendant turns his wheel in the direction in one constant circuit after another until his blue lamp goes out. If, on the other hand, the red lamp shines out, the switch is turned in the opposite direction, and the resistance in the shunt circuit is increased. The dynamos work on the same circuit normally, but each is provided with a switch for cutting it out. This switch consists of a couple of bars pivoted at one end, and which a cross-bar carries three plates, about 1ft. long; which can be brought down between three pairs of fixed contact-plates, each pair thus closing, as it were, one of the plates on the movable lever. A pressure-relieving tends to force up the bars from the movable portion of the switch, and a catch keeps it in position when the plates to which it is brought are required to be in the circuit. If there is any reason to suspect that a dynamo is not doing its proper amount of work, a touch on the key of the switch at once causes the needle to arm, which flies up and breaks the circuit. The suspected dynamo is then connected to the test battery of league, 1,000 in unit, which is erected in one of the towers on the top floor, and if it raises those to a state brilliant incandescence, the machine is credited with being in proper order, and is supposed what must be looked for elsewhere. The machine, as we have mentioned, possesses a nominal capacity of working 1,800 lamps, but it is not intended to have more than just 1,200 lamps to at once; hence, if one unit raise the to brilliant incandescence, it is in a condition to start in full capacity. The normal condition of Edison's lamps is just short of what would be termed brilliant incandescence. The reason the dynamos not worked up to what is alleged to be full capacity can be easily gathered from what we have said. At present, the bulk the generating establishment is supplying the electrical of the whole area is lighted. When the other half is coupled, as we may assume that it has been will be able to supply the 14,000 lamps, now wired; but already there is no reserve in case of accident to one of the machines. The engineering has been provided for, it is alleged fact that the machines are capable of working more than 50 per cent. above their rated power. Given only one machine at the station, and one lamp on the circuits, and the current would be delivered to the latter in many places, for it is nearly and pure, and while scarcely heated the air, certainly does not vitiate it by the presence of a number of carbonic acid. Should sundry defects will be discovered before arrangements before many weeks are although it must be acknowledged that the Edison and Swan lamps are working well, and have endeavoured to make the installation as complete as possible in every detail. We have heard of some defects in the insulation of the main leads, and the New York people may be relied upon to imagine some exciting fearful freaks of the "electric fluid" on the present the installation has settled down to ordinary work, and as the plant on the large scale, it will unquestionably of great advantage to the engineers of similar installations, especially if, as is to be hoped, they will favour us with accurate accounts of the actual cost are published.

THE ELECTRIC LIGHT IN A FRENCH WORKSHOP.

THE electric installation at the railway works of Saint Denis is pronounced by *Le Moteur* one of the best examples that could be cited of the great variety of applications of which electricity is susceptible, and the numerous services it may render when judiciously employed.

The workshops and sheds of Saint Denis are exclusively—at least in the part lit electrically—devoted to the construction of railway carriages. The numerous machines located in this manufactory are driven by a seven-engine of 60-horse power, of which there is always at least, 10 available (otherwise) during the whole time of work, but the nature of the work does not allow of taking more than 10 in a permanent way at any moment; and yet this available force would be insufficient for lighting the workshops, which is effected with 70 arc-lamps of the Weston system, and 24 Maxim incandescent lamps; representing, when the whole is in operation, a work of 15 to 16 horse-power. This difficulty has been got over by the use of accumulators in the following way:—The dynamo electric machine which, in the evening, feeds the Weston lamps, serves by day to charge the accumulators, which, in the evening are discharged through the incandescent lamps. Thus, the available work of the engine is utilised throughout the day, and a single dynamo-machine suffices to supply the whole lighting service, which is then established under the best economical conditions.

The accumulators employed in this installation is a combination of the Faure and the Sellon-Volckmar system, with inductors in circuit. Its furniture, which consists of 220 accumulators, an electro-motive force of about 250 volts, and a current of 200 ampères, is found sufficient to feed 10 lamps in circuit, which is less than 25 effective volts per lamp.

By day, the machine-current is sent into the accumulator with gathered plates of the Keiath system, arranged in two series of 30 elements each. A two-direction commutator allows of changing the course of the current at will, in the Weston lamps, or to the accumulators. The arrangement of the machine requires, in this latter case, some special precautions. It has been stated that the inductors of the machine were placed in the same circuit. It results from this that if the machine were directly shunted to the accumulators, at the moment of charging, the current of them would increase the excitation, and consequently the current produced in the machine, and the effect of this would be to quickly *complete* the accumulators, instead of filling them, and perhaps they would be damaged. The following method is adopted to obviate this:—The circuit of the machine is first closed through a number of sulphuric acid voltameters, of the same kind as those which serve

SCIENCE:

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Since we last referred to Mr. Edison and his incandescent lamp, the subject has been advanced another step and the final stage of complete and unqualified success achieved; permission has been granted to the Edison Light Company, to place surface conducting wires under the streets of New York City, and in the course of the next two or three months one large district of that city will be enjoying the full benefits of Mr. Edison's system of electrical illumination.

Taking a retrospective review of public utterances on this question during the last eighteen months, we now extend our condolence to a certain class of professed scientific experts who have maintained, from first to last, the impracticability of Edison's well-devised plans.

Never in the annals of scientific discovery has a grosser attempt been made to pervert the truth, and mislead public opinion.

As one instance among many, let us take up what is offered as a standard work of reference on this subject: "The Electric Light, its Production and Use, embodying plain directions for the working of galvanic batteries, electric lamps, dynamo-electric machines, etc," by J. W. Urquhart, C. E., edited by F. C. Webb, M. I. C. E., M. S. T. E., London, 1880. Under the heading of "Edison's Lamps" we find "much interest has been taken in the sensational and often absurd announcements, concerning apparatus in course of perfection by Mr. T. A. Edison, of Menlo Park, New York (?), and it was in *some quarters* thought, that when he had set himself about the task of inventing an efficient subdivision of the electric light circuit, *something* would in all probability be done."

"There is little probability, however, that this lamp (the horse-shoe carbon), will prove constant. Burnt paper in various forms has been repeatedly tried before, and it is assuredly not constant, in the best possible vacuum obtainable." "We may indeed rest assured, that upon further reflection, Mr. Edison will abandon this imperfect burner." The same authors in speaking of the "Sawyer lamp," describe it as "the best incandescent lamp of this kind that has been invented."

Such being the teachings of an educational work, written by professed teachers on this subject, let them be compared with the actual results achieved, and the relative positions of the two men at this moment. Seldom has the irony of events demonstrated more forcibly that the honest work of a man is proof against the assaults of fraudulent or ignorant critics, and that the leveling influence of time always reveals the truth.

On the various attempts to imitate Edison's lamp we shall offer but a few words, for most practical inventors are usually plagued by men who endeavor to duplicate their successful inventions. If "imitation is the sincerest of flattery" we suppose Mr. Maxim is merely desirous of paying Edison a high compliment. Concerning Mr. Swan, of Newcastle, England, who professes to have perfected a horse-shoe carbon lamp, apparently identical to that of Mr. Edison's, we would draw attention to the significant fact, that in Messrs. Urquhart and Webb's work on the "Electric Light," dated as recently as April, 1880, and published in Mr. Swan's own country, not a single reference is made to the Swan electric lamp—in fact, his name does not occur in the book. This would appear to be conclusive evidence that neither Mr. Swan, nor his lamp, were known in England up to that date—unless he is included among the nameless crowd, spoken of by the authors, who had "repeatedly used burnt paper in various forms," and who *failed to secure constant results, even "in the best possible vacuum obtainable."*

were of special interest; earthquakes were reported in New Hampshire and California on the 19th, and in Maine on the 21st.

HISTORY OF THE APPLICATION OF THE ELECTRIC LIGHT TO LIGHTING THE COASTS OF FRANCE.

I.

THE value to navigation of thoroughly lighting our coasts is too evident to require any argument in its favor; and, in view of the immense interests at stake, there is no question but that improved methods of lighting should be adopted, almost regardless of expense, providing that the advantages gained are in any way commensurate with the cost.

France has long appreciated this; and it is to her that the world owes the Fresnel lens and many improved lamps burning successively whale, vegetable, and mineral oils. She has finally led the way, as usual, in the use of the electric light, which has been definitely adopted for the lighting of her coasts, after many expensive and conclusive experiments; and, when the plan has been fully carried out, France can boast of having the best and most systematic method of coast-lighting of any country in the world.

The United States has followed France. Our optical apparatus has been almost exclusively imported from that country. We use lamps made after French patterns, and now we are making experiments to determine its value for our lighthouses. This is deemed sufficient excuse for giving full details of the French system. The information has naturally been mostly obtained from French sources.

It was in 1863 that the electric light was for the first time used in lighthouses. The experiment was made with an Alliance machine in the first-order lighthouse of la Hève, near Havre; and the results were so satisfactory that doubtless all the lighthouses would have been immediately furnished with electric lights, had it not been for the great expense attending a general alteration. It was proved that the electric light was seen about eight kilometres further than the oil-light, and that, in time of fog, the range of the former light was more than double that of the latter.

M. Quinette de Rochemont, ingénieur des ponts et chaussées, published in 1870 a report upon the lighthouses at la Hève. Below are some extracts:—

"The electric light having been installed for six years at la Hève, enough time has elapsed to allow us to form an exact idea of the value of this means of producing light for the lighting of coasts. Sailors take pleasure in recognizing the good services rendered them by the electric light. The advantages of the system have been highly appreciated: the increase in the range of the light is very apparent; and, although, on a slightly foggy weather, many ships can continue their voyage, and enter the port at night, which they could not when oil was used. The light, which at first was rather unsteady, gradually acquired a remarkable fixity, thanks to the improvement of the apparatus and the attention bestowed by the keepers. The fears which were at first entertained regarding the delicacy of certain parts of the apparatus are not realized in practice. The accidents have been rare, the extinctions short and very few,—two only during this period of six years having had a notable duration: one, of an hour, was due to an accident to the steam-engine; the other, of four hours, should, it appears, be attributed to malevolence. Under these circumstances it seems hardly worth while to worry about possible accidents."

Since 1863 experience has only confirmed the favorable views of M. Quinette. The lighthouses of Gris-Nez, France; Cape Lizard, England; Ostenx, Russia; and Port Said, Egypt,—have been provided with electric apparatus; and there is a question of placing it in the lighthouses of Flushe and Palmyre, France, and in several lighthouses in other foreign countries.

The following information was furnished by MM. Sautter and Lemonnier:—

"When the light is to be fixed, the optical part of the apparatus is composed of a lenticular drum of *papier mâché*, which renders the rays horizontal in the vertical plane while allowing them to diverge in the horizontal plane. The dimensions of this drum vary from a diameter of half a metre for a fourth-order light to one metre for a first-order light. This increase in diameter of the apparatus is sensibly proportional to the increase in diameter of the carbon-pencils between which the voltaic arc is produced, and which determine, by their position, the dimensions of the electric light. It follows from this that the vertical divergence remains the same in the different types of apparatus. When the light is to be revolving, the fixed lens is surrounded by a movable drum formed of straight vertical lenses, of which the form varies according to the characteristics desired to be given to the light."

Revolving electric lights have this great advantage over revolving oil-lights: the flashes can be given a duration equal to that of the eclipses. In oil-lights, when the light is concentrated in the form of flashes, there are two ends in view: 1°, to augment the intensity, and consequently the range, of the light; 2°, to create an appearance different from that of a fixed light. The first can only be obtained by giving the flash a duration much shorter than that of the eclipse; or, in other terms, by making the angle of the luminous beam a small part of the angle embraced by the lens. Moreover, this angle depends on the dimensions

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The Edison System on Board Steam Vessels.

The Edison system of electric lighting has contributed largely to demonstrate the merits and advantages of the electriclight over all other means of illumination for steam vessels, by the uniform success and satisfaction which have attended its use in numerous installations. Assuredly it needs but an installation like that on board the Pilgrim to prove the general practicability and the desirability of the electric light for steam vessels of all kinds, and at the same time to bring into relief the particular excellence of the Edison system for the purpose.

Although we gave in our issue of June 23 an extended notice of the installation on the Pilgrim, which was a thorough enough review of the peculiar features of this electric lighting feat to call forth from the officials of the

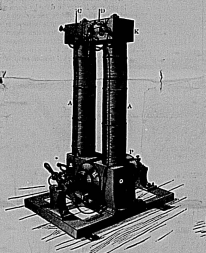

FIG. 1. THE EDISON Z DYNAMO.

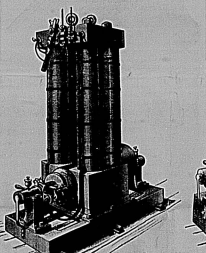

FIG. 2. THE EDISON L DYNAMO.

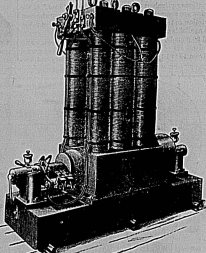

FIG. 3. THE EDISON K DYNAMO.

Edison company the compliment that it was the best account yet published on the subject, and which also enjoyed the distinction of being reproduced in several of our foreign exchanges, we had nevertheless proposed to enlarge still further on the installation, with illustrated descriptions of the apparatus used. Meanwhile, however, installations of the Edison system have been in progress on several other vessels, and the details and data made accessible to us concerning them reveal some novel features of value. In view of the fact that the adaptation of the electric light to navigation is an important question at the present time, and one which is being made the subject of comparative study by electricians as well as shipowners and builders everywhere, we thought that a comprehensive review of all these installations, with illustrations of the principal apparatus used, would afford our readers a better idea of the nature of the problem, and, at the same time, of the adaptability of the Edison system to its requirements. The installations which we shall notice have either been lately completed or are in process of completion, and consist of one ferryboat, one United States man-of-war, and three merchant and passenger steamships. The apparatus used in these installations is the same as was used in the Pilgrim, with some exceptions. We shall, therefore, refer to the Pilgrim plant only casually to point out the differences.

FERRYBOAT FANWOOD.

The installation on board the ferryboat Fanwood, of the Communipaw Ferry line, operated by the Central Railroad of New Jersey, is the first we shall describe. The plant comprises 60 lights operated by one dynamo-electric machine of the type known as "Z" (Fig. 1), placed in the hold of the Fanwood. It is, of course, impossible to do full justice to the Edison machines in the limited space allowed by a general description like the present. We shall confine ourselves to a brief glance at their most salient features. The "Z" machine consists of a tall, upright U magnet, in the magnetic field of which revolves a cylindrical armature. The pole pieces rest on the iron base of the machine, a solid piece of non-magnetic material being interposed so as to prevent the short circuiting of the lines of force between the two pole pieces by the iron of the base. The cores of the armature coils are built up of thin sheets of iron insulated from each other by paper discs and strung together on a wooden mandrel, through which passes the shaft. By thus constructing his cores of isolated pieces, Mr. Edison obviates in a great measure the occurrences of Foucault currents, and to this is due the comparative absence of heat in the armature, even after it has been running several hours. The armature, which is ten inches in diameter, is wound in 54 sections that loop between the commutator segments, as in Alteneck armatures, but the "diagram" of winding is different, and is of Mr. Edison's invention. An excellent feature in the construction of these armatures is the covering of stout canvas, which fits over the ends closely. This not only protects the connections from accident, but prevents the churning of the air, which is noticeable in uncovered armatures, and which is undoubtedly accountable for the absorption of some mechanical energy without useful return. Mr. Edison adopted a different course also in disposing both the commutator and the pulley (P) inside of the bearings. We have no doubt that the arrangement presents advantages over the other way of placing the commutator and pulley outside of the bearings. The conductors from the collecting brushes lead up to insulated binding posts *C D* above. One of them includes a hand switch, by turning which the circuit may be opened or closed.

The dynamo is worked by means of an Armington & Sims high-speed engine of a type specially designed for electric light purposes, and shown in Fig. 4. This engine is of the class designated "B" by the makers, and has a cylinder 8½ × 10 inches.

These engines are remarkably small and compact in design, weighing about 4,000 lbs., and occupying a floor space of only 48 × 90 inches. The engine is characterized throughout by excellent adaptation of parts and skillful workmanship, an excellent proof of which is the fact that when running at the speed of 300 revolutions, as in this case, it can scarcely be heard. The chief feature of excellence of these engines, however, and that which probably determined their adoption by the Edison company, is the precision with which the governor performs its functions. The principle on which these engines are

built for the Oceanic Steamship Company and which will ply between San Francisco and the Sandwich Islands, have both been fitted with identical installations of the Edison system. The installation consists in each case of 226 lights, for which the current is supplied by two "Z" and one "J" dynamo-electric machines, operated by a "B" Armington & Sims engine, making 300 revolutions per minute. The automatic regulator is not used, the variations of current being so slight that a hand regulator answers all practical purposes. The lamps are of the "A" type of 10 candle power and give 16 candles. They are divided as follows:

Dining Saloon	12
Passengers' cabins	100
Staterooms	100
Social Hall	1
Ladies' room and bath-room	2
Directors' room	2
Smoking room	1
Music	1
Doctor	1
Engineer's, steward's, purser's rooms, barber-shop	3
Kitchen	3
Hall alley	1
Engine-room	10
Boiler-room	4
Boiler-room	4
Steerage	16
Hunting and mooring engines, etc.	20

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THE EDISON DYNAMO-ELECTRIC MACHINES.

governed is, besides, very simple indeed. It consists in regulating the throw of the slide valve by causing the eccentric moving it to vary in eccentricity. This is done by using two eccentrics. One is fastened to the crankshaft as usual. The other can move on the first, and the slide-valve is worked by the eccentricity of its periphery

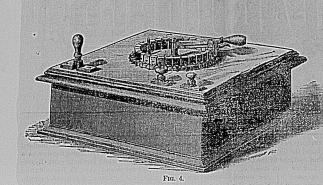

FIG. 4.

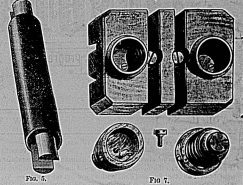

FIG. 5.

FIG. 7.

just as if it were directly attached to the shaft. It is movable, however, and under the control of the centrifugal force of two weighted levers carried by the fly-wheel, by which it can be caused to move around. Now, when the speed is below the normal rate to which the engine is adjusted, the outside eccentric moves over the inner eccentric, so as to produce a greater total eccentricity, and the throw of the slide-valve is consequently lengthened. On the other hand, the moment the speed exceeds its normal rate, the second eccentric rotates and the total eccentricity is diminished so that the throw of the valve is shortened.

This governor is said to be so quick and accurate that variations equivalent to nearly the whole "load" of the engine are compensated for instantly, so that not the least variation in the light can be perceived. The steam pressure available on the Fauwood is low, varying between 12 and 20 pounds, so that a condenser has to be used. This condenser is of the Knowles pattern and affords a vacuum of from 10 to 13 pounds, ten water of the ordinary temperature being used for condensing. This makes a total available working pressure ranging between 20 and 30 pounds.

The engine is belted direct to the dynamo, the driving pulley being 40 inches in diameter, and the dynamo is driven by a 10-inch pulley at its normal speed of 1,500 revolutions. The electromotive force developed is controlled by the amount of resistance in the field magnet circuit of the machine. In this case the electromotive force is maintained at a standard of nearly 100 volts, and the current supplied to the external circuit has a volume of about 50 amperes. The current is taken from the terminals of the machine by conductors of No. 8 insulated copper wire, laid in grooved moldings. This size of wire, which has an area of section of 16,510 circular mils, is considered sufficient to carry the current with safety. In the Pilgrim installation, however, it will be remembered, the conductors have a smaller section, and are both inclosed in an iron pipe filled with an insulating compound, as shown in Fig. 5, which represents a short section of such a conductor. The area of section of the Pilgrim is nearly 500,000 circular mils.

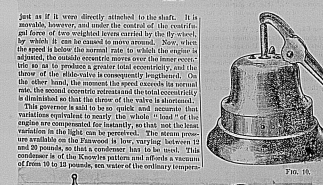

FIG. 10.

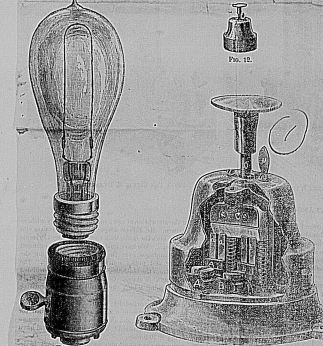

FIG. 1.

FIG. 11.

FIG. 14.

FIG. 12.

FIG. 6.

FIG. 8.

FIG. 9.

which supply the lamps there. The general distribution above is effected from the "centre of illumination" as on the Pilgrim, and all similar installations of the Edison system. The main lead divides into two branches which pass up to the middle house, one on each side, to a small "switch closet" situated above the roof of the shaft on either wall. At this point the conductor divides into five branches. Each branch is provided with a safety-catch and also with a special switch. Thus, if an accident happen on any one of the five branches the safety catch will automatically cut the circuit at this point or if in any case it becomes desirable to interrupt the current purposely in one part it may be done by means of the switch. Moreover as all the switches are collected together and conveniently located, the whole system is under the easy control of the engineer. The switch closet can be locked and thus all possibilities of willful or ignorant tampering are avoided. The safety catch, shown in Fig. 6, is an ingenious device by means of which a fusible strip is

FIG. 13.

be conveyed this form of conductor—which is made of varying sizes—is always used, being preferable for many reasons; but when a comparatively small volume of current only is to be carried ordinary copper wire is used.

The mains from the dynamo proceed two to a bunches, which extend the whole length of the hold, one on each side, and

FIG. 7.

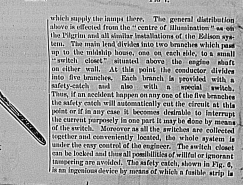

FIG. 10.

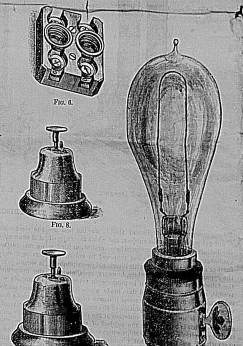

FIG. 1.

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FIG. 8.

FIG. 9.

included in each conductor. The general arrangement of the Edison safety catch will be plainly seen from the figure. The screws serve to insure good contact with the conducting wires. The central cavity is lined with thin sheet brass, which is provided with a screw-thread into which a cap can be screwed. This brass thimble is connected with one of the strips of metal through which the connecting screws pass. At the bottom of the central cavity is a disc of thin brass which is connected with the strip leading to the other connecting screw. Now a short piece of fusible wire is soldered to this disc at one end and to the brass thimble at the other, thus completing the electrical connection. It will be seen that each side of the safety catch is independent of the other. Only one side may be used if desired, the other conductor being permitted to run undisturbed by cutting out, but this makes "assurance doubly sure," and is equivalent, in fact, to two safety catches on.

When the heat developed on that branch of the circuit becomes raised abnormally one of the two, or both, fusible strips will be fused, and thus open the circuit. An interesting and ingenious modification of this safety catch used on the Pilgrim and other boats may be conveniently described here (Fig. 7).

This form is intended for use at the points where two conductors are tapped by branches. It supplies at the same time an easy and convenient manner of effecting the connection between the mains and the branches at the point of division or bifurcation. It will be seen that there are two double grooves in this case. The two vertical grooves in front receive one set of conductors and the two horizontal grooves (on the reverse side) the other set, the screws serving to secure them and at the same time to convey the current to the brass lining of the cavity with which they are in electrical connection. In this case it is not necessary to cut the main wires. From the bottom of each cavity extend metallic strip to one of the horizontal screws serving to fasten the branch at the same time to provide electrical connection between the sides and bottom of the cavity is effected in this case by a kind of screw that contains the fusible strip and which is represented separately at the lower part of the figure.

The cap screws into the cavity. To the inner surface of its metallic covering one end of the fusible wire is soldered, as seen in the left hand view; the other end being soldered to a brass disc on the tip of the cap which touches the metallic strip at the bottom of the cavity when the cap is screwed down firmly, thus completing the electrical connection between the main and the branches. When the strips become fused, the caps are taken out and sent to the factory or to be repaired, and other caps may be put

FIG. 12.

FIG. 6.

FIG. 8.

FIG. 9.

the bottom of the central cavity is a disc of thin brass which is connected with the strip leading to the other connecting screw. Now a short piece of fusible wire is soldered to this disc at one end and to the brass thimble at the other, thus completing the electrical connection. It will be seen that each side of the safety catch is independent of the other. Only one side may be used if desired, the other conductor being permitted to run undisturbed by cutting out, but this makes "assurance doubly sure," and is equivalent, in fact, to two safety catches on.

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FIG. 13.

FIG. 1.

FIG. 11.

FIG. 14.

in their place. The switches used also constitute a most interesting device (Fig. 8). In order to give the reader an idea of its construction, we will refer to a larger size (Fig. 9), which is used on the Pilgrim and other boats, and which is shown with its brass covering partly removed. The two ends of the conductor are screwed to two pieces of metal *A* *B* by means of large, flat-headed screws. From each of these two pieces of metal, which are insulated from each other, two contact springs *a* *a* *b* *b* project upward vertically. By depressing the knob or handle, in opposition to the spiral springs shown in the figure, the flat contact strip of copper *C* screwed in a block of insulating material, is lowered down so as to form electrical communication between the springs *a* and *b*, closing the circuit. As the rod *O* is lowered, moreover,

FIG. 7.

FIG. 10.

FIG. 1.

FIG. 11.

FIG. 14.

FIG. 6.

FIG. 8.

FIG. 9.

a catch is forced by a spring into the notch in the rod *O*, shown in the figure, and thus the switch is locked in the closed position.

The catch holding the rod *O* is controlled by a detent or trigger *N*. Therefore in order to open the switch it is only necessary to move this detent slightly. The moment the catch leaves the notch in the rod *O* the spiral springs force the switch up with a jump, thus breaking the contact between *a* and *C* instantly. This rapid motion on breaking the circuit is of great importance, and it is for this purpose that the switch has been constructed in this form. When a branch conductor is carrying a current of large volume, say 50 or 75 amperes for instance, the vaporization or deflagration of the metal on rupturing the circuit is likely to cause the formation of an arc, which would still keep the circuit closed, while it would give rise to some danger. If, however, the rupture of the circuit is made very abrupt the arc doesn not have time to form.

The same design is used in different sizes. Thus, in some cases where the switch is intended to be adapted to a large main, the springs are so powerful that the rod has to be depressed by means of a lever, as shown in Fig. 10. On the other hand, the switch is used in smaller size for small branch conductors and for single lights (Figs. 11, 12).

From the "switch closets" on the Fauwood, the five branches run upward and across the ceiling of the midship house on each side, where they divide into two sets, three branches going toward one end of the boat and two branches going the other way. Each branch supplies one of the chandeliers in the cabins, there being three chandeliers at one end of each cabin and two at the other, owing to the fact that the cabins are longer at one end of the boat than at the other.

The sixty lights are divided as follows:

Cabins, each 3 chandeliers of four lights	40
Middle house, engine room, 2 four-light chandeliers	8
Midship deck	4
Two houses, 1 over each	2
Bow	10
	60

The conductors supplying the current to the lights in front of the midship house at each end, and the branch which supplies the light over each pilot-house, first go to the pilot-house itself and pass through switches by which the three lights may be controlled, so that if the light they cast forward interferes with the pilot's vision in a dark night, they may be put out temporarily.

The lamps (Figs. 13 and 14) are of the well-known Edison make, with elongated glass bulbs and carbon filaments in the form of a U. As seen in Fig. 13, the joint between the lamp and its fixture is made in the same manner as in the double safety catch, having a screw cap (Fig. 7). The circular wall of the cavity of the fixture in which the lamp is screwed are connected with one wire and the bottom, which is insulated from it with other. Likewise the metallic disc on the tip of the lamp base is connected with one end of the carbon loop and the threaded portion with the other. Therefore this simple operation of screwing the lamp into the fixture suffices to form the connections. The design of the chandeliers is very unique and tasty. The installation is now complete, and the Fauwood began in resume its regular work a couple of days ago. It is scarcely necessary to add that the lights work well and give entire satisfaction. One feature on which we may take occasion to compliment those intrusted with the work is the particular care which was taken to conceal the wires. All what have been beautifully arranged in all suggestions of wiring. All what have been beautifully arranged in all suggestions of wiring. All what have been beautifully arranged in all suggestions of wiring

VOL. II.—No. 1.

The Edison System on Board ...

The Edison system of electric ligh... largely to demonstrate the merits and ... tri light over all other means of illumi... sels, by the uniform success and ...

THE ELECTRICAL WORLD,

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THE GRAMME DECISION.

Of the decision rendered by Judge Blatchford this week, in the suit of the Gramme Electrical Company against the Arnoux & Hochhausen Electrical Company, for infringement of the Gramme patent, it may be said that it has surprised many by its quick appearance, while it has surprised many more still by the manner in which it disposes of the case. That the verdict would be rendered in favor of the Gramme Electrical Company was generally anticipated and expected, even by many who had occasion to hope for the contrary. Under the circumstances, a decision adverse to the Gramme Electrical Company must have seemed a most agreeable surprise indeed. Those whose conscience had made them realize that they were trespassing—and they are numerous, for nearly ...

Concluded from page 3.

composed of three "Z" magnetic fields grouped into one. It is of the same height, and has the same size of armature, though longer still, than that of the "L" dynamos. In this case the armature has 64 sections and weighs 650 lbs. The total weight of the machines is about 8,000 lbs., and it occupies a floor space of 89×70 inches. It employs the same size pulley as the "L" dynamo, and has the same normal speed of 900 revolutions. In the installation on the Pilgrim the two "K" and the "L" machines are all connected in parallel circuit to the same mains, and develop a uniform electromotive force of 108 volts, under which circumstances the "K" dynamos deliver a current of 235 ampères to a normal circuit, while the "L" delivers 188 ampères.

Two ways are provided of regulating the supply of current of the "L" dynamo on board the Trenton. One is by means of a hand regulator, as on the Fanwood, and the other by means of an automatic regulator like that used on the Pilgrim, though of smaller size. Each regulator may be introduced in the circuit at pleasure by a suitable switch specially provided for the purpose. The Edison automatic regulator is shown in Fig. 10. At the left-hand side are two electro-magnets whose poles are joined by a frame through which passes a rocking shaft. The armatures of the electro-magnets are supported by extensions from this shaft, from which a frame also extends downward between the magnets, that carries at its lower side a bent contact spring, which can slip over the contact segments, between which the regulating resistance is looped. It will be evident that when one magnet is energized the contact strip will move toward one end of the inverted circumference formed by these contact segments, and that when the other magnet is energized the motion will proceed in the other direction, so that by sending the current through one or the other of the magnets the resistance introduced in the field magnet circuit will increase or diminish according to the case. The relay magnet shown at the right is included in the main circuit, its armature, which oscillates between two contact points, being normally held back by a spring. When the proper amount of current is supplied to the circuit by the armature the relay counterbalances the springs sufficiently to keep the armature between the two contact points. If the currents weakens the armature is retracted by the spring and its extremity closes a circuit through one of the signal lamps shown, and through one of the magnets, and this magnet moves the rocking shaft until the resistance in the field circuit has been diminished sufficiently, after which the relay having resumed its normal power from the increase in the current, it attracts its armature and opens the local circuit. If, on the contrary, the current is too strong, the armature is attracted too far and closes a circuit through the other signal light and magnet, and the regulating contact is moved back, so as to introduce resistance in the field circuit.

The mechanism is very ingenious and its operation is very accurate and satisfactory.

The arrangement of conductors on the Trenton is most peculiar and interesting. The lights are all supplied by three distinct circuits which reach it by different routes. One of these circuits is the regular circuit, and is provided with switches and catches for each of the ten branches which radiate from a switch-board placed at about the centre of illumination. The other two are extra circuits, intended for use in emergencies. The Trenton being a man-of-war, the eventuality of naval conflicts had to be provided for. It might happen, for instance, that a cannon shot would tear away the conductors in one part of the ship, and this would leave the men in darkness, perhaps. By the insertion of a plug in the switch-board another working circuit is instantly provided, and a third may in like manner be brought into requisition if the second should also meet with destruction.

There are 250 lamps on the Trenton, while the capacity of the "L" dynamo is below 200 lights, but as a rule only a part of the lights are in use at a given time on board the Trenton, and thus the demand will not be likely to exceed the supply of current. The lights are divided as follows:

Gun deck: 1 between, 1 over each gun, gangway, admiral's cabin and staterooms	64
Main deck: 1 red and 1 green sailing lantern, 2 masthead lights	4
Berth deck	66
Orlop deck	55
Starboard gangway	6
Miscellaneous: storerooms, powder magazine, shaft alley, hold, engineer and firemen's rooms	55

The red and green and the masthead lights are each of 32 candle-power. The other lamps are of the "A" type of 10 and of 16 candles, having a resistance of 208 and 125 ohms respectively.

An interesting feature is the use of a guarded reflector for every lamp that is exposed to injury. The lamp is inclosed in a kind of lantern-shaped box, the back of which is composed of a semi-cylindrical reflector, and which is closed by a convex wicket door made of fluted iron rod one-eighth of an inch thick, which gives it strength enough to resist a powerful blow. This efficient and useful device is the design of Mr. J. H. Vail, Superintendent of the Edison Company for Isolated Lighting, under whose supervision the installations are made.

STEAMERS ALAMEDA AND MARAPOSA.

These two sister merchant and passenger steamers, lately built for the Oceanic Steamship Company, and which will ply between San Francisco and the Sandwich Islands, have both been fitted with identical installations of the Edison system. The installation consists in each case of 238 lights, for which the current is supplied by one "L" and one "Z" dynamo-electric machines, operated by a "B" Armington & Sims engine, making 320 revolutions per minute. The automatic regulator is not used, the variations of "load" being so slight that a hand regulator answers all practical purposes. The lamps are of the "A" type of 103 ohms and give 16 candles. They are divided as follows:

Dining Saloon	12
Passage-ways (stateroom deck)	10
Staterooms	100
Social Hall	9
Ladies' room and bath-room	4
Directors' room	5
Captain's "	3
Mate's "	2
Doctor's "	2
Engineer's, steward's, purser's rooms, barber-shop	6
Kitchen	3
Shaft alley	4
Engine-room	22
Coal bunker	10
Boiler-room	4
Steerage	4
Hoisting and steering engines, etc.	38
	238

The feature of special interest in these two installations is the arrangement of the stateroom lights. The lights are suspended from the ceiling of the berth and inclosed with a globular glass shade that gives a beautiful mellowness to the light. The conductors pass through a switch placed near the door before going up to the lamp. It will be seen that by this disposition the light is under the ready and convenient control of the occupant of the berth, while at the same time the lamp itself is so placed that it is out of reach of the occupant of the berth and less likely to accident, and besides it is disposed so as to shine to give the most satisfactory illumination.

STEAMER KINAU.

An installation of the Edison system is also being completed on board the steamship Kinau, a coasting trade vessel, plying between the Sandwich Islands. This installation is very interesting. It comprises 118 lamps, supplied by a new type of Edison machine, called the "100 Light dynamo," which differs from its sister types "K L Z" mainly in having a magnet field with cores shortened and somewhat further apart. It is run at 1,500 revolutions. The power is obtained from an "A" Armington & Sims engine with 6½ × 8 cylinder, and running at 350 revolutions. The hand regulator only is used to maintain the supply of current constant.

Two kinds of lamps of the "A" type of 208 and 103 ohms, and giving 10 and 16 candles respectively, are used. They are disposed as follows:

Engine and boiler rooms	15
Freight deck	25
Dining saloon	10
Social Hall	4
Staterooms	55
Kitchen	3
Captain's room	2
Director's "	2
Mail "	1
Hoisting engine	1
	118

The lamps in the staterooms are arranged in the same manner as those in the staterooms of the Alameda and Maraposa, above described. The steamer is intended to carry heavy freights and cattle, and in order to minimize all chances of accident the lamps on the freight deck are inclosed in guarded reflectors like those used on board the Trenton. Besides these, a powerful *search light* is also provided, because in some parts the coast is very shallow and the ships must remain at some distance, while it is convenient and sometimes indispensable to illuminate the coast from the ship.

The search light is of the arc type, and is run from the same machine that supplies the incandescent lamps, being connected in multiple circuit just like an incandescent lamp. The feat of running arc and incandescent lamps in parallel circuit together has always been considered extremely difficult if not impossible, hitherto, but we are informed that it is successfully accomplished in this case. The arc lamp is provided with a suitable reflector, by means of which its rays may be projected in any desired direction.

All of the above installations, including that on the Pilgrim, were made by the Edison Company for Isolated Lighting. We are indebted to the kindness of Superintendent J. H. Vail, for the information conveyed in the above details. The work of the Edison Company shows the results of the conscientious study of every condition, and the adoption of the best methods available to arrive at the desired effects, and it is supplemented by that careful attention to details which is certain to insure thoroughness and perfection in the results. We have so often seen good systems of electric lighting fail to give the results that could properly and justly be expected from them, just by careless unskilled engineering and manipulation, that we are glad to commend competency in this case. With a good system and carefully made installations like those just reviewed, the Edison Company is sure of a lucrative ...

ELECTRIC LIGHTING MEMORANDA.

The principal topics of the week in electric lighting circles—or perhaps it would be more accurate to say circle—has been the report of the Committee of Inquiry upon the affairs of the Metropolitan Brush Company. It may be remembered that the last general meeting of the proprietors of the Company was of the usual character—that is to say, tempestuous. The Directors were vilified, the accounts rejected, and a Committee of Inquiry (nominated from the discontented shareholders) appointed duly of investigating the previous conduct of the Company's affairs. The report was couched in the strongest language, with reference to the floating and management of the concern; and the Committee concluded their labours by filing a petition for winding up the Company. The principal reason for continued existence proffered by the Directors at the general meeting was that the Company had secured a Provisional Order for lighting a portion of Holborn, and they hoped to carry it out at a profit. The Investigation Committee have satisfied themselves that the Order can only be carried out at a loss; and, moreover, that as, to comply with the conditions of the Order, the Brush Company (the licencee for using which cost the Company £295,000) cannot be used alone, the Company would have to begin operations by acquiring rights to employ other apparatus. The Directors met the issue of this alarming statement by distributing another circular, simply denying the assumptions and conclusions of the Committee, but without attempting to disprove them by arguments. The Board contented merely that in filing the winding-up petition the Committee exceeded their powers. Meanwhile, the Chairman, three other Directors, and the Solicitor to the Company have resigned their offices. The last rumour in connection with this affair, which has attended the notice of several daily newspapers, is to the effect that the discontented shareholders have been "squared," and that peace reigns once more at No. 110, Cannon Street.

The report and statement of accounts of the Anglo-American Brush Company—the "old original" grandfather of all the Brushes in the eastern hemisphere—has been issued, and is a most remarkable document, much too complex for thorough examination within the limits at our disposal in this column. It is exceedingly difficult to understand the precise significance of accounts of this order, which assumes a general tendency to writing off is manifested in various places. The Directors confess to a "heavy loss;" but the portion of the Company's transactions, their dealings with Mr. Lane-Fox, in respect of his celebrated patents, may be studied. First, Mr. Lane-Fox sold his patents to the Company; then he agreed to buy them back again for the sum of £20,000. Then he would not effect "a resale, upon the result of which he counted, to enable him to settle the claim of the Corporation." So the "Corporation" kept £14,000, which they owed to Mr. Lane-Fox as part payment. Then the lawyers went to work; cross-suits being instituted respecting those monies and counter-claims. Then a compromise was effected, whereby Mr. Lane-Fox got back his patents, and granted a license for their use to the "Corporation." He also agreed to pay the "Corporation" 20 per cent. of all the profits that he might make on these. All this, and for the first charge upon all Mr. Lane-Fox's electrical patents, "the Corporation agreed to transfer to Mr. Lane-Fox £14,000 in shares of the International Electric Company, and to make him a cash advance." Was ever such a jumble of buying and selling? Who could tell from all this who—and who—was bought and sold? Nay, everybody who owes £60,000 which he cannot pay gets off with a jumble of shares, a cash advance, and apparently the same

The oldest Electric Lighting Company in England—or rather, to be more strictly accurate, the oldest system that has been longest in operation—is the Jablochkoff; perhaps best system of arc lighting for street lamps is not a guarantee of financial prosperity; and, after experiencing much trouble, the present Company is to be wound up very shortly. It is intended to form another Company, to take over the property and business of the one that has failed. The existing holders of paid-up shares will receive ordinary shares of the new venture, which rank behind twice their number and value in 6 per cent. preference shares. If a sufficiency of the latter class of shares is not subscribed for, it is difficult to see how the concern can go on.

The annual meeting of the Electric Sun Lamp and Power Company has lately been held, when the Directors, with Lord Henbourne at their head, resigned in a body, and a new Board was appointed. This change has been explained as being due to the necessity for reorganization on a more practical and economical basis; the fashionable advertisement element having been proved incapable of doing business. When executing the "happy despatch," the noble Chairman laid the usual fling at the Board of Trade for opposing in the bad the aspirations of the Company. Some opinion that it would be better to wind up the concern voluntarily, without further delay. But this course was opposed; and therefore the Company will probably be allowed to drag on its languid existence until all the capital has been spent. The Chairman gave the comforting assurance that even if the Company went into liquidation, the unpaid capital would be called up. Under these conditions, the new Directors, who were described as holders of half the capital began their reign with free powers to do what they like with the money lists.

ELECTRIC LIGHTING MEMORANDA.

The accounts of the Swan Electric Light Company, and the proceedings at the extraordinary general meeting of the Company on the 15th inst., do not give the circumstances of the concern in a very favourable light. The capital received amounts to £210,125, against which stands a sum of £219,407 paid for British and Foreign patents, and another sum of £51,608 for plant and stock-in-trade. The profit and loss account admits a loss of £903, which, with £5000 for preliminary expenses, makes an unfavourable balance of £5903. On June 30 the cash in hand was £16,532, and debts receivable amounted to £20,551, while the liabilities were £35,786. So that, assuming the debtors to be solvent, and the debts to be paid in full, the available liquid assets were just over £20,000, which, for a concern constructed upon a capital expenditure of nearly £200,000, can scarcely be called a strong position, especially as the business is worked at a loss. At the extraordinary general meeting, the Chairman said he believed the Company had made a profit of £7000 clear of all expenses; but as this has been written off for depreciation, the shareholders must wait awhile for their dividend. The meeting was called to approve of the Bill in Parliament for enabling the united Swan and Edison Companies to undertake the Provisional Orders obtained by the two Companies separately; but it was stated from the chair that all difficulties had been removed, and it was hoped the desired object would be attained "without so expensive a "process as an Act of Parliament." From this it may be understood that the Bill will be dropped; though whether or not the Orders will be carried out any the sooner remains to be seen.

From some recent proceedings in the Chancery Division of the High Court of Justice, it would appear that the process of cutting up a defunct Electric Lighting Company may sometimes be nearly as costly and troublesome as the operations of the Company while living. A concern rejoicing in the name of the Electric Carbon Storage and Apparatus Manufacturing Company of Scotland, Limited—registered in England as an English Company, but having its manufactory situated at Leith, near Edinburgh—has come to the usual end. The Company tried to do business in England from its Scotch home, and on one particular occasion distinguished itself by endeavouring to start an installation of electric lighting in an important parish of South London, whereof the governing authorities at the time manifested a desire to dabble in this kind of speculation. The attempt failed, however; for the promises of the Anglo-Scottish speculators were too conspicuously hollow; and shortly afterwards the Vestry of whom they were addressed received from the alarmed ratepayers a sharp check in their exchequer. Little was heard of the Company with the long name; but it now appears that their property in Scotland has gone under the auctioneer's hammer. The auctioneer has wisely held possession of the premises at the request of his own charges, and also because certain processes known in Scotch legal practice have been served on him, forbidding him to part with the rest of the money. The English liquidator has now interfered, with the object of having the money paid into Court; but the auctioneer objected that if he obeyed any such order of an English Court he should be disobeying the injunction of the Scotch Court. Eventually, the liquidator obtained his point, coupled with the obligation to take steps for harmonizing the orders of the two national systems of jurisprudence. All this is very interesting for the lawyers concerned on both sides of the Tweed; but the creditors and shareholders of the Company must regard these complicated proceedings in a different light.

The poor Metropolitan Brush Electric Light and Power Company must be in desperate straits—or, indeed, is a notorious fact—when one of their officials is driven to write to a newspaper published in Liverpool, complaining of the recklessness of the Committee of Shareholders who are determined to wind up the Company. This gentleman calls himself "the Alien Master of electric lighting on a large scale in this country"—whatever this may mean. It is certainly the city where the first considerable disaster overtook the Brush system; but this is scarcely a pleasant reflection for anybody connected with the speculation. The burden of the official complaint is that the Metropolitan shareholders are blind to the extraordinary advantages of the Provisional Order for Holborn, which the Directors and officials desire to carry out, in the spirit—almost acknowledged on their part—of throwing good money after bad. Why the pitiful story should be told to a Liverpool multitude, or what possible effect the favourable judgment of Liverpool people could have in respect of a Metropolitan electric lighting speculation, is not apparent. The tone of the communication in question is despondent in the extreme, and not very welcome in warrens. There is a poor look-out, undoubtedly, for the later and less fortunate school of electricians and other officials who are now trying their hardest to keep the Brush bubble inflated; but, again, what has Liverpool to do with the fortunes of the London concern?

American Gas Light Journal. March 17, 1884.

THE ELECTRIC LIGHT IN PHILADELPHIA, PA.

Again is the house of the electricians divided against itself. This time it is a fight for monopoly. The Electric Lighting Company, which is virtually the Brush Electric Light Company, has filed a bill in the courts here praying that the Underground Electric Light and Power Company be enjoined from supplying light in this city by means of electricity, and asking compensation for damage done to their business by the said Underground Company. The Brush Company says that its right to supply light by means of electricity is, by the terms of its charter, exclusive, "until the said corporation shall have, from its earnings, realized and divided among its stockholders, during five years, a dividend equal to 8 per cent. per annum on its capital stock." Such a dividend, it is asserted, has not been paid; and therefore the Underground Company is a "pirate."

About three years ago the Brush Company built an extensive and well appointed plant in the neighborhood of Twentieth and Chestnut streets; and, if memory serves aright, first illuminated our streets on the 5th day of December, 1881. For one year they ran their plant on Chestnut street, from river to river, gratuitously. Then they succeeded in making a contract with the city, and now furnish us with 66 arc lights along our streets, for which we pay 55 cents per night per light. They illuminate Chestnut street, from the Delaware to the Schuylkill, and then crossed across the bridge to Thirty-third street; and Market street, from Thirty-third street to Forty-first street, in West Philadelphia.

The city, however, takes a very small proportion of their business. They have now 636 arc lights in operation for private consumers, and contracts out for some 50 more. Their plant is running to its full capacity to supply that demand, and they are obliged to put off new customers until they are able to put up new dynamos. To private parties the charge for lights is from $22 to $28 per light per month, according to the number of lights; that is from about 73 cents to about 93 cents per night.

Now an outsider might suppose that amount of business was all that the Brush men could desire, and that they should grow rapidly rich, if the stories of the economical production of electricity be true. But that statement about the eight per cent. dividend belies such seeming prosperity, and shows us that there must be something radically wrong somewhere. A partial explanation is that here, as elsewhere, they have had to buy their experience very dearly; their works were, in a measure, experimental, and they were handling something the exact nature of which is not quite known, and which is prone to freaks that are often as costly as they are curious.

And then, about three months ago, a cloud appeared upon the horizon. The Underground Electric Light and Power Company obtained from the City Councils permission to use, for the purposes of experiment, the old iron lamp-posts along Chestnut street that had previously been used for gas lights, which, when the electric illumination became satisfactorily established, were no longer lighted. They then placed two of their dynamos in the new *Record* building, and carried their wires thence along Chestnut street, from Ninth to Broad street, through the underground conduits of the American Sectional Company, which are laid at a depth of about two feet below the surface. At each lamp-post they made connections, and took their wires up through the hollow socket. Then they removed the old gas lanterns, and placed in their stead quite handsome "Excelsior" lamps of the Hochhausen pattern, which are in general appearance quite like the Brush. They have run those lights thus far also without expense to the city, in order to demonstrate the practicability of carrying electric wires underground.

So far as it is possible to judge now, they have entirely succeeded. Their lights burn steadily and pleasantly; the intensity of the arc, at such a small elevation, is overcome by using shades that are wholly ground glass—those in the higher lights of the old plant being half clear and half ground glass. In the conduits, opposite each store or dwelling, arrangements are made for connections, and they are now running some lamps for private consumers. Some of these are on side streets, and working very successfully, thus demonstrating the practicability of taking the wires also around corners underground as well as if operating on straight lines. The company is at present busily engaged in fitting up a plant on Eleventh street, near Shissom; and, so far from appearing alarmed at the suit brought against them, are arranging their affairs with the air of men who have come to stay.

Now, whatever be the justice of the pleas of the Brush Company, the public will be sorry to see the Underground Company enjoined from pushing their system here. The good citizens have long protested against the countless telegraph and telephone poles and wires that are strung through our streets, only to be greeted with an additional forest of electric light plant. If such be allowed to continue, it is but a question of time when the very vault of the heavens will be hidden from sight on our principal streets. O, thrice blessed that we are! We have now three aerial systems of electric light operating in our beleaguered city, and they have not yet run their course.

The Brush Company, besides the arcs named before, are preparing to light Delaware avenue, from Vine to South street. The Maxim Company, who had some 25 lights stretched along on North and South Delaware avenue, have just started some dozen lights on Broad street, immediately north and south of the new public buildings, and have strung them on most unsightly wooden poles, that have not even the saw virtues of being straight. And, lastly, the Thomson-Houston Electric Light Company are running their lamps, by sufferance, along the line of the Reading Railroad on Pennsylvania avenue.

Leaving the esthetic consideration out of view, it seems the height of folly to carry through our streets so many wires charged with currents of the highest intensity—nothing less than bottled death and destruction. It has been shown that it is not a necessity so to do, and if we must have the electric light, let us have it under proper conditions. There is no doubt that the overhead wires "must go;" and the sooner the better.

As was shown, the Brush Company is not doing an extraordinarily profitable business, and it is the best conditioned electric light company here. We believe that want of capital hampers the electric men in many directions. The public have ceased to regard the light as a luxury; in fact, it is now almost a synonym for "will-cost" investment. And since electricity has not proved so wonderfully cheap and lucrative as an illuminant, we may soon hear of gas again in street lighting.

And, in that connection, it is curious how little is known, even by well informed people, as to what can be done by gas. They think that its limit is in the burners of the street lamps that they see emulating tallow dips along our highways. Would that the trustees of our gas works here had enterprise and "push" enough to induce the city to give gas a "show" alongside the electric light, and to put up in our streets a few of the new high-power gas lanterns. We warrant that ninety-nine hundredths of the natives would be thoroughly and genuinely astonished. We believe it was done with that result in enterprising St. Louis, Mo., and that it would be anywhere a most remunerative experiment.

Let us hope that gas men will come to the front and "show their hands" before the streets are monopolized by electricity.

A.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT. [Feb. 12, 1884.

ELECTRIC LIGHTING MEMORANDA.

The truce between the Shareholders' Committee of Investigation and the Board of Directors of the Metropolitan Brush Company, mentioned last week, was of very short duration. After the report of the Committee had been issued, and they had filed their petition for winding-up the Company, numerous interviews and conferences took place between the Committee and the Board, resulting in the agreement of the latter —or the remainder of them badly, for the Chairman and three others had resigned—with the proceedings of the former. This was the foundation for the rumour of conciliation before mentioned. It is, however, the details of the policy adopted by the Committee were subsequently disclosed to the Directors, the latter resumed their hostile attitude, because it transpired that the Shareholders' Committee were determined to have a majority of their number on the Joint Committee to be formed to supervise the winding up. In addition to this, the Shareholders' Committee introduced many things into their programme to which the Board would not consent when they learned the particulars. The hostilities have been actively progressing during the past week; circulars to shareholders and letters to the newspapers succeeding one another without cessation. It has at last been agreed on all sides that this course of action does not settle anything; and so an extraordinary general meeting has been convened for to-day. At this meeting will be decided which side is to have the command in the friendly fisticuffings; and the extent of the powers of the joint Liquidation Committee will be defined. It appears tolerably certain that a demand for the return of a large amount of money will be made upon the promoters; but as the Committee will ask for powers of concluding any compromise that would seem to them desirable, the affair may be brushed up after all. An attempt is to be made to form out the Company's Provisional Orders to Sub-Companies; but this design is almost assuredly proved abortive, either on account of inability to float the Companies for this purpose, or by the action of the Board of Trade, who will certainly look very closely into any schemes of this origin and character.

The Anglo-American Brush Corporation have held their meeting, and passed the remarkable report and statement of accounts mentioned last week. From the report of the proceedings there does not appear to have been any discussion of the figures; so that it may be inferred that the shareholders are resigned to see their property drifting no man knows whither. Of course there was the inevitable laudation of the wonderful 2000-candle Brush lamps, which are so much better in every possible way than any other lamps that can, might, or would ever be thought upon earth. Mr. Hammond was there to talk about the success achieved at Chesterfield, Brighton, and Eastbourne. It may not be uninteresting to remark, with reference to the Brush lighting in the City of London—the only example wherein extinctions are considered as serious and worth advertising at any cost—that a correspondent in a daily newspaper has stated that "between "six and seven" attendants are required to watch the lines of 30 lamps apiece over the length of nearly a mile. This "is about one man every five lamps, each man receiving "at least 47*l.* per annum—a very fair estimate, considering "the character of the duties—each lamp therefore costs, on "this head alone, 47*l.* per annum." Nothing of this was heard at the meeting; but neither was it contradicted. There is small wonder, in such circumstances, to say nothing of the graver troubles of the "Corporation," that even the Directors confess to a heavy loss on their last year's working.

A little more than a year ago Mr. Odevaine R. Coope wrote to *The Times* to say he had lighted his country house at Bere-church with incandescent lamps; and he then gave some figures relating to the cost of the very fine establishment of the system, was £1400 or., and the estimated average expense of lighting 200 lamps for 1150 hours per annum was £292 15*s.* 1*d.*, or after the rate of 0·07 of a farthing per lamp per hour. Mr. Coope has now written again, after a year's experience, to say that beyond a few minutes' troubles caused by the belt slipping, and a little temporary annoyance caused by a drunken engine-driver, he has not had any mishap for the 1823 hours during which the lamps have been in operation. The total cost works out to £359 18*s.* 9*d.*, or, as Mr. Coope says, 0·05 of a farthing per lamp per hour. It may be remembered that when Mr. Coope began his experiment, somebody asked whether all the machinery would not have to be in action to enable a single light to be used in the house; and to this Mr. Coope failed to give a satisfactory answer. Now, also, even *Engineering* asks how it is that all Mr. Coope's lamps were burning, on an average, for hours a day all the year round. Our contemporary says "the inference to be drawn from his "letter is that every lamp was put in action at dusk, and "kept alight until nearly midnight, in all the rooms; as "was absolutely within it, until the engine was stopped for "the night." Of course, this makes the method of computing the cost per lamp-hour appear favourable to the system. "A "farthing per lamp-hour looks a very small sum; but £359 "per year for lighting a single country house is an amount "not very often paid," in the opinion of *Engineering*. Another journal, the *Engineer*, comments on the letter—the author of which, by the way, it persistently calls Coope, as though the writer had never heard of the great brewing firm—and points out that the owner of Hurstbourne Hall has given only the barest cost, without allowing for profits, the cost of long conducting cables, or many other expenses that would heighten the rate at which the same lighting could be supplied by a trading Company. It is undoubtedly the best way to look at these figures in the manner of *Engineering*, and to take note of Mr. Coope's gross expenses, while reserving judgment as to whether his method of reduction to lamp-hours is justifiable.

Electric Lighting at the Bank of England.—In

the course of last year the directors of the Bank of England, who adopting electric lighting throughout the building, resolved as a first step to entrust the Electrical Power Storage Company the fitting up with incandescent lamps of the private dining suite, the bill office, and a portion of the accountants' room, giving a total of 150 lamps. The work has now been completed, and on Monday afternoon the deputy-governor (Mr. J. P. Currie), accompanied by several of the directors, made an inspection of it, and expressed their satisfaction with the result. The Faure-Sellon-Volckmar accumulators spoken of have been adopted. A dynamo charges the 150 lamps at all hours during their ordinary service, or in case of fog or other unforeseen circumstances, to give a whole day's lighting without working it. Swan lamps are used, which are fixed on specially-designed brackets attached to the present gas fittings, each lamp having a switch attached to the present gas fittings, tap, so that the control over the lighting is as complete as under the old system, with the advantage that when desired the whole may be lit or extinguished in a second.

AN IMPORTANT INVENTION!

Now Ready, Price 1*s.*

Directions for Incandescent Lighting.

Being the Latest Information on Electric—Incandescent Lamps on Long Circuits—Combination with Present System—Apparent Gain.

Reprinted for THE STANDARD COMMERCIAL BULLETIN

An Invention which will be welcomed by electric lighting interests everywhere as marking such an important practicability as incandescent light, has just been perfected by Mr. W. S. Stevens, electrician of the New England Westinghouse Electric Lighting Company of this city.

Heretofore incandescent lighting companies have sought for the most part to establish isolated plants. It is only within a few months that the

VILLAGE PLANT SYSTEM

has been considered a success and while there are quite a number of such plants projected and for which plans and contracts have been made, there are but two or three in actual operation in the country. The first one was installed at Roselle, New Jersey, and was installed by the Edison Company, which, by the way, it persistently calls Coope, as though the writer had never heard of the great brewing firm—and points out that the owner of Hurstbourne Hall has given only the barest cost, without allowing for profits, the cost of long conducting cables, or many other expenses that would heighten the rate at which the same lighting could be supplied by a trading Company. It is undoubtedly the best way to look at these figures in the manner of *Engineering*, and to take note of Mr. Coope's gross expenses, while reserving judgment as to whether his method of reduction to lamp-hours is justifiable.

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SOME NOTES FROM AMERICA.

(FROM OUR OWN CORRESPONDENT.)

New York, Jan. 15, 1884.

In a former letter,* speaking of electric lighting in New York, I stated that upon the comparatively unsuccessful issue of the Brush Company, and also upon the energy given for their introduction, which they paid, had in hand the lighting of the streets by the electric system of Mr. Brush, and therefore his Company were not willing to put out more until they knew what was to be the result of the working of these experiments. While this would be a correct statement as to what had been carried to the point which would warrant their lighting, nevertheless the unwillingness to supply the system was not true between the Brush Company and the Edison Company. Directly after the latter Company had commenced operations they had their hands full, and the two companies could not attend to the wants of their customers. The former struggled of the Brush system, while the latter Company had their hands full with the Edison system, which, as I have before stated, their interests forced for this country control of the Edison lights, which they purpose using in the near future in connection with Mr. Brush's storage batteries for interior lighting. The special system which they pay, lighting of houses, now operates in the better portion of the city, and would have in its effect, *the rationale* being that a large number of batteries, which would be charged by comparatively small power, and these storage stores. They then lights would be sold to consumers at a less price than they would charge for their lighting, nevertheless the perfect steadiness of this Mr. Brush's improvements of the storage battery. I am informed that the Edison Company have now in their stores in this city a large number of lamps with gold plates. It was the announcement of the Brush Company that they would shortly commence the manufacture of their lamps that induced the difference between them and the Edison Company. The representatives of each of these companies have made free use of the public press in the discussion of their respective merits, and as the result we have been treated to a number of letters in which each party claims the superiority of its system. Mr. Bates, President of the Edison Company, seems to be the very perturbed state of mind. He says that the loss of life, owing to the high tension employed by the Company; and as the public will not pause to discriminate between the systems of the two companies they will have to bear part of the unfavourable condemnation. He says he is particularly distressing to the gentlemen who are putting in the Edison system, that the Company have a number of lamps in their stores for the purpose of the Edison to perfect a plan of lighting which shall allow all other things, would be a success. He says that there will be no difficulty to make this clear to the public, as many lives are lost by other systems of electric lighting. One thing is certain, and that is that all the Edison's public have already had ample opportunity of seeing what the system is capable of, and that they will not be likely to have a very serious effect on the fortunes of his Company. Mr. Bates says, Mr. Brush, of the Brush Company, has stated that this new storage system is not to be in the course of safety, and in support of this statement says that the Company have not as yet, but they will only have a location of 40 lights. Still Mr. Bates admits that it is the 2000-volt current to the batteries, and that the 40 lights are to be run by that, and is keeping the best of the Edison Company awake at night. However, the Brush Company are not yet ready to introduce their new scheme, and will not be for some time to come.

The Edison Company, operating in the streets of New York City, have informed their customers that, the price for their lights will be reduced from the first of April next. The rate they are to charge is 25 cents per 1000 cubic feet of gas in New York by 6 dols. 25*c.* and the candle power 25, I do not see that this reduction necessitates figures in that way. Moreover, the New York Companies are not worrying over what is to be the charge of the Edison Company, as they have been selling gas at 2 dols. 50*c.* per 1000 feet, a difference of 3 dols. 75*c.* per 1000 feet. This has been the case since electric light has had its day; that its present position is one of stagnation as far as retrogression; that it has not hurt the gas business in the past, nor is it going to do so in the future.

The Edison Company have secured permission to lay their mains in the streets of this City. They purpose to manufacture "a rare hydrogen" gas for a term, and to charge for it at the rate of 2 dols. 50*c.* per 1000 feet. The Company agree to furnish gas at 1 dol. 50*c.* per 1000 cubic feet for light the street lamps for 12 dols. a year (the present rate is 17 dols. 50*c.*) Should the Company not have the City the street lamps for the first year they pay for it the next year. It is not yet announced what action of the city will be elected from the Edison Company. Mr. Vanderbilt, the President of the concern, who has recently ruled his central interests, is just possible that the Company will not select any section. Should they do so, it will be a great boon to the City, as they would be directly benefited by the reduction in price, because the burden will eventually fall on the consumers. True, the new Company are restricted as to price, and are enjoined against combining with other companies. But after they once get into operation it would doubtless be necessary to repeal these clauses, imposed as they are only by the Gas Commissioner; so that in the long run the consumer would finally be benefited.

Opposition works are likewise being started in other cities. Chicago, as an example, already blessed (?) with a multiplicity of companies, is to have another, which is to make a water gas. It is passing strange that municipal authorities will not learn from past experience that cheap gas is not to be obtained by cheap opposition companies. On the other hand, a different feeling would the gas loving public of the country to-day if in each city there were but one company, and that one under the legislature as to price and purity!

* Jan. 5, 1884.

GLEANINGS AND MISCELLANEA MEMORANDA.

It has been announced that the Maxim-Weston lights in Queen Victoria Street, City, will be removed in consequence of the Company not being able to afford the expense of keeping them going. The Company explain that the cost of this particular advertisement has been practically thrown away; for, as a matter of fact, they have not been able to extend their connection in consequence, and are no better off, from a business point of view, than when the experiment was started. This is what the letter of the Managing Director really means, although it is not to be supposed that he would write to *The Times* in these words. He says his Company will now wait until the Commissioners of Sewers are "in a position to allot off the City in large sections." By this time the Company may find themselves in a somewhat different condition, if all reports are to be credited. It may be conceded freely that the lighting of Queen Victoria Street by the Company has, on the whole, been very good. It would not be overstating the facts to speak of it as the best street lighting by electricity in London; but the cost must have been enormous.

The position and prospects of electric lighting at the present time have been discussed by the *Engineer* in a decidedly depressing style. It is now the fashion for some of the publications which at one time upheld the system in question through their zeal thin, to assume the attitude of the good-natured but candid friend, and expose all its weaknesses. In pursuance of this amiable policy, the *Engineer* tells the electricians that they have missed their grand opportunity. They are informed that "a sixth or seventh gas-works will give more light than all the electrical apparatus in Great Britain put "together." Yet on their present connection, such as it is, electricians have spent, in one way or another, more than two millions of money subscribed by the public. Our contemporary summarises the principal installations of electric lighting now working in London; and declares, when it is all summed up, that "the work done by the electrical engineers is as a drop "in the ocean compared with that done by the gas engineers." The main reasons for this backwardness are given as, in the first place, want of confidence in the light on the part of the public; and, secondly, that it is not only too dear but too troublesome. This is a very fair statement of facts which are possibly unpalatable to many people, but cannot be ignored on that account.

The Electrical World has a very outspoken article upon "expert quackery," which must commend itself to the smarting consciousness of many disappointed stockholders in electrical concerns. Truth to tell, one of the great plagues of the investor are the quack professors—chemists, electricians, and what not, who are always to be found ready, at the beck and call of promoters, to deliver lectures, make speeches, and indite testimonials in favour of money-getting schemes. The public have of late heard enough of the exploits of these gentry, who may occupy chairs of physics and chemistry at educational establishments, but are always to be heard of at meetings of Companies where the shareholders are required to receive instead of dividends. Our contemporary expresses the hope that "simple ventila- "tion will purify the expert business, without a course of "active disinfection." We hope so too; for it is certainly time to see men who should occupy an honourable position—men with the title of "Professor" before and the coveted initials "F.R.S." after their names—in the train of stockmarket speculators.

Mr. Edison has been interviewed on the vexed question of electrical motors for railways, and has stated that he is building a locomotive of this order for the Metropolitan Railway of London. The great inventor declares his belief in the future applicability of such engines for short runs, and where there are many stoppages. We will reserve our own prophecy until the machine in question is regularly running between the Mansion House and the Tower. It must be confessed that the chief peculiarity of most electrical railways so far has been the prolonged use of "temporary" steam locomotives to do the work. An instance of this is supplied at Wimbledon this year, where, as locally announced some months ago, the Gamp tramway was to be worked by electricity. As a matter of fact, the work has been done as of old by the "Wharncliffe" steam-engine; the electricians not being ready in time. We have not discovered any published notice of this fact elsewhere, although, of course, the declaration of what the electricians were going to do was blazoned far and wide.

From Sydney intelligence comes to the effect that the local Edison Electric Light Company—the only system that was regarded there with any degree of favour—are under a cloud. The light was introduced, with the usual flourish, into the offices of the leading newspapers, the Exchange, and a large restaurant. At all those places—the only ones where it was tried—the lighting has now been discontinued, of course without public notification of the fact. Gas in Sydney is 9*s.* per thousand cubic feet; so the Edison system had as good an opening as at home in New York, and much better than in England. The reasons for the discontinuance of the system cannot be ascertained; but the result is naturally a great damper upon the Edison cause in Australia. Yet one would imagine that the conditions for the development of incandescent lighting in the Antipodes are peculiarly favourable. Probably the old drawbacks—costliness and unreliability—are at the bottom of the trouble here as elsewhere.

of supply. At a meeting of the Local Board in September, 1867, Mr. Marshall remarked that without an increase of 50 per cent. in the supply the whole water-seven hours now, then fifty-required—would be deficient. The venerable Archdeacon then went on to refer to the eminent geological and engineering testimony given at the former inquiry in favour of the chalk scheme; and said he ventured to assert that the Local Board had made up their minds that they would not go to another source for water. If this scheme now proposed was sanctioned, the Board would ultimately incur the responsibility of bringing down the water from Ware.

The following is the report presented at the meeting:—

Mr. *Bramley*, C.E. (partner in the firm of Bateman and Co., and Engineer to the Somerset Water Company), said he thought the present source of supply at Ely quite a wrong one, and that filtration, on whatever system, would only elevate the water from its natural condition. There was no ample supply of pure chalk water a few miles off. Had he been called in in the first instance, and shown the samples of water taken from the river, he should have strongly advised the Board to go to the chalk. He had not the slightest doubt that they could get a supply of water from the chalk hills to the east of Ely. A total lodging would cost 250 or 300 for 10 or 20 feet in depth. His opinion was that and filtration would remove particles in suspension, but not those in solution; so that, as far as his opposition was concerned, the water, though clear, might be no better for the process. He believed the town would drink that, when the water was turned, the filters would be too little to receive it up. He thought the expenditure of £2000 in the construction of the filters would be thrown away money. He had seen the supplies which were from very much worse sources found at the entrance of the chalk. He had no fear whatever that there would be any lack of water at any time. In the case of a plant like Ely he would estimate for a consumption of 20 gallons per head daily. His firm had had a good deal of experience in stopping waste. At Stone-land Ely shielding the iron mains and using waste-water meters they had reduced the consumption from something like 40 gallons per head per day. Much of the water wasted by defective fittings. At Ely the defects in the service pipes and fittings might be detected and remedied. For supplying Ely with water from the chalk, he would sink the well at Teddington. He had estimated the population at 9000; not the daily consumption of water, including that for road watering, at 20 gallons per head, or 180,000 gallons in all. There were some scattered villages which would require to be supplied, but the population of Ely was increasing daily, making a total population of 10,000 persons. The water could be pumped, during twelve hours of the day, with a 12-horse power condensing engine; and 1000 gallons would be raised if necessary. He estimated the cost of the works, including pumping station, shifting of well, filtering tanks, engine and boiler, and cottage, at £3000. He estimated that the annual working expenses would be about £300. He would recommend 10-inch cast-iron mains for the town, and 12-inch and 15-inch cast-iron mains, 12,000 yards long, would be required along high road and joined on the present main at Ely. He considered a very large annual saving upon the present expenditure would be effected. He could, in fact, be as considerable as nearly to pay the interest on the loan borrowing the sum of £15,000. He considered that the capabilities of the whole plan for the chalk supply would be less than that of the extreme supply of the Lea and Ware. He had seen a great many wells sunk in the chalk, and he had never known one to fail for drawing water at a short distance from the river. The expenses of a chalk water scheme at Ely would be of the same character as those at Saffron Walden, with the exception of expense for the softening process, which was to be adopted at the last named place.

In cross-examination by Mr. Marshall, engineer said that he had no objection to raise to the plans of the Board (which he had not seen till that day), except as to the filtration. He agreed at the meeting of the Board that the chalk was always a safe source to look to for water. Water from the chalk was always found at the bottom of hills. The quantities of water from the chalk and the fields, the form of rain was nearly the same. He had no theoretical objection, and not much any experiments as yet to ascertain the quantity of water that could be obtained from the chalk at Ely. Speaking generally, he was extremely in his experience in other chalk districts, that there was a sufficient supply of water in the Newmarket chalk hills.

Archdeacon Emrar having commented on the evidence by which his scheme was supported,

Mr. *Marshall* said that he was glad to find that the gentleman had repeatedly expressed their conviction that it would be unwise on their part to expend a sum of £15,000, or more, on water supply of a small and not opulent place like Ely. Even with all the skill which the English brought to it in these days, a handsome supply might be obtained from the water from the Thames, purified by mud filtration. On Thy, Dr. Frankland had said that the water was as good as that from the Lea or the Lea and Ware, and pronounced it to be fit for drinking.

Mr. *Hopkins* remarked that Dr. Frankland had not always expressed satisfaction with the Thames water.

Mr. *Marshall* observed that Dr. Frankland's conception of purity was founded on chemical considerations; whereas Thy had been free of a pestilent medical man.

The Chairman referred Mr. Marshall to Dr. Thy's medical opinion of the samples of water taken from the Lea, which was also condemnatory.

Mr. *Marshall* intimated that, rather than incur the responsibility of undertaking a water scheme, the Board would stand by it, and let the Central Board carry it out and take the risk.

The Inspector intimated that a mandamus might be obtained against the Local Board to compel them to carry it out.

Mr. *Marshall* said that a mandamus might be mischief had as yet resulted from the use of the river water, and that the town would recall to future if the Board were to adopt the chalk scheme. The prosperity of resulting to the town from a water supply was beyond all question. The Local Government Board, by their having given their sanction for a new issue from the river. No person whose name was being inquired into by the Local Government Board, who, on the other hand, might have told the Local Board to go ahead in their boldness.

The Inspector pointed out that this would not have been the case if the Board had not before them the report of the Local Board had case. He had been very much impressed by the Public Health Act.

Mr. *Marshall* said that, in his employers' point of view, the chalk supply was not the main question. The great thing with him was as to the completion of the present supply. They wished to compel Cambridge to divert the sewage from the river. He looked upon the conduct of Cambridge in this matter as a scandal; it was a deliberate ignoring of a public duty—a daily infringement of an Act of Parliament. He would move the Local Board that they could attain the end in view by the direction of the river water as by passing it into a well by Ely. Nevertheless, if the Local Government Board were not satisfied with this, he might say, on the part of the Board, that they would, upon an intimation from the Board above, they would be prepared to proceed with the construction of a shielding reservoir, although they would not construct them of the town good will.

Although the previous might be very useful sometimes, in removing the opposite of the water in them to the effects of light, heat, and air would cause the development of animal and vegetable life, and their appearances at times would be rather disgusting. The Board had had a meeting that morning at which the subject of the Lighthouse Illumination degree, beyond question, and in fact—as regards the question embarking on the chalk water scheme. If they carried out the scheme they proposed, they would be setting on a complete experimentation, and would be in much the same place as the sanitary catalogue than the University town.

The Inspectors said he had listened patiently to the evidence brought before him, also to Mr. Marshall's speech. He should read through his notes, and report to the Local Government Board, who would communicate their decision to the Local Board.

The inquiry then closed.

PROFESSOR TYNDALL AND LIGHTHOUSE ILLUMINATION.

The following letter of Professor Tyndall will be read with interest, containing as it does the history of the lighthouse illumination dispute, beyond the mere question of economy:—

Commander of Atlantic steamers had long deplored the absence of any light on the Irish coast between the Fastnet and the Old Head of Kinsale. The captain of a famous Canadian described to me, on the spot, in the autumn of 1867, the anxiety he experienced when passing over those ill-famed miles in thick weather. It was at length resolved to establish a light on the dangerous promontory of Galley Head. The Irish Board of Inspectors of Irish lights recommended, and I think, at a meeting of the Board, decided to erect a first-class catoptric light, revolving once in two minutes, and a flame-bearing, if not a flash, in the world. Soon after its completion it was visited by a Committee of the Elder Brethren of the Trinity House, attended by their engineer, who subsequently wrote a report of his visit. It could not be called a public report; but it was communicated in manuscript to the Board of Trade and was quite in accord Boards, which I was permitted to read. Mr. Douglass was quite in accord with the recommendations which Mr. Brevoort and Sir James Douglass had made in relation to the inventions of Mr. Wigham. The Board of Irish Lights, having good reason to hesitate before accepting as final the criticisms of the Trinity House Engineer, asked me to read his report. Hesitation, courteously offering at the same time to put their steam yacht, the *Princess Alice*, entirely at my disposal. I accordingly spent twelve days in Long Island, Cork, and Galley Head light. Mr. Douglass, Mr. Brevoort, and Mr. Wigham were also present.

The Galley Head light is revolving catoptric. Four tiers of lenses are mounted one above the other; each tier presenting its own lenses, and the weather darkness, these lenses are flashed in succession; the power of the single light being sensibly doubled, trebled, or quadrupled, according as the light is the uniform, or the combination of two, three, or four tiers of lenses. The lenses are of barrows varying from 19 to 24 inches in diameter. The light is placed in the centre of the apparatus, the lighthouse, is raised over eighty feet above the sea. The light is thus instead of being permitted to pass the meridian without interruption, is flashed automatically four times, in each of which the full intensity of the flame is put forth. Having made a series of 20 experiments at different distances (15 miles for the greatest), the vessel sent me to a point 10 miles, where, the earth's rotundity coming between me and the light, it disappeared. I then steamed in the direction of the light itself until I could read the time by my watch, almost as if it were close at hand; while after the light had "set," every pulse of the flame was visible as a gleam in the surrounding darkness. As regards power and distinctiveness combined, no light previously invented to the mariner can be put in competition with the Galley Head quadruple flash. And, as before, I am happy to the commanders of the great ocean steamers concurred in the opinion that the Galley Head light would be a boon to navigation of the most marked and valuable kind. In the latter case, Captain Lund calls it a "splendid light, easily distinguished from any other in character." Captain Brooke, who had the charge of viewing the light in very hazy weather, calls it "a most excellent light." Captain Hewett, of the *Cunard*, calls it "a very fine light." Captain Cleeves describes it as "a most powerful, beautiful, and unmistakable light."

HOUSE OF LORDS.

THURSDAY, MAY 10.

A petition for additional provision in the Ipswich Gas Bill, from the Ipswich Gaslight Company and the Corporation of Ipswich, together with the proposed clauses and amendments, was read, and referred to the Examiners.

HOUSE OF COMMONS.

MONDAY, MAY 7.

THE BOARD OF TRADE AND PROFESSOR TYNDALL.

Mr. GIBSON asked the President of the Board of Trade whether it was true that Professor Tyndall, D.C.L., F.R.S., had resigned his position as Scientific Adviser to the Board of Trade and the Lighthouse Boards; and, if so, what reasons he had assigned for so doing.

Mr. CHAMBERLAIN replied that Professor Tyndall recently resigned the positions named, but had not stated his precise reasons for so doing. The circumstances were given in a long correspondence between Professor Tyndall and the Board of Trade, for the production of which the right honourable gentleman would perhaps wish to move.

Mr. GIBSON gave notice that he would move for the correspondence.

THURSDAY, MAY 10.

A petition against the Dumbarton Water Bill was presented from Lord Blantyre.

LIGHTHOUSE ILLUMINANTS.

On the motion of Mr. GIBSON, a copy was ordered of correspondence on the subject of a proposed investigation into the respective merits of gas, oil, and electricity as lighthouse illuminants, including correspondence between the Board of Trade and Professor Tyndall, F.R.S.

THE ELECTRIC LIGHTING AT THE HOUSE.

In Committee of Supply on the Civil Service Estimates, on the vote of £21,110 to complete the sum of £37,110 for the Houses of Parliament, reference was made to the recent introduction of the electric light.

Mr. GORST, complaining of the varying brilliancy of the light in the reading-room, asked whether any other than the Edison Company had been invited to tender for the lighting, and whether tenders would be solicited from other companies before the electric light was used in other parts of the building.

Mr. SHAW-LEFEVRE explained that as a proposition had been made to him by the Edison Company to light the dining-rooms and library of the House experimentally for a very small sum, he had thought it desirable that members should see what the effect would be. It did not appear to him that electric lighting in its present stage was a proper subject for competition. When arranging for the lighting of the Law Courts, he had considered the whole subject, and had decided that he could not invite competition. It appeared to him to be the best plan to select the system he thought most likely to answer. He came to the conclusion that the Swan light was best adapted to the Law Courts. Between the Swan and the Edison systems he saw little difference. As he gave the preference to the former in the case of the Law Courts, it appeared to him not unreasonable to try the Edison system in the House. Whether it would be ultimately adopted he could not say; but he would consult the comfort and wishes of honourable members. Perhaps the interest of the noble lord opposite (Lord R. Churchill) in this subject arose from the fact that it was generally understood he was a shareholder in the Swan Company.

Lord R. CHURCHILL repudiated the suggestion that he might be interested in the Swan or any other company; but the Swan Company had, he said, lighted the Law Courts in a manner which had satisfied everybody, and had made almost superhuman exertions to get the lighting ready for the opening ceremony; and on this account they certainly deserved some notice from the First Commissioner of Works. The complaint of the other electric companies was that, without saying a word to any of them, the Office of Works concluded an arrangement with this Yankee adventurer, who was shrewdly suspected of having stolen the patent of Mr. Swan, and had allowed him to light the House of Commons; which was, without exception, the greatest advertisement they could possibly give to an electric lighting company. It was now known all over the world, wherever there was a Parliamentary Assembly, that the Edison Company were lighting the House of Commons. Though he was not interested in these companies, there were Directors of the Edison Company in the House, and the right honourable baronet the member for the University of London was the principal Director of the Edison Company. Mr. Bouverie, a great supporter of the Whig party—(laughter)—was a member of the Edison Company; and it was, he believed, notorious—and if not a fact it could be easily disproved—that Mr. Preece, the Electrician to the Post Office, was a large shareholder in the Company. It was important that, when electric lighting was the subject of very extensive speculation on the Stock Exchange, any Government official who thought it right to introduce this system of lighting into public buildings should take the utmost care that there should not be the slightest advantage given to one company over another. The Edison Company had already had, at the Post Office, the trial which the First Commissioner said they ought to have. He (Lord R. Churchill) hoped, before the Government concluded any further arrangements with this most adventurous Company, the First Commissioner would put up to tender everything with respect to the lighting of the House or public buildings; reserving to himself, of course, the right of ultimate selection.

Mr. SHAW-LEFEVRE said he was sorry if he had done the noble lord any injustice; but his speeches on this subject appeared to him to have been directed, not from the point of view of the interests of the public and of economy, but in the interests of some rival company to that which had been lighting the House. There was not a word that had been said against the selection of the Edison Company to light the House that was not equally applicable to his selection of the Swan Company at an earlier date to light the Law Courts. The Edison Company laid before him certain reasons, upon which he was satisfied that their system was best adapted to the House at the time. For one thing, they had (and they were the only company who had) a noiseless dynamo—(Lord R. CHURCHILL: "No.")—and it was a great object that the process of lighting the House should be accomplished without noise. But the difference between the Swan and the Edison system was so small, that, on the whole, he thought it not unreasonable to give the Edison system a trial. As to its belonging to an American "adventurer," this he thought was a very unfair representation. Mr. Edison was one of the most distinguished scientific men of the day, and was beyond all suspicion of the character mentioned by his noble friend. The Company formed in England was of a highly respectable character, presided over by Mr. Bouverie, who, the noble lord insinuated, was a political supporter of the Government. When the contract for lighting was made, no considerations of this sort had any weight with the Office of Works.

Mr. O'DONNELL said it was strange that the Swan Company, having done well in the Law Courts, were not allowed to try the House of Commons also.

The subject then dropped, and the vote was agreed to.

ELECTRIC LIGHTING MEMORANDA.

ONE of the most satisfactory statutory meetings that has recently been recorded of an electrical company was that of the Electric Lighting, Contract, and Maintenance Company, which was held on Wednesday last. This concern was started about a year ago with the express intention of executing contracts for electric lighting, if such business could be done at a profit; the Company being at the same time free from all entanglements in connection with patents, and willing to carry out any system that might be found to answer. At the first meeting, in July last year, the Chairman confessed that the Company had not succeeded in finding any work in which they could prudently venture their capital. After the expiration of nine months more, the same story has been repeated from the chair. The Company have very wisely kept their capital, but have not done a stroke of work; and the concern is therefore to be voluntarily wound up. The shareholders have reason to be thankful to the Directors for the care with which the paid-up capital has been preserved through a period of great temptation. It cannot be altogether pleasant to the Board to confess a failure; but the Directors have at least the satisfaction of feeling that they have discharged their trust as honest men. The closing remarks of the Chairman are most instructive. He observed that all the working proposals that the Company had received would have involved them in great risk and small gain. He scouted the idea that electric lighting could now be supplied at the price of gas in England with any hope of profit. A well-managed Company working their own plant, and not overburdened with money expended in the purchase of patents, might pay their way and keep going; but more than this he would not allow. Candidly, the Chairman thought his Company had "come into the world a little too soon." He made a few remarks in abuse of the Electric Lighting Act, which he contended had done more than anything else to prevent the electric light from competing with gas; but if the commercial prospects of the system are such as he described, what can it matter, in the long run, whether there is an Electric Lighting Act or not? The fact appears to be that the Chairman wanted to find an excuse for the Company's failure outside the very sufficient ones already mentioned, and so he fell back upon the misdeeds of the Board of Trade.

On the same day a concern that has made a little more noise in the world—the Hammond Company—held its second ordinary meeting. According to the published report of the proceedings, everything passed off smoothly on this occasion, and a dividend of 5 per cent. was declared. In addition to this (which would require about £4000) the sum of £5000 is to be written off the goodwill and concessions account, the reserve fund is to be increased by £3000, and £1088 is to be carried forward. From this statement it would appear that the Hammond Company have found the secret that has eluded other speculators of the same stamp. There is, however, a cloud over the prospects of the Company, in the shape of a dispute between them and the parent Brush Company respecting the wretched Lane-Fox muddle. In consequence of the misunderstanding about the possession of the exclusive licence for the Lane-Fox lamp, the Hammond Company have had to return more than £68,000 in cash and shares to their concessionary Companies. At the same time they think to recoup themselves for this loss by a claim upon the parent Company; and, as a first step in this direction, have withheld a payment, presumably for plant, otherwise due to the Brush Corporation. An action is now pending upon this matter; but, besides all this, it is declared by *Money* that the Company's affairs are rotten in the extreme. It is deduced from the published accounts that the result of the year's working—including, of course, the great Chesterfield contract—is a dead loss of £9521. The money for the dividend and other charges is therefore obtained from the sales of concessions, which are now over; and, if all the liabilities are discharged, the Company would begin their current year's working with a cash balance of only £4209. It also appears that the liquid and locked-up assets of the Company amount to £42,091, as representing the paid-up capital of £80,050. Besides these there are, of course, a number of assets properly characterized by *Money* as imaginary, and consisting of goodwill and concessions, contracts in progress, and shares in sub-Companies. At the meeting, the eloquent founder of the Company, fresh from his lecturing tour, stated that "in the "past few weeks he had been confining himself almost ex-"clusively to inspiring confidence." In the hope that he will be able to do this for some time longer, he has just been granted a salary of £1000 a year. As the Company are losing £10,000 a year by their operations in Chesterfield and elsewhere, Mr. Hammond's services in this line, if successful, must be considered cheap at the money.

The Corporation of Leeds are at present determined to expend the—for them—magnificent sum of £10,000, for the purpose of finding out for themselves the real cost of electric lighting. They will not move under licence, for the Board of Trade will not make things pleasant by relieving them of the necessity for affording a compulsory and constant supply in their contemplated experimental district. It is curious how corporate bodies never seem able to learn much of each other, for surely there might be found places where the same half-hearted way of going to work has been tried, with results that might be instructive even to Leeds. Is Hull inaccessible, for instance? What has electric lighting cost Hull, and how much benefit has there been realized from the expenditure? Or what of Norwich? Surely it is time that this waste of money in timid "experiments" with portable engines, second-hand dynamos, and rickety lamps, was stopped. If the Corporation of Leeds will consult Mr. Gordon, he will speedily disabuse them as to the amount of instruction they will get for £10,000. But, again, how in the world can the cost of electric lighting in the regular way be ascertained if all the essential conditions as to constant supply and the other matters objected to by the Leeds Corporation are left out? They may in this fashion obtain the luxury of a few incandescent lamps for their municipal buildings; but this really appears to be all they desire. If so, how will the ratepayers be benefited by such an absurd waste of public money in what might be described as a piece of corporate vanity? What an example to set before other consumers of gas in the town!

ELECTRIC LIGHTING MEMORANDA.

The different Electric Lighting Companies which retain pretensions to an active existence are making themselves exceedingly troublesome to the public authorities of nearly every town in the Kingdom. The country newspapers are full of reports of Town Council and Local Board meetings, wherein proposals emanating generally from the Hammond-Brush or the Edison Company are discussed with more or less show of electrical learning. At Ipswich, for instance, the Hammond Brush, the Edison, and the Gulcher Companies have all (simultaneously) asked sanction for applications for licences, or given notice of intended applications for Provisional Orders. The electric light has not yet appeared at Ipswich, and the majority of the Council are afraid of the cost; but here again was heard the familiar tag about other towns trying electric lighting, and "Ipswich ought not to be behind." It might well have been thought that one experiment would be sufficient to prove the advantages of any system, or the reverse; yet the localized "brushes" are still as indefatigable in soliciting opportunities for trying "experiments," as though the notorious 2000-candle power lamps were always fresh and new in every fresh place. Volumes have been written on the adventures of books, coins, and other portable property; but, judging from the way in which Brush lighting starts up in one place after having been tried and rejected in another, the travelling experiences of a workable Brush dynamo machine must be quite as worthy of record.

At the time when so much stir in the matter of licences and Provisional Orders for electric lighting is agitating the provinces, reports of the general meetings of the Electric Lighting Companies in London are full of instruction respecting the other side of the picture. The principal work done at these meetings is usually certain alterations in some of the Articles of Association, in order to obtain Stock Exchange settlements. This is always put forward as the most important object to be attained. Business may or may not be coming into the concern; the work or contracts in hand, if any, may or may not be profitable; but so long as a little financing can be done, who cares? There are seldom any other resolutions to be passed at these meetings; and, it is scarcely necessary to observe, there is never any dividend to declare. The report of the first general meeting of the Birmingham and Warwickshire (Brush) Company is a good specimen of many others. This undertaking is a child of the Hammond Company, which is a child of the obligations of this hopeful family are even more obscure than most genealogies of another kind. The original stock-in-trade of the so-called local Company (whose meeting is, of course, held in London) was a valuable "concession" of the right to the Brush patents in the district named in the title. Soon afterwards it was discovered at the London office that part of the borough of Birmingham was not in Warwickshire at all, and so it became necessary to expend a further sum of £20,000 in the purchase of similar rights in Staffordshire and Worcestershire. Now the Chairman has an inspiriting tale to tell of the receipt of one order for lighting on exhibition, and of several most promising inquiries. Therefore the Company is flourishing, although the question of dividends is still in abeyance.

Sufficient mirage has already been made of Lieut.-Col. Festing's ecumenical triumph in the so-called lighting of the South Kensington Museum by electric lamps, as compared with the previous gas lighting; but it is possible that recent experiences at the Birmingham Town Hall may be similarly misinterpreted by electric lighting partisans. It has been widely admitted that the state of the atmosphere of the Hall during the recent Musical Festival was greatly superior to that observed on previous occasions of the same kind. This time the Hall was lighted by incandescent electric lamps, and the improved effect was, of course, wholly set down to the change to this system from the foul, polluting, suffocating combustible supplied by the Corporation Gas-Works. This was a great lift for electricity, and a great discredit to gas, so long as the first crude results remained without other explanation. Something has since been stated, however, which the audience at the Festival could not be expected to know—namely, that, in view of the event, a thorough overhauling and rearrangement had been made of the ventilation of the Hall. Previously the fresh air inlets were very inadequate, and generally took the form of draughts; while the openings in the ceiling for the escape of hot and vitiated air were only competent to discharge the contents of the Hall once every four hours. Added to this, the heating arrangement consisted in warming air taken from the Hall and returning it again, instead of admitting a fresh allowance from without. Now, however, by new ventilators making use of currents induced by gas-jets, the atmosphere of the Hall is changed completely every half hour; and thus the highest temperature under the ceiling is easily kept about 40° lower than before. The superior comfort of the audience at the Festival is thus easily accounted for without ascribing to electric lighting a virtue which it does not possess. Indeed, it will be seen that the vitiated gas is one of the principal agents in effecting the beneficial change in question. It will only be following established usage, however, if in future all the credit of supplying fresh air to the Birmingham Town Hall is appropriated by the electricians, without a word of acknowledgment to the ventilating engineers, but for whom the atmosphere of the Hall would have remained as foul with incandescent lamps as it used to be with gas.

ELECTRIC LIGHTING MEMORANDA.

From all parts of the country intelligence comes to the purport that the Board of Trade will not have to grant (simply as many Provisional Orders under the Electric Lighting Act as at one time appeared to be demanded. The local authorities of Leicester, Rochdale, and many other important towns, together with nearly all the London Vestries, have decided to sacrifice the preliminary expenses incurred by the Act, and to abandon their proceedings, at least for the present. Mr. Chamberlain's declaration to the effect that powers would not be granted to corporations unless it offset of lighting some of them, has had the principal motive in taking action was of speculators, whose from speculative intentions. The Rochdale Town Council, like many other local authorities, had endeavoured to obtain some precise information that might serve as a basis of action, or at least of argument. With this object they obtained a report from Sir Charles Bright and Mr. Muirhead undertaking in the centre of the town. This report has been published, and amply testifies to the skill and care bestowed upon the question by the eminent authorities already named. According to them, the establishment referred to could provide incandescent lighting at a cost to the producer of exactly 16s. 0¼d. per lamp per 1000 hours per annum. The lamps would, of course, be equal to 20-candle power. The report obligingly compares this scaling with the cost of gas, which is assumed to be, at 4s. per thousand cubic feet, just £1 17s. 6d. for the same number of hours of lighting by a burner consuming 5 cubic feet per hour, and liberally allowed to afford the light of 12 candles. It was but a poor compliment to the eminent electricians who had made themselves responsible for these statements, that the Corporation, upon receiving this report, immediately and unanimously passed a resolution not to proceed with their application for a Provisional Order under the Act. But they mean to imply any distrust of the figures that had been so carefully worked out by the electricians, without a word of acknowledgment to the ventilating engineers, but for whom the atmosphere of the Hall would have remained as foul with incandescent lamps as it used to be with gas.

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symmetrical with the parallel is rendered incomplete and unsatisfying by the absence of a meter for the electrical supply. The Company's charge, if they ever commences business, will probably resolve itself into a fixed sum per lamp per quarter, and will be stated at this minimum. If, in addition to this, consumers are expected to find their own lamps (which cost 6s. each, and require renewal at least three times a year), the Corporation must not tremble for the future of their gas supply in view of the competition of the Compton-Windsor Company.

The American correspondent of *The Times* has recently given a hopeful account of Mr. Edison's proceedings in New York; and it is significant of the comparatively feeble interest taken by the investing public in such matters, that a communication which at one time would have convulsed stock markets everywhere is now practically unnoticed. The great inventor is, of course, doing wonders; but that is his usual occupation, and is therefore not news. One of his children—the Edison Insulated Company, a concern which is devoted to lighting mills and warehouses by installations contained on the premises—has recently declared a dividend of 30 per cent.; to which special attention is drawn as being the first profit earned by any company for lighting, pure and simple, without help from the sale of plant or concessions. We are glad, moreover, that Mr. Edison's knowledge of the conditions of the electric light question in England is complete. To his mind the price of gas here is the one factor in the problem which requires solution. The writer goes on to remark that "it is in this problem to which he has applied himself with so much success." There is evidently some mistake in these two sentences, but we cannot undertake to point it out.

The Electric Lighting Committee of the Hull Corporation, who have employed Messrs. Siemens Bros. to light a portion of the town under the provisions of the Local Board Acts, are not much pleased with the result that can be obtained from the Brush system. As will be seen by the report in another column, a special meeting of the Hull Committee was recently convened for the purpose of drawing the immediate and serious attention of the contractors to their "non-compliance with the terms of their electric lighting contract;" and, having done this, they adjourned further consideration of the matter for 24 hours. At Cleethorpes—the scene of the latest attempt at public lighting by a Brush Company—the Local Board are much incensed with the failure of the experiment. The incandescent lights have been condemned on all sides, and the contractors have promised to replace them with arc lamps. Hero, however, at Chesterfield, the authorities, having begun to experience the ways of electricians, have been by no means the slnps of a dimly Order, which has been transmitted to the Corporation, and has also been explained and commented on in a local newspaper. The matter of most general interest in these documents is the basis upon which rates for electrical services are to be levied. The undertakers wish to reserve power to elect whether they will charge consumers by quantity or time. They have found it necessary to define a unit of "electrical energy," which is the energy contained in a current of 1000 amperes flowing under an electro-motive force of 1 volt during one hour. Although this unit is the energy required to feed 20 incandescent lamps of about 15-candle power. The Corporation contemplate a charge per quarter of a year, of £1 10s. for any quantity up to 100 units; "and for each unit over 100 units, 8d. per unit." According to this scale, it is computed that the Company's maximum charge will be equivalent to gas at 6s. 8d. per thousand cubic feet. In case consumers are charged by the number of hours, the price is to be levied on the supposition that the consumer uses the maximum current specified by the Company. Thus, although it may be interesting to attempt a comparison between the charge for electricity and that for gas measured by meter, it is

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The Chesterfield Corporation, however, have been by no means slow to experience the ways of electricians, and have begun to sign the contract handing over their district to the latter for a definite time. We have not heard from Chesterfield since the Company have yet redeemed their reputation. The electricians, however, have a firm friend in the Town Clerk of this place, for we observe that this gentleman is always willing to oblige inquirers with a good character of the contractors' "efficiency and economy." As the statement does not agree with the published opinions of Alderman Gee on the same subject, we should like to be informed whether at the time this letter was written the contract in question had actually been accepted by the majority of the Corporation.

It is suggested in the *Solicitors' Journal*, that local authorities who have decided not to avail themselves of the Electric Lighting Act may nevertheless have power to contract with any person for the supply of electric light in their streets, under the well-known provision of the Public Health Act, 1875, section 161. This is manifestly true, and the new law' him during all the hours of supply. Thus, although it may under previous general legislation. But our legal contem- poraries appears to forget that it is for an undertaking for a private lighting that the question of the Board of Trade is

required." There is no Order necessary for public lighting, or even for private lighting by a company of adventurers willing to take the same risks as an unauthorized Gas Company.

Notwithstanding the support afforded by several local celebrities, the Dalziel Electric Light Company—one of the Brush swarm—has come to grief at last. The concern has had a brief but troubled existence, having started with a nominal capital of £10,000, of which £16,280 has been actually called up. An attempt is now to be made to sell the plant and goodwill as a going concern; but the result of this proceeding is not difficult to foresee. A professional shareholders is to be appointed with a committee of five. This is but the beginning of the wreckers' season in the electrical speculation.

SOME NOTES FROM AMERICA.

(FROM OUR OWN CORRESPONDENT)

New York, Nov. 22, 1882.

The scientific world has just been called upon to mourn the loss of one of the most distinguished workers—a gentleman who, by his original researches and patient investigations, has made himself honoured throughout the civilized world. Professor Henry Draper will be regretted the more that he has been taken away while in the prime of life, and at a time when it seemed as if his labours were but begun. Those who have followed the course of astronomical photography, and the work he did in this connection has made for him a world-wide reputation, will know that it was not unreasonable to expect that he was the discovery yet to be given to the sun. This was in 1867, after a long and patient investigation. He was then sent by the Government to Peru, to observe the transit of Venus, but was unfortunate in the weather, and failed to secure a picture. The latter applauded his discovery; but the Britishers were slow to acknowledge the correctness of his claim to the honour. It was a long time before Professor Draper's habit, whenever the sun in its business appeared in the heavens, to enter the Observatory and take a picture of it. Many of these pictures he invariably gave his guests a practical exhibition of. On the evening before his illness assumed a serious aspect he showed the members of the Society, and had a quite unique display of the objects of interest. The following morning the Professor was taken seriously ill; yesterday at 10, and under this he rapidly sank. He lingered until the morning of Sunday, the 20th inst., when he passed away at the early age of 45.

The electric light companies in New York continue to make a little progress, but perhaps not as much as they have accomplished in the early days of the year. The United States Company, controlling the Maxim patents, is supplying in the city four stations, from which they have one 25 and two 200 horse-power lights. At one station they have a 50 and two 200 horse-power lights working, the capacity of which is said to be 200 arc and 2500 incandescent lights, and I have been informed that the total exactity of the Company's plant is further 2170 lights of 20 candle-power. The Company states that they have 1500 incandescent and 511 are lights now in operation, including 72 used for street lights. It is also stated that they have in the city 141 miles of are lights give the highest, or perhaps more correctly speaking the least disagreeable light of any are lamp with which I am acquainted. The lamps with comparative steadiness, and the unpleasant visual pressure are so painfully apparent as in the Brush lights, I do not, however, wish to give you the impression that the Maxim lights are free from defects. On the contrary, I have witnessed many failures during my visits to the stations where the lamps are in operation in inferiorly lighted streets. Take the case of the Canal Street, the prospect is about as gloomy as one would wish to see. The Brush Company at present is about as gloomy as one would wish to see. have witnessed the capacity of their present plant, and are not willing at this time to make any extensions. The Company controlling the Maxim patents are now erecting a station, according to their account, they contract for the saking is that Mr. Brush is doing little at present. They claim to have 1000 lights in operation, till it is known what will be the result of the experiment. This Company supply direct lamps, and they claim to have not 211 day lights in large stores and about 500 night lights.

Some reporters of the Daily Papers have been going round interviewing the parties who are using the Edison lights now supplied from the Company's central station. Few of the consumers appear to be satisfied with the result of the experiment. One of the consumers was not resting there to say anything, so they would call again to see it. The general complaint seems to be that the light was so brilliant as one moment and dim the next. One party did not think it was a gas flame. The reporter thought it was not a light by which to read a gas flame. The reporter thought it was not a light by which to read a gas pea, but added: "We like it better than the light was not so much as anything." I suppose this is what "dim gas" means. It does not look like a commercial basis." The cause of the dull or feeble power of the lights is said to be that the Company can run only one of their six engines at a time. It will be remembered that one of the advantages of the Edison system is that where several dynamos are in use the electricity from each of them is run into one main conductor, the several engines of the several dynamos into one main main. At least this was one of the advantages claimed for the system on paper. It is now said that as they attempted to run two dynamos, that as it was impossible to run the engines at the same speed—they would not work smoothly; the one engine driving the former to become stopped as with reelse; the result, of course, being a miserable forked flame. Further, people are beginning to realize that the Edison light is not so luminous a substance as they have been led to believe. The truth is the number of deaths caused by water gas in New York City almost equals the number of new patients in hospitals. The *Sanitary Engineer* declares that 11 deaths have occurred in the city in consequence of the use of this gas, since the 1st of January. If there is to be a fight between gas and electricity, this is a heavy load for the gas industry to carry to the conflict. A few evenings since a man was found lying on the walk in front of a hotel at two o'clock in the morning. At about the same hour a lady observed a colour of gas was perceived in the vicinity of the apartment in which the lady was asleep. On turning on the gas, the man was found to be dead, and the man died shortly after he was discovered. Of course it is stated that the man died from the gas—in fact, this is the stereotyped explanation of these disasters; but it seems strange that a man who had lived in the city for some time should not have known better than to have put a gas flame in a closed room. The truth is that the gas—making a large percentage of carbonic oxide is very liable to be blown out by an ordinary draught; and these accidents, I think, are not occasioned by people blowing out the gas, but by the flame being extinguished by some draught or current of air. Another case—a policeman in the city—was found in a lodging-house in Chatham Street, asphyxiated by gas; death followed in a few minutes. A removal into the open air. Strange that a man so used to the vapor of a large city as a policeman must be, should be guilty of such gross stupidity as to go to bed in a room in which gas, in the aromatic of these accidents which appear in the Daily Press, or rather inside is made of the fact that its water gas that creates such havoc; and surely the Company have no authority has to bear the burden of the sins of our water gas friends. But the managers of the electric light companies let these opportunities for a word in season on the gas business pass "unimproved." On the contrary every such accident is graphically described in large type in the journals devoted to the cause of the new illuminant. So the public are being "educated" to the belief that gas is a death-dealing substance.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT. [Oct. 17, 1882.

EDISON LIGHTING IN FRANCE.

IN a recent number of the *Revue Industrielle* M. Ph. Delahaye has ran article on the progress of the Edison lighting movement in France, which contains so much side argument, and is so badly expressed, that it deserves translation into English in its entirety. The length of the sentences, however, against this method of treatment, and already generally known. M. Delahaye begins by telling whatever may be the opinion of the public during the past few years with the significance has tolerated into business certain images which do not conform to the elementary principles of true industry. It has been incessantly believed, until recently, that any enterprise worthy of being taken up by a joint-stock company should at least rest upon a serious basis, and should have been proved to give a sufficiency of practical results before an appeal is made to capitalists. Laboratory experiments, even when in the guise of working installations, should only be regarded as encouragements to adventurous spirits, who are notable to valuer gains; it is not usually permissible to augur from the particular to the general, and to proceed to work on a large scale upon the authority of a few limited experiment. Still, however, every one says now-a-days that time is money; and the old method has the inconvenience of employing a great deal of this capital. Consequently, inventors of a new motor made than they are always to us in all their maturity; and the public are asked to defray the cost of a frequently inconsistent and precipitated education. By reason of the peculiar opportunities which it affords for speculation, electricity has been selected as the subject of certain financial projects which appear to threaten its future; and it is from this reason that has instigated M. Delahaye to discuss and consider—not as an enemy to electricity so much as a foe to speculative electricians.

At the beginning of the present year the speculative fever began in France by the formation of a company for the utilization of Edison's system by the aid of electricity, whereby a great number of benefits were to be conferred upon mankind at large and the company in particular. The company is now dissolved, and for some time after this fallen electrical speculation made its home chiefly in England. Recently, however, the fever has reappeared in France, although it is as yet confined to the provinces. The Edison system of electric lighting is the cause of this new outbreak, since there is no French invention of the kind sufficiently potent to draw money out of the pockets of French capitalists. Therefore the names of the shareholders in the new concern is declared for expatriation. A Continental Edison Company has been formed in Paris, with a capital of one million sterling, which possesses all the European rights of the inventor, and takes 45 per cent. of the capital of all subsidiary companies formed under its auspices. The principal work of the Company will therefore be the establishment, in all quarters of Europe, of companies, who will be made to pay dearly for the right of buying and using the American machines and lamps. It is to this method of exploitation that France is indebted for the Bessancon Electric Lighting Company, upon which we have already commented, and for the Edison Electrical Company of Dijon. The prospectus of this enterprise appears to have been M. Delahaye's incentive to write the article now under notice.

It is pointed out to begin with, that the demonstration given in this prospectus of the economy of electric lighting as compared with gas at Dijon rests on a false assumption that the price of gas at this place is 45 c. per cubic meter, whereas the legal price is only 32 c. Anyone who is desirous of ascertaining the income for electric lighting is complained of, and with reason, since it consists in stating what would be the cost of gas at 45 c. per cubic metre to obtain a light equal to the Edison 16-candle lamps. This, as M. Delahaye points out, is the wrong sequence of reasoning, because the electric lamp is the chief aim, and not the gas, which is already in position. It so happens, moreover, that gas-burners of 16-candle power are rarely met with in private houses, where the rate of consumption per burner is more frequently 6 or 4 cubic feet per hour. Therefore to base an estimate of economy upon a supposed hourly consumption of about 8 cubic feet for every burner, is contradictory to every-day practice; and to attempt to obtain the number of burners in use in a town like Dijon by dividing by this fantastic figure the quantity of gas sold, is absurd. M. Delahaye repeats here

A PRIVATE ELECTRIC LIGHTING WORKS.

MR. W. Spottiswoode, P.R.S., ex-President of the British Association, has given practical evidence of his belief for electric lighting by following the example previously set by Dr. Siemens, and provides the luxury of lamps for his country residence near Grossbrook. The record of the installation, as given in the *Engineer*, is not perhaps extended to remove the prejudices of those who regard this method of lighting as at present a costly toy. It has been constructed in the grounds, for the purpose of supplying light, water, and power for the house, stables, and gardens. A 12-horse power (nominal) steam-engine, of the latest pattern, supplied with steam from a vertical boiler, and all the necessary appliances for working the extensive machinery, electrical and otherwise, are placed in charge of an efficient engineman. The whole system of lighting which comprises four circuits, each of 50 Swan lamps, and four large arc lamps placed outside the dwelling-house, and ten more in the park, is under the control of an electrician. Telephonic communication is arranged so that the owner of all this apparatus can listen at will to the exact hum of the dynamos, while rejoicing in the power it produces. The engine is fitted with a speed governor, known as Deadman's velometer, which is said to regulate the speed of the machinery so effectually that the engine driver does not know whether the dynamo is doing any work or not. The panel is believe in the scientific effects of the lighting, not being responsible for the expenses. It would be deemed impolitic, perhaps, to ask for an appendix to the narrative of the *Engineer*, stating the cost of the establishment, and the working charges, not omitting a compensative record of the amount saved in the items of gas, oil, or candles.

ELECTRIC LIGHTING MEMORANDA.

The promoters of electric lighting companies are usually difficult of access, and the speculators who have taken shares in these ventures are not easily disturbed as long as shares can be bought and sold; but in a recent number of the *Electrical Review* there is a letter from Mr. Charles T. Wright which cannot well be overlooked. This gentleman (who, if we do not mistake, is connected with the British Electric Light Company) betrays something very like an accusation of fraud upon the persons who issued the prospectuses of nine of the Consolidated Brush Companies, in respect of their statements regarding the licenses for the Lane-Fox lamps. It appears that all the prospectuses in question contain the assertion that the stock-in-trade of the Companies includes the exclusive right to use and sell the Lane-Fox lamps in the districts referred to. Mr. Bright asserts that, so far from this being correct, the British Electric Light Company possesses prior rights as to these precious lamps; and he thereupon indulges in gloomy remarks about directors and vendors having, in his experience, been compelled to refund money contract has expired. The Hammond Company have given invested on the faith of flying prospectuses. Now the question notices wholesale of their intention to apply for licenses for arises—Who is to move in a matter of this kind? Here is an sessation of fraud, or of criminal negligence, levelled by a sufficiently well-known man against a swarm of directors, solicitors, and other officials connected with public Companies, some aggregate capital amounts to millions. The allegation is specific and unmistakable, and how is it to be met? For those who, like ourselves, regard the first and second claim to exploit the wonderful lamps in question as of about equal intrinsic value, this looks like a "very pretty quarrel as it stands;" and we shall gladly take up a place in the ring for the purpose of seeing it through.

The Vestry of St. George's, Southwark, held very advanced notions respecting the manner in which the Electric Lighting Act should be worked by local authorities. At a recent meeting of this important governing body it was resolved that application for a license or a Provisional Order for supplying electric lighting should not be made by them at present. This practical resolution was followed by another, to the effect that any independent applicants for Provisional Orders or licenses shall be opposed, unless they will consent to hand over to the Vestry one-half of their profits beyond 7½ per cent. This brilliant stroke of administrative genius has already found its way to fame, and has awakened an echo in sympathetic minds even so far as Worcester. The proposal to be admired for its boldness, if not for its originality. For the former, because it starts with the assumption that a Company undertaking the electric lighting of the parish will actually realize more than 7½ per cent. profit; and, with the approval of the Board of Trade, will be found willing to bribe the Vestry with *one-half* of all the gains made in excess of this figure. Unfortunately for any claims to originality which the authors of this notable decree may fondly cherish, it is merely a mutilated copy of the regulation under which the gas supply of Paris is conducted. This experiment, as the inhabitants of the French capital know by sad experience, has resulted in keeping up the price of gas to nearly the London standard, and in forcing a generation of discontented consumers and shuffling administrators. There is fortunately not much probability that the St. George's Vestry will obtain immortality on further than the Gaseous scheme, which would make of the ratepayers' representatives, and natural guardians, partners with a band of exacting speculators.

At last it has been notified by the Hammond Company that they cannot do anything to improve the lighting of Chesterfield by the Brush and Lane-Fox lamps; and, simultaneously with this declaration, Alderman Cree, who has waited patiently while the experiment in question has been dragged on for a year, has written to the *Standard* with a view to the insertion of special clauses for the protection of the town in any Order that may be eventually issued. field Town Council, that 'the lighting is a pronounced A local Brush Company and the Edison Company appear to failure. Mr. Hammond has visited Chesterfield repeatedly, be the only competitors left; and it is even doubtful whether and told the inhabitants of his intention to make the town a these will trouble the Corporation. show piece wherein the ability of his Company to undertake public lighting should be brightly manifested. This has indeed, been done so well on paper, that, even within the last few days, an Alderman of Hanley could speak in public of the successful lighting of Chesterfield by electricity. It now remains to be seen whether any notice will be taken of Alderman Gee's statement of facts, as opposed to the misrepresentation that has been allowed to pass current for so long. It is a curious commentary on an observation of the Alderman—that not one instance has occurred of the interference of electric lighting into any shop or house in Chesterfield, notwithstanding the persistent energy displayed in this direction by the Hammond Company's agents—that a memorial has just been presented to the Town Council, by a number of ratepayers, asking for facilities for the general supply of electricity for lighting. It would be instructive to learn how this precious memorial was originated and managed. The Town Council, however, have decided to apply for a licence under the Act, although it is scarcely likely that they will continue to move in the line of trammels in the readiest manner. Hence each means because the pole of a huge electrifying machine, lying in wait for the unwary individual who should complete the circuit by stepping upon both the metals at once. The state of affairs here described was first made manifest to the public observed to display sudden fire and unrivalled liveliness of action when crossing a certain part of the road. A crowd was soon gathered opposite the "great horse-exhilarating station," as a newspaper report terms the spot in question; and before long the cause of the mysterious display was discovered. Lucidity to harm was done; but the Edison Company had a fine opportunity for pointing out that if the Brush current had taken a similar course, every animal, instead of being merely frightened, would have been killed on the spot. It happened that a workman employed by the Brush Company was killed about this time by touching the wires attached to a lamp; and the public mind is somewhat distrustful of the system in consequence. Mr. Edison says that all such wires should be buried out of harm's way; but this appears to be what he has not been able to do with his own leads. It is therefore a question how intense currents can be insulated so as to combine with safety, taking due account of the factor of carelessness and blundering.

Some very peculiar business is at present going on between the Faure Electric Accumulator Company and M. Philippart, their promoter or patron. This individual and his friends hold the controlling interest in the Company, and he also has "an arrangement" with another Company, who, it is stated, own the only accumulator fit to compete with the Faure battery. M. Philippart has now ordered that the Faure Company shall cease to exist as an industrial concern—a decision which they had obtained at great cost from the parent Company, which he did not think was worth much, as "electric lighting is now in rather low water." All of the Devon and Cornwall Company was fain to admit that their business receipts up to the present time amount to the small sum of 200 10s. and no more. After this, who should deny that Brush lighting is a paying business?

In connection with the present scare among Brush Companies, it may be noted that a strong point with the petitioning shareholders is the misrepresentation of the Company's position in the matter of the licences for the Lane-Fox lamp. All these concessionary Companies, which are now in such a bad way, were started in business with a stock-in-trade consisting of a guaranteed connection between British and Lane-Fox lamps. Unfortunately, the word *exclusive* was inserted in the prospectuses with reference to both systems, whereas there existed an assignment to the British Electric Light Company of the precious Lane-Fox patent. It now remains for the Court to say whether this blunder, which is now admitted by the incriminated Boards, amounts to a false pretence or not. It is curious to note that the excuse proffered by the respective Chairmen, the evidence of a previous agreement as to what they should say. Every man declared in effect that the mistake was of no importance, because the supposed right to the Lane-Fox lamps is not worth the smallest coin of the realm to anybody. Thus the ingenious inventor's (?) fame is sacrificed upon the altar of expediency. Mr. Lane-Fox has now a good opportunity for soothing his wounded vanity by asking these gentlemen to show what value the other part of their concessions possesses.

An exciting discussion took place at the special meeting

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Nov 14, 1882

ELECTRIC LIGHTING MEMORANDA.

The influences of the Birmingham Town Council has at least extended as far as Wolverhampton, for at a recent meeting of the Town Council of the latter place it was decided to follow the Birmingham lead in the matter of the Electric Lighting Act. The Wolverhampton authorities have passed through the period of doubt and inquiry experienced by their more populous bodies all over the Kingdom; and in their difficulty they applied for guidance to Mr. J. N. Shoolbred. This gentleman's report did not convey much comfort to his anxious clients, for although he told them something about the arrangements of such an experimental electric lighting installation as everybody saw or heard of before the Act came into being, he naturally failed to prove that any such undertaking would be either safe or profitable. He and the Borough Engineer appear to have set their minds upon a somewhat in the Brush model. This proposal is mixed up in some way with a project for the amalgamation of the two rival Companies which have "arrangements" with M. Philippart. We shall be much mistaken if this mysterious transaction turns out well for the parties interested. The era of concessionary electrical schemes is past, and will not be revived again in our time.

ELECTRIC LIGHTING MEMORANDA.

There is a strong rivalry everywhere between the Brush and Edison factions, each side being active in disparaging the other. The rivals may be further described as comprising on the one side the distributors of intense currents, and, on the other, the partisans of currents of low intensity. Thus it is curiously lamentable experience on many occasions that the Brush current is destructive to human life, and is also able to cause damage to property. On the other hand, it is the special boast of the Edison people that a man might, without much harm, grasp with bare hands the two wires connected with an Edison dynamo. In the streets of New York, where both systems are to be found in a few localities, the Edison leads are underground, while the Brush wires are strung overhead. A short time since there was a leak from the Edison cable, and the electricity was led by some circuit by stepping upon both the metals at once. The state of affairs here described was first made manifest to the public by the eccentric behaviour of a number of horses, which were soon gathered opposite the "great horse-exhilarating station," as a newspaper report terms the spot in question; and before long the cause of the mysterious display was discovered. Lucidity to harm was done; but the Edison Company had a fine opportunity for pointing out that if the Brush current had taken a similar course, every animal, instead of being merely frightened, would have been killed on the spot. It happened that a workman employed by the Brush Company was killed about this time by touching the wires attached to a lamp; and the public mind is somewhat distrustful of the system in consequence. Mr. Edison says that all such wires should be buried out of harm's way; but this appears to be what he has not been able to do with his own leads. It is therefore a question how intense currents can be insulated so as to combine with safety, taking due account of the factor of carelessness and blundering.

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of the Sheffield Town Council last Wednesday, when the desirability of applying for an Electric Lighting Order was considered. In the event, the proposal to apply for an Order was carried by the casting vote of the Mayor, who qualified his action by observing that it was prompted by deliberate opposition to three prominent shareholders of the Sheffield United Gas Company, who voted the other way. This was not a very worthy speech of a judicial functionary, since it seems to imply the preponderance of private over public interest on the part of gentlemen who probably serve the public as faithfully in two capacities as his Worship does in his own temporary office. The amendment which so nearly ousted the original motion was substantially the same as the proposal recently adopted by the Birmingham Town Council; and the debate was marked by all the confusion and misapprehensions which the Electric Lighting Act has so well succeeded in fostering. It is not easy, in discussions of this character, to say which side numbers the friends or enemies of gas and electricity respectively. Everything is in confusion, none knowing what to advise. The only thing perfectly certain is that the ratepayers will have to foot the consulting fee expenses, whether their representatives apply for an Order or whether they prepare to pose as discriminating opponents in the mere spectators.

The Corporation of Chesterfield, whose experience of electric lighting is exceptional, mean to apply for a license from the Board of Trade, avowedly for the purpose of keeping speculators out of the town. From the remarks of Alderman Wood, at a recent meeting of the Town Council, it appears that the Hammond Company have expended from £5000 to £6000 upon the 22 arc and 100 incandescent lamps with which they are supposed to light the town, notwithstanding the fact that the work was done in the cheapest and ugliest manner, are "absolute commercial failures." Whom is the puzzled The Watch Committee have not yet decided that the lighting is a success, and therefore it is impossible to say how long the present experiment may last, since the year's contract is for only to begin from the time when the lighting is accepted as satisfactory. It would not be polite for the Council to declare their intention of forcing out the Hammond Company at the earliest possible moment; but it is not difficult, easy, and respect with other purveyors of electric light, to read between the lines of their decision to invoke the authority of the Board of Trade.

ELECTRIC LIGHTING MEMORANDA.

There has been very little stirring in matters electrical during the past week, the principal event having been the meeting of the Electrical Power Storage Company on Wednesday. The Chairman committed himself to the statement that the prospects of the Company are "of an assuring and flattering character," and the debate was marked by "ing chamester"—an assertion supported by reference to the performances of the inamear, mentioned in these columns last week, and to other notable successes. The meeting seems to have gone as harmoniously as might be expected when, out of a nominal profit of £216,359, not a penny of dividend is available. Our caustic financial contemporary The gas-barrens are, of course, carefully kept in readiness to be turned on in case of the expected breakdown of the new system. The appearance of the rooms by the new light is scarcely so good as before, since the lamps are hung much lower than the old burners, and consequently the decorated ceilings and upper portions of the walls are not so well lighted out. Still, if we must be sacrificed, we must be sacrificed to make some sacrifices.

The gentlemen who now constitute the directorate of the Electrical Storeage Company formed under the patronage of M. Simon Philippart must sincerely regret the incompetence of the Belgian Government in procuring the arrest of Philippart in Paris, virtually on the ground of his being a defaulting bankrupt. M. Philippart came to grief in 1878 amid circumstances sufficiently notorious at the time; and after this event he remained in obscurity until he again burst upon the financial firmament as the promoter of the French storage battery scheme of electric lighting. An affiliated Company was soon afterwards formed in London, and not long ago this same M. Philippart managed to drive out the independent element from the English Board, and reconstruct the Company in accordance with his own elevated ideas. Part of his object in doing this was to effect a combination of all the storage battery interests into one Faure-Sellon-Volckmar constellation. Everything appeared to be going on very well with M. Philippart again—as well, indeed, that certain of his old Belgian creditors thought they should like to share in this prosperity. Other unsecured claimants were lodged with the Brussels authorities respecting M. Philippart's effectuous to discharge his old obligations, with the result already told. By a "simple combination few could ever have reckoned upon," the great financier was arrested, bail being refused, on the same evening when he was to have presided at the inauguration of the lighting by Swan lamps, fed by Faure accumulators, of Pigeon's restaurant in the Avenue de l'Opéra. We are told that the victim of his relentless creditors was surprised and "considerably annoyed" at this treatment. The Parisian police are manifestly too unscientific for this "accumulating" age. Possibly before M. Philippart is at liberty to preside over another gathering of electricians, he will have been taught something about "induction" as well as of "storage."

It seems but as yesterday that Mr. Gray, M.P., and his friends were preparing to set the Liffey on fire, or better, by the aid of the Dublin Electric Light Company, which was to unfold the blessings of Brush lighting to the benighted population of the Irish capital. Never was a greater outcry made concerning a very small matter; and seldom have the mutual congratulations of sanguine speculators been more swiftly and entirely silenced. Before us to-day lies the notice of sale of all the property and effects of the Company, with the doleful inscription, "In Liquidation." Everything, from the license to use the Brush patents, which cost more pounds than it will fetch pence, down to the worn-out fire-bars, is offered for sale by tender on the 14th inst. If not then sold, the whole will probably be knocked down at auction. The liquidator announces that the concern is still "going," and that any one with sufficient capital will find a "large field for successful enterprise" open to him. Meanwhile, what of the capital of the Company?

ELECTRIC LIGHTING MEMORANDA.

Electric lighting companies must still be content to live by their losses, if we may believe a great many reports, concerning which there is little room for doubt. Nobody knows in the City of London; the Hammond enterprises at Chesterfield is notoriously a costly advertisement; and the Edison undertaking in the Holborn Viaduct can scarcely be otherwise regarded. And the same character is ascribed to the last undertaking of the Edison Company in connection with the experimental lighting of the library and smoking-room of the House of Commons. This installation, consisting of 258 lamps of the usual type, was started in working on Monday last week with a fair measure of success, according to various accounts, although the amount of light afforded is not thought to be sufficient. It has been stated that the cost of this experiment to the country will not, in the first place, exceed £800; but that the work has cost the Company more than £2000. Thus the electricians will again pay for their advantage. to be turned on in case of the expected breakdown of the new system. The appearance of the rooms by the new light is scarcely so good as before, since the lamps are hung much lower than the old burners, and consequently the decorated ceilings and upper portions of the walls are not so well lighted out. Still, if we must be sacrificed, we must be sacrificed to make some sacrifices.

The gentlemen who now constitute the directorate of the Electrical Storeage Company formed under the patronage of M. Simon Philippart must sincerely regret the incompetence of the Belgian Government in procuring the arrest of Philippart in Paris, virtually on the ground of his being a defaulting bankrupt. M. Philippart came to grief in 1878 amid circumstances sufficiently notorious at the time; and after this event he remained in obscurity until he again burst upon the financial firmament as the promoter of the French storage battery scheme of electric lighting. An affiliated Company was soon afterwards formed in London, and not long ago this same M. Philippart managed to drive out the independent element from the English Board, and reconstruct the Company in accordance with his own elevated ideas. Part of his object in doing this was to effect a combination of all the storage battery interests into one Faure-Sellon-Volckmar constellation. Everything appeared to be going on very well with M. Philippart again—as well, indeed, that certain of his old Belgian creditors thought they should like to share in this prosperity. Other unsecured claimants were lodged with the Brussels authorities respecting M. Philippart's effectuous to discharge his old obligations, with the result already told. By a "simple combination few could ever have reckoned upon," the great financier was arrested, bail being refused, on the same evening when he was to have presided at the inauguration of the lighting by Swan lamps, fed by Faure accumulators, of Pigeon's restaurant in the Avenue de l'Opéra. We are told that the victim of his relentless creditors was surprised and "considerably annoyed" at this treatment. The Parisian police are manifestly too unscientific for this "accumulating" age. Possibly before M. Philippart is at liberty to preside over another gathering of electricians, he will have been taught something about "induction" as well as of "storage."

It seems but as yesterday that Mr. Gray, M.P., and his friends were preparing to set the Liffey on fire, or better, by the aid of the Dublin Electric Light Company, which was to unfold the blessings of Brush lighting to the benighted population of the Irish capital. Never was a greater outcry made concerning a very small matter; and seldom have the mutual congratulations of sanguine speculators been more swiftly and entirely silenced. Before us to-day lies the notice of sale of all the property and effects of the Company, with the doleful inscription, "In Liquidation." Everything, from the license to use the Brush patents, which cost more pounds than it will fetch pence, down to the worn-out fire-bars, is offered for sale by tender on the 14th inst. If not then sold, the whole will probably be knocked down at auction. The liquidator announces that the concern is still "going," and that any one with sufficient capital will find a "large field for successful enterprise" open to him. Meanwhile, what of the capital of the Company?

MORE ELECTRIC LIGHTING ACCIDENTS IN NEW YORK.

The New York Sun of the 18th of February gives an account of "two more explosions" which occurred at 121, Front Street, in that city, on the previous Saturday morning. It appears that the first floor of the building in question is lighted by the Edison Company, while the other portion is lighted by gas in the usual way. The gas was supplied through an ordinary 1-inch service-pipe (not a 2-inch pipe, as stated in the newspaper); the electric wires themselves being also laid in a pipe, but of smaller calibre and size—as not informed. Both pipes passed into the building under the steps, within a few inches of each other. Overhead, in the basement hall, was the electric meter; and although we were nothing about a gas-pipe being near at hand, the gas-pipe, which follows, this hall, both pipes were in close proximity here as well as under the steps. At the time of the first explosion a man was employed in the electric wires was the first to burst. The fracture occurred at the angle where the gas-pipe turned to enter the building: "and immediately afterwards," we are told, "the meter exploded." An *employé* of the Edison Company was sent for and he could not account for the explosion; but through the rest of the day had something to do with it. The report goes on to state that two different explosions afterwards occurred: the water-pipes leaking in the gas-pipe, set the gas on fire, and set fire to the gas-pipe. As shown of fire was extinguished. The explosion of the electric company cut off the electric wires at either end of the tunnel, and the gas-pipe was plugged up. Mr. Edison ordered an investigation to be made, and republished the idea of the electric meter exploding, he was misinformed. Assessments as it contained nothing explosive, but remarked that when the wires were replaced they would not be carried through the gas-pipe. They had, he said, "been by experience that it was best to keep the wires away from other metals." This looks like a further display of danger, though not chiefly expected.

The latest and most written information dated the 13th inst.) in regard to the occurrences; and also a cutting from a newspaper, which looks like a resuscitation of the whole affair. It reads thus: "Superintendent Chimmond, of the Edison Electric Light Company, reports that the explosions at 121, Front Street, were caused by the rubbing off of the insulating material on one of the electric wires. A spark was created, and soon heated the neighbouring wires, which burnt the electric service-pipe. Escaping gas from a gas service-pipe took fire, and the electric fluid ignited the second explosion." This is very clear, and gives the gas a good half share in the business; but I should like to know Mr. Chimmond's reasons for his becoming deceived of the "insulating material" by rubbing, while lying quietly in a pipe; and how will he prevent such an occurrence in future? If the defect in the lead has caused at the time of putting it into the pipe, what has so lately occasioned it would have happened at starting. Should not Mr. Chimmond rather be on the look-out for the explosions, or whatever took place, were due to the burning of the "insulating material"? Your readers will be inclined to think so, when they come to consider the condition the gas-pipe was found in, or a part of it, and read the last of the investigation took place about, or some little time before the explosions and the firing of the gas, as reported in the *Sun*.

Although we only read in print of the doings of Mr. Edison and his explosive, now that the gas-pipe was plugged, there representing the New York Gas Company were not asleep; for I happen to know that the gas-pipe was carefully examined, and, to the astonishment of all concerned, three large holes (for its size—1 inch) were found in it near where the electric defect was found to be, each hole indicating clearly that it had been formed by the *fusion* of the iron, not lead. Does not this show us why Mr. Edison has determined "to keep the wires away from other metals" in future? The perforated pipe is in the possession of the Gas Company.

W. H.

June 30, 1883.

ELECTRIC LIGHTING MEMORANDA.

Since the matter was last mentioned in these columns, the Chairman and other Directors of the Commissioners of Sewers of the City of London have been far as may be gleaned from the report of the proceedings, busily debating the question of electric lighting. The strange the principal, if not the only business done during the year manner in which the Special Committee have dealt with the has been to maintain 31 lamps at Middlesbrough. Cannon references left in their hands during the past nine months Ina Street is in Middlesex; yet it was the concern of the York- evidently caused deep dissatisfaction among the rest of the shire Brush Company that was being discussed. The Direc- Commissioners; and it will scarcely be surprising if the whole tors claimed that the working referred to was profitable, arrangement is altered once more before anything is done. It is becoming evident to the Commissioners—as it has always been to observers of their proceedings—that their scheme of source, of less than £900 per annum, will maintain offices keeping the property in themselves, yet quitting the actual work and staff in London as well as works in Yorkshire. The not more. At a recent meeting of the Court, one of the with one another. Thus the Yorkshire Brush is about to be members wished to put to the City Solicitor a series of ques- tions which would have brought this particular point into a strong relief. Unfortunately for the purpose of the ques- tioner, he so framed his inquiry that a negative answer to the first of them quashed the remainder. It was desired to know whether the contracts must be made before the Provisional Order or Licence could be obtained; and then if the grant of the Order would release the Gas Company from their responsibility. It should have been earlier per- ceived that a negative reply could easily be made to the first question, which was the case; whereupon the others were ruled as being out of order. This is regrettable, because the information would have been equally valuable on the supposi- tion that the contracts were to be made after the Order had been obtained as under the opposite condition. It is the opinion of many competent persons that, in any circum- stances, the Electric Lighting Act would enable the Chartered Gas Company to put the City authorities in a fair stroke so soon as the new light became commercially successful in a given district. Whether the Gas Company will stand upon their rights in this unpleasant manner need not now be discussed, as the preliminary conditions are still purely imaginary; but their action would not be affected in the slightest degree by the circumstance of the competing light being introduced by the authorities or by semi-independent contractors. This is the point upon which the City Solicitor should have been heard. It was felt, however, that a strong opinion on the point must damage the Commissioner; and so the matter was dropped, and the doubt hushed for a time.

While dealing with the proceedings of the City authorities, it should be observed that the Sewers' Committee have failed to obtain from the electrical supply companies with whom they have been treating, anything like a comprehensive or satisfactory tender. There are only two offers left to be finally considered; and one of these does not bear the stamp of seriousness. The Edison Company are willing to continue their present show, on compulsory terms, charging for the public lamps the rate now paid for gas. There is not much information in this statement. The Gilchrist Company pro- pose to light the thoroughfare from Bishopsgate to Aldgate High Street for 25s. per quarter for every 20-candle power "nominal" lamp. Private consumers are to be charged 8½d. and 6d. per commercial unit, respectively, by the two contractors. This is the basis upon which the Commissioners are now asked to apply for a Licence; but it is doubtful whether such a step will be taken, in view of the vague but positive responsibilities attending the possession of such powers. It is somewhat curious that whereas, when they were last heard from, the Committee wanted to spend £200 in experiments, they can now publish information, such as it is, upon which they profess to be ready to go before the Board of Trade. The whole affair is a sham from beginning to end. The Committee evidently wish to be relieved of their duties, and would be much obliged to everybody if their reports and opinions could be quietly lost sight of, and as quickly as possible forgotten.

Another Brush Company have not to hear more or less apologetic speeches from the Chairman and other Directors. The meeting was held at the Cannon Street Hotel; and, as usual, was of a somewhat stormy character, as may be understood from the fact that the report and accounts were not adopted.

Now that the dead season has fairly begun, some of our electrical and engineering contemporaries are amusing their readers with the discussion of a proposal by M. Gaulard to light the Suez Canal by electricity. It is not needful to explain how the work was to be done, since the author of the scheme estimated the cost of the complete installation at something less than £100,000; while one of his critics (equally qualified to deal with these matters) contends that the cost of the leading conductors alone would be £940,000. The disputants are still hammering each other with volts, ohms, and other deadly weapons of electrical controversy; while the Philistines stand apart and smile. After this further evidence of the certainty of modern electrical science, who shall doubt the truth of the well-worn saying, that electric lighting has passed the era of experiment, and entered that of commercial fact and experience?

ELECTRIC LIGHTING MEMORANDA.

As time goes on, the position of the Board of Trade with regard to electric lighting appears to grow worse and worse. It will be remembered that when the Electric Lighting Act was drafted, it was recommended as a notable departure from all established practice, inasmuch as it sought to deal before, rather than after, the event. It was supposed that in this way the growth of those dreadful vested interests which the gas and water companies had succeeded in creating for themselves, would be prevented; and the path made straight for the eventual requisition of all electrical undertakings by the community. From the experience thus far acquired of the working of the Act, it may almost be thought that the Board of Trade will themselves soon begin to wish they had not been in such a hurry; but had waited until everybody knew what was needful in the way of legislation. Of all the criticisms of the Act, and the proceedings of the Board of Trade under its powers that have yet appeared, the sharpest is that emanating from Mr. T. H. Blakesley, M.A., recently published in pamphlet form by Sampson Low and Co. Some Mr. Blakesley's observations are warmly taken up by the *Engineer*; especially those whereby it is shown that the Board of Trade rules are mostly in favour of the consumer against the consumer. We do not now speak of the questionable way in which the Department has turned to account the Orders on the first comers; for upon this there are numerous mistakes which Mr. Blakesley points out in the drafting of the Orders. Thus it is said the clauses enjoining electrical companies to supply every street within their compulsory district, are so loosely drawn that the companies are only required to lay their wires in a street, but not through it new along it. Consequently, a distributing box laid under the pavement at the beginning of a street, would, in law, be held to serve the King's Road, Chelsea, which, according or the only thing on this earth that never comes to an end. Another important matter is that any Electric Lighting Company may supply intermittent currents if they so choose. These currents are useless for driving motor machinery, or charging secondary batteries; and are, moreover, very dan- gerous to life. If we remember aright, Mr. Monkton is partly responsible for this, for he induced the Parliamentary Com- mittee to believe that there was no such thing as a good or bad current; all supplies of electro-motive force being as simple of application as so much gas or water. On the whole, the *Engineer*, in regarding the present technical and legislative condition of matters electrical, anticipates a period of confusion and turmoil in the autumn and winter, which will, on the one hand, tell against the progress of electric lighting, while on the other it will be a disgrace to the Board of Trade.

The Annual Report of the Grosvenor Electric Light Company has been issued, and as might be expected, has been criticised by our financial contemporary, *Money*. There will be a huge post-mortem inquiry before long upon all these companies; but meanwhile it is to be hoped that the Directors of all such anæmic enterprises are possessed of sufficient insensibility to patiently endure the sacrificing which they receive. The Grosvenor Company is that which has received the support of Professor Crookes, who gave them (for a consideration) the form of incandescent lamps invented by himself expressly with a view to avoid the defects of all previously existing models. Even with these advantages, however, the Com- pany appear to have lost £18,878 on their first fourteen months' working; and to have thereby shown that the patents which are valued in the accounts at £198,779 can scarcely be worth anything at all. Our contemporary has a rough-and-ready way of estimating the value of patent rights; for it, it says, the possession of a patent brings the owners of it to lose so many thousands of pounds a year, what can be the value of the patent? Certainly not what was paid for it on the assumption that it would return a profit. The meeting of the Company was held on the 28th ult., and was of a somewhat stormy character, as may be

ELECTRIC LIGHTING MEMORANDA.

Nor much is heard as yet of the Electrical Exhibition at Vienna, for very obvious reasons. It was opened with sound and state on the 16th inst., by the Crown Prince; but it was not naturally in a very unfinished condition. It has been said that the English sections practically did not exist on the opening day, except as an excuse for the appearance on the scene of Lord Stanley, Sir Frederic Abel, and Sir William Siemens, in their ornamental British Commissioner. The English Government did not support the undertaking very liberally for combination being limited to £500. This is quite enough, under the circumstances; for the Austrians, in holding their exhibition at this time, are "a day after the fair." Very few English exhibitors of electrical machinery, especially in connection with lighting, can now afford to throw away much money in showing their goods without immediate prospect of selling them. There may possibly be an unoccupied field for company promoters in the East of Europe; but as everybody with capital in Vienna must be fully aware of the state of the electrical share market in England, the chances for making an indirect profit out of the present opportunity for advertising must be slight.

The financial condition of the Pilsen-Joel and General Electric Light Company is ruthlessly exposed in the current number of *Money*. The Company have now been working for thirteen months with a capital of £25,925. On the first year's revenue account there is an admitted loss of £7152, but the Directors—who have received £1160 by way of fees for conducting the affairs of the concern to this pass—find the results of their operations "by no means discouraging." Of course the Directors are in negotiation for some important public contracts—the managers of these undertakings are all wonderful negotiators—but it seems that another call of 10s. per share has become necessary. Under these circumstances, our contemporary kindly prepares a balance-sheet, showing what is termed the position of the Company after the elimination of "bogus assets," such as goodwill and patent rights; and by this statement the concern stands with a deficiency of £90,511. This is pretty well for one year's operations. The shares of the Company are stated to be worth 2s. 6d. less than nothing: that is, would-be sellers must give half-a-crown with every share, in order to get rid of it.

As might have been expected, the recent declaration of the Board of Trade against electrical licences for speculative companies has awakened many strong protests, from people—multitude of granting permission for electrical undertakings included in the General Act—Provisional Orders and Licences—the Board would have a preference for the latter, as being their own special invention for the occasion. Of course the restriction of Licences for large areas to local authorities was an afterthought; but, even so, it is not by any means clear that electrical supply companies are justified in regarding it as a further limitation of their rights. There is much reason in what the Board of Trade now say about the duration of a Licence being too short for the repayment of the undertakers; and it will be remembered that this was one of the strongest points urged on behalf of the Electrical Companies before Mr. Stanhope's Committee. It was solely for that benefit that the duration of Provisional Orders was extended to 21 years, upon Sir J. Lubbock's representation. And yet now, the electricians turn round and complain because they are debarred from obtaining the shorter term which they originally condemned. They ask why, if they succeed in securing the consent of a local authority—the only previously-known preliminary to the grant of a Licence—they should be driven to the expense of seeking an Order. If they have as much experience as Gas Companies have of the feebleness of local authorities, and really mean business, they would regard the temporary favour of the latter—not as a reason for trusting to it for six years, but as an assurance that the time was favourable for going to the Board of Trade for an Order. It is possible, however, to believe that all these complaints are honestly founded.

From copies of the *Melbourne Argus* just to hand, it appears that the Edison lighting of the Assembly and Legislative Council Chambers repeats in Australia vagaries in which it occasionally indulges in England. What is described as "mild" by the result of short-circuiting two of the lamps. "In each case there was a noise resembling that produced by a rocket, and an infinite heat was produced which melted the brass brackets. The molten metal, dropping on the cushioned seats, burned them slightly." Fortunately the lamps had been, and further damage was prevented by the prompt action of the officials. On the same evening the numerous than the one quoted above, but not more plainly based on truth or experience. Indeed, it was scarcely worth while to say anything by way of explaining the course that has been followed through necessity. If the shareholders of the miscellaneous Brush Companies were not previously united in interest, there was a wonderful confusion of Directors; for it is reported that the Chairman of Hammond, who spoke as Managing Director of the Company which bears his name, had just previously presided over the Birmingham and Warwickshire Company's meeting. It must be consoling to these gentlemen to know that nobody is likely to interfere with their friendly little schemes of amalgamation, as in the similar proceedings of Metropolitan Gas Companies. At least, if the Board of Trade should eventually take any interest in the matter, it will probably be handled by a branch of the Department which will be constituted for fresh business at the beginning of next year.

It is reported that the Alliance and Dublin Consumers' Gas Company have bought, for £10000, the plant of the defunct Dublin Brush Electric Light Company. What amount of truth there may be in this statement we do not know; but, if true, it is at least to be hoped that the Gas Company do not intend to take the enterprise that brought the Brush speculators to grief. The news is a striking comment on the pretensions of these latter, who made a market of a "concession," which they had obtained for a song, to a Provincial Company, and raised a considerable sum of money, a large proportion of which was spent upon plant and tools. Now we are told that all this grand venture, concession, plant, goodwill, and all the hopes of the Brush interest, have been delivered up to the local Gas Company for the ridiculously small sum of £10000! The latter have during the past year or two kept up a fair electric lamp in ventilation of the permission granted to them in their Act of 1859 to supply gas, and other improved means of lighting. It is perhaps as well to keep this particular enactment from lapsing, so long as the capital applicable under the same Act remains available; and the Company may have private reasons for adopting their present course. Notwithstanding all this, however, on general grounds it is regrettable to see a prosperous Gas Company tampering with electric lighting in this fashion.

Electricians are their own foes in one thing—the ill-luck that constantly attends their efforts to achieve special success on "show" occasions. Whenever their services are required for a great banquet, or a great evening party, the electric lights are in favour of something going wrong just at a critical moment. This was the case at the Guildhall on the evening of the Lord Mayor's banquet. In one newspaper only—*Lloyd's*—worthy of mention for its disinterested confession of the truth, it is stated that in the middle of the presentation of the distinguished visitors "the electric light immediately," over the dais flickered and disappeared, leaving the gorgeous "group in comparative shadow."

A statement of the actual cost of the electric lighting of the London Road Station, Manchester, has been published; and the figures are in marked contrast with the fanciful estimates of electricians. The annual gas bill of the station formerly

ELECTRIC LIGHTING MEMORANDA.

THE amalgamations of Electric Lighting Companies, to which reference has already been made in these columns, was agreed to on the 12th inst.; and henceforward the Yorkshire Brush, the Birmingham and Warwickshire Brush, and Formanit Company. The circumstances of the amalgamations are sufficiently out of the ordinary to call for some comment. Mr. Robert Hammond on the occasion. This individual is reported to have let leakers that the public are "anxious to have the electric light"—the chief evidences of which is talking to amalgamations as an alternative to winding up. This reminder of Mr. Hammond's observations are less based on truth or experience. Indeed, it was scarcely worth while to say anything by way of explaining the course that has been followed through necessity. If the shareholders of the miscellaneous Brush Companies were not previously united in interest, there was a wonderful confusion of Directors; for it is reported that the Chairman of Hammond, who spoke as Managing Director of the Company which bears his name, had just previously presided over the Birmingham and Warwickshire Company's meeting. It must be consoling to these gentlemen to know that nobody is likely to interfere with their friendly little schemes of amalgamation, as in the similar proceedings of Metropolitan Gas Companies. At least, if the Board of Trade should eventually take any interest in the matter, it will probably be handled by a branch of the Department which will be constituted for fresh business at the beginning of next year.

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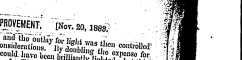
A statement of the actual cost of the electric lighting of the London Road Station, Manchester, has been published; and the figures are in marked contrast with the fanciful estimates of electricians. The annual gas bill of the station formerly averaged £174; and the outlay for light was then controlled by economical considerations. By doubling the expense for gas, the station could have been brilliantly lighted; but this was not thought of. Electric lighting was introduced; the annual coating £2481, in the first place, while the annual expense, including depreciation, is no less than £626. In four years, then, increasing the total cost of lighting the station to £7447, or about 4¼ times the average previous cost of gas. It is admitted, moreover, that the electric lamps have "sometimes failed unfavourably when trains have been entering the station;" although, in fairness, it should be added that the light is now deemed so reliable that the gas-brackets still remains—the miscellaneous of the 22 lamps. Now lamps are being got ready, however, which will further swell the capital account; but, it is hoped, will remove the last objection. Comment on these figures is superfluous.



ELECTRIC LIGHTING IN NEW YORK CITY.

[FROM OUR AMERICAN CORRESPONDENT.]

A reader of the JOURNAL writes to inquire what is the information in regard to the progress made by the electric light in New York City, about which I have treated of at different times in my "Notes." I fear that I cannot gratify his request. The truth is that there is very little information which they do not possess. City is the same as in other municipalities, when the electric light is the rule per lamp was put down very low, and the gas-burner introduced was a very poor one. Then as soon as we had it, others followed suit. This was a weight that was soon expected; for the light was a novelty, and so was quickly appreciated by the general public.

In the matter of street lighting, last year the Company took out the equivalent of 47 lamps. I say equivalent, for in two instances—there are 6 lamps at the top of a high mast; these 6 lamps are reckoned as being equal to 25 ordinary lamps, or, in other words, are supposed to give 150 lights. This calculation has been altered for the present year, the Brush Company have been cut down in this respect; the Superintendent of Lamps claiming that these 6 lamps are only equal lighted by 12 of the street lights, thus they are at present for 300 lamps. So these lamps are now figured as being equal to 12 lamps in number. In addition to the above, two masted lights on Brush system, of 30 each, will soon be in use for the public lighting. These are to be worked from the Fifth Avenue Station, and will be the first use of the electric light used for street lighting. The price charged for city for these lamps is 70 cents per lamp per night, or 350 dols. 50 c. a year. The lamps are reckoned at 2000 candle power, the Brush Company calculating by French measurement; while the United States Company's are supposed to be of 2000 candles power by their nominal tests. Each of the latter lamps is of 9 amperes, 2½ volts, burning 3 feet an hour, while 450 arc street lamps will be required to be supplied with 10 amperes. These gas lamps put out by the new illuminant—an insignificant figure when it is remembered that there were about 21,000 street lamps in use prior to the introduction of the electric light.

When we come to compare the cost of the two systems of lighting, the following statistics will be interesting. The cost of gas per lamp per night, as charged by the Company, is 10 dols. 50 c. per annum, or 10 dols. 50 c. 365 nights = 3832 dols. 50 c. These were replaced by electric lights, reckoning as a basis of one of the latter to seven gas lamps, because would be 547.357 dols. It is thus clear that the cost of the electric light must be greatly reduced before it supplants gas for street lighting.

For private lighting a similar state of things prevails; that is, the electric light is employed for the lighting of stores, offices, and some of the large quality of gas used. They are chiefly used in stores, warehouses, and similar places; and the principal purpose here is for advertising, rather than for lighting. I shall not be far out if I place the total number of electric lights in use in New York City as 1500, which includes public and private lights. The large lights of 2000-candle power when used for private lighting, are usually charged for at the rate of, 1 dol. per night, or 365 dols. per annum per lamp.

No practical work has yet been done here with the incandescent light. The Edisonian scheme for lighting the lower part of the city still drags. How it is promised that everything will be ready by the fall.

Finally, I have yet to learn of a single instance where the gas-meter has been removed for the electric light.

ELECTRIC LIGHTING MEMORANDA.

The fashion of amalgamation is making further headway among electricians; for it is announced that the Diamond Company are about to annex not only the Yorkshire Brush, but the Birmingham and Warwickshire Brush and the Ferranti Companies. It is curious to reflect that, only a few months ago, there was supposed to be such a wonderful business in electric lighting, that every English county—not to say nothing of foreign lands and distant colonies—was thought to require a separate Company for providing one particular system of lighting. Now the contrary opinion prevails, and it is found expedient to consolidate; for experience shows that both work and profit are scarce, even when concentrated in few establishments. We are not sorry all concerned here to reconcile this fact with the supposed continual progress of electric lighting; but the truth remains as a sign of the times, whatever interpretations may be given to it. After all these family arrangements have been concluded among the Brush offspring, it would be a neat way of completing the process of re-absorption if they were to go back to their parent, the original "Anglo-American Brush Corporation. And even if this concern should afterwards retire across the Atlantic, to the native land of all the Brushes, and drops its much-abused prefix, the corpse of electric lighting in Great Britain would not materially suffer.

Writing of the Brush system, we are reminded that the lighting in the district of Ludgate Hill and Blackfriars, London, was very unsatisfactory during the past week. The particulars have given elsewhere; but it is enough, to show the serious nature of the difficulty, to state that the Brush lamps in this important district could not be lighted at all on Monday night, and for several successive nights they were out at intervals. The gaslamps were brought into use nights after night to supply the deficiency; and last for this timely aid, the consequences would have been very serious. The Police and City authorities were naturally concerned; for it is no small trouble to have the streets plunged in darkness at the busiest period of the evening, when the shops are being closed, and the thoroughfares are choked with passengers hurrying to all points of the compass. It is nearly time that the miserable farce was stopped, and the danger of a grave disaster removed. It has been abundantly proved that it is the presence of gas that protects the Electric Lighting Companies in carrying out their advertising. The Gaslights and Coke Company, the Brush Company (and the Edison experiment too) would long ago have been driven out of the City.

The Edison Company have also been in trouble in New York, according to the newspapers; and great inconvenience has been caused to the subscribers by a general breakdown of the supply. To give the Company due credit, they seem to have been doing their work as well of late than their customers were wholly unprepared for what has happened. Nobody conversant with the case has been expected by any, of all, electric lighting worthy of being regarded as a commercial system. Electricians, when approached with misfortunes to the limited seals of their operations; and they hoped to set up in the future, similar interruptions of supply could not occur. This excuse has never been accepted by thoughtful observers; and it must stand discredited after the recent New York experiences. From come to hand, it would appear to have been a case of too much rather than too little current; for the safety links of feasible metal attached to all the services were destroyed, These are intended to protect the lives and property of the subscribers against the introduction into their premises of dangerously powerful currents; and the principal satisfaction to the electricians in the present case is probably the evidence that the device acted in the proper manner. Electrical machinery does not invariably answer the purpose expected of it; but those safety links have proved a noble exception. However, whether from excessive pressure or otherwise, the instructive fact remains that Mr. Edison's lights went out with startling suddenness and unanimity, notwithstanding all the care bestowed upon the arrangement and management of the generating and distributing plant, and the daily presence of the inventor himself.

It has been pettishly said in some scientific journals that the owners of the gas industry, at home and abroad, wilfully refuse to acknowledge the advantages and progress of electric lighting; forgetful of the fact that gas lighting was, in its infancy, even more ridiculed and abused than electric lighting is now, even by interested opponents. If the originators of this complaint would take the trouble to peruse our columns during the past year or two, or even to duly appreciate the three preceding paragraphs, they would see that there are two sides to the question even of electric lighting. We surely cannot be blameable for exposing the sides which partisans of the new movement studiously endeavour to conceal from public gaze. Nobody who reads our columns week by week will accuse us of neglecting any available sources of information on this interesting subject. It is not our fault if experience confirms the belief that the shadows of electric lights are very dark indeed, and that the public are often the latter warned against danger by the introduction of a little gaslight among them.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT. [Nov. 27, 1888.

ELECTRIC LIGHTING MEMORANDA.

It has transpired that the Electrical Exhibition at Vienna has resulted in a very heavy loss; and it is asserted that the guarantors will be required to pay at least half the amounts for which they made themselves liable. This is unfortunate for the Council of Arts as may have entered their names for large sums, under the impression that they would thereby obtain a certain degree of notoriety without incurring any real expense. The result is not surprising to an observer of the West of Europe. Vienna is badly situated for holding exhibitions. It is a very delightful capital—perhaps the most industrial in civilization. All its paying visitors must come from the West; and after these have been surfeited with shows of electrical lamps and machinery at home, they can scarcely be expected to go to the banks of the Danube to see more. Hence the Vienna enterprise has been left almost entirely to the Austrians and their South German neighbours, with disastrous results from the financial point of view. As to the scientific aspect, there is not much to be said. The electricians and their friends claim that great things were demonstrated; and wonderful improvements upon the Paris Exhibition of 1881 shown in the lighting department. Upon this point there is conclusive evidence on the contrary, which has not been mentioned in any of the English newspapers or scientific journals wherein notices of the exhibition have appeared. It has been ascertained that the consumption of mechanical power for a given amount of light has not been lessen was held. As a matter of fact, twice as much coal was consumed in Vienna as in Paris, to produce a given lighting effect; but it is acknowledged that the Austrian coal was greatly inferior to that consumed in France. In the face of this fact, it again becomes evident that the progress of electric lighting, in whatsoever direction it has gone, has not been in the way of economy.

The Metropolitan Railway Company deserve to have their underground stations successfully lighted by electricity; for they have made numerous attempts in this way, but hitherto, without much encouragement. At one station and another, they have set up generating machinery, the working of which filled the ladies' tunnels with an exasperating roar; while the lighting of the platforms was—in certain spots—so dazzling that the drivers and guards (human mothers as they are) could scarcely see the dim signals. One after another these experiments have been abandoned; but now a decided success is announced. The "secondary generating" system of Messrs. Gaulard and Gibbs has been installed at three or four stations. This system consists in sending a powerful alternating current—derived in this case from a Siemens dynamo, driven by a 85-horse power steam-engine—through a closed metallic circuit, upon which insulation coils are placed where required. An induced current is derived at these points; and this supplies the lamps. The idea is a good one, and works well in practice; as shown during the recent Inventions Exhibition at Aquarium. It is said by experts, however, that the induction apparatus costs a great deal of money, and that the loss of conversion is necessarily heavy. This is a matter concerning which nothing definite has yet transpired. It will be a question of comparison between the losses and waste of this and the more direct systems. Nonsee them can boast of cheapness; and if Messrs. Gaulard and Gibbs can see their way indeed in providing a steady and safe light, they will have done great things. Unfortunately, there is no better guarantee against the instantaneous stoppage of the induced than of the primary currents more commonly used.

We do not hear so much now as a few months since about the utilization of natural forces for conversion into electrical energy, to be again transformed into light. The elevated and practical geniuses of the daily newspapers at that time broke into indignant queries why every watercourse did not lady to light all the towns on its banks, and why the tide were still permitted to rise and fall "in vain." Where running streams did not exist, and the sea was also inconveniently distant, the rainfall was to be stored up, or the winds were to yield their strength for the service of lighting lonely villages by night. All this maudlin talk has died away; and the gas steam-engine remains the chief source of mechanical active. Recently, however, the question of gas has benefited the topic afresh, in a momentary departure from its usual calm scene; being apparently stung by the "candescent electric lighting, under the most favourable "conditions, must at present be at least twice to thrice "that of gas." As a remedy for this disastrous state of things, it is asked whether something could not be got out of a windmill, wound up by a windmill, and allowed to fall slowly over a cliff or down a well! The suggestion is made, in a very faint-hearted manner, as indeed it might be; and its appearance in a serious scientific journal merely shows how sore the cull is felt to be, for which such a remedy could be entertained, even as a dream.

The present stagnation in matters electrical has been commented upon in the *Science Monthly*, in an article wherein it is admitted at the outset that "somehow the general sen- "blem of domestic electric light does not seem to advance "much." There is acknowledged to be a steady crop of minor electrical inventions; but the speedy advent of the system of electric lighting or electric locomotion on a large scale is not yet indicated. After admitting this, however, the article proceeds to offer a "crumb of comfort," by pointing out that the electrical world is now subsiding into the normal state; the apparent stagnation being only apparent, and wholly due to the high pitch of excitement in which it has been kept by the rapid succession of startling discoveries within the past few years. All this is very nice and consoling; but it is probable that many people, who have made their money without seeing any hope of its return, will question the statement that the present stoppage is only apparent. It is too real to them; and "when the overcharged "market is purged of its superfluity," and the wonderland returns to prosperity takes place, it will not be the present losers who will participate in it.

ELECTRIC LIGHTING MEMORANDA.

The New York public are becoming seriously alarmed on the subject of the overhead electric light wires that have been strung recklessly over the city by the Brush and other electric light companies. The *New York Times* has been fanning the agitation for the compulsory removal of these wires, which are stated to be altogether 500 miles long. The danger is traceable to this source is threefold. The current conveyed through the wires is sufficiently powerful to strike dead any man who may touch them under certain conditions; the wires have become overloaded, and thus set fire to buildings; and, by interfering with the working of the fire-alarms telegraph, as they have repeatedly done, conflagrations are enabled to get beyond control before any intentions of their breaking out can reach the firemen. Lurid articles, more *Jarndyce*, headed "Wires that Burn and Kill," have appeared in the columns of the above-named newspaper; and the opinions thereupon of various Fire Commissioners, Chief Engineers, and other more or less important members of the Fire Department, have been diligently collected. After perusing these blood-curdling narratives, we are positively relieved to think that in England we enjoy the protection of an Electric Lighting Act. In New York at least one Company never took the trouble to ask anybody's leave to erect their poles and string wires along the streets; but "simply went ahead, and did it at their own sweet will." This would probably be applauded at the time as a display of native "smartness" by the same newspaper writers who now clamour for the removal of the unauthorized wires. To the credit of the Edison Company it should be stated that all their wires are underground.

The reports and statements of accounts of the various concessionary Brush Companies in England are coming out in rapid succession, as they were all originated at about the same epoch of mad speculation, and will probably die off by the same epidemic. The South African Brush Company have lost £6,420 on the year's working, exclusive of parliamentary expenses. The chief business done seems to have been some spot, 49,725*l.* and for which the Company were paid only 22,253*l.* At this rate, as there is some cash in hand, it is estimated that the Company will last a year or two longer. In the columns of *The Times* the reports of the two longer, South-Eastern Brush Companies have appeared together, in a very curious manner. The former confessed a loss of £33,13*l.*, and the latter admitted a loss of £23,31*l.* "Against "this loss, however, is to be set the value of the 29,000 "shares of £1 each in the Consolidated Electric Company, "Limited, which the Directors consider are fully worth their "nominal value," &c. These words are the remainder of the report, and the total in the two cases, excepting only the trifling difference of the figures representing the respective losses. We have often remarked the family feeling that prevails among the Brush companies, but never before observed it in so decided an expression as the issue of identical reports. The Midland Brush Company have also held their ordinary general meeting, and confessed to a loss of 22,29*l.* The Chairman told the proprietors that no more calls would be made, as the Board "had had no means of employing the "money." Finally, as the main result of the meeting, the capital was reduced from 250,000 to 270,500. This does Brush lighting prosper.

In course of time the truth about the recent brilliant display of electric lighting at the Fisheries Exhibition may be told, in disconnected fragments; but it will scarcely appear as a whole. It has been stated that the greater part of the expense in connection with this display was borne by the exhibitors; the Executive Committee paying very little more than praise and complimentsfor the services rendered. It might have been thought that the time had gone for costly advertisements of this order, of which there have been too many, even for the participants, since it is tolerably certain that only the pioneer speculators—such as the original Brush and Edison Companies—have found profit available. Perhaps the fact that the lighting was obtained on such cheap terms, was one of the reasons why so little notice was taken of its occasional failures. At all events, it may be hoped that there will be no more gratuitous lighting of

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April, 1883.

ELECTRIC LIGHTING MEMORANDA.

Many people will not be very sorry to hear of the return to England of Mr. Edward H. Johnson, of the Edison Electric Light Company. Visitors to the late electrical exhibition at the Crystal Palace, as well as those who happened to meet Mr. Johnson in the committee-room of the House of Commons when he gave evidence on the Electric Lighting Bill, will not readily forget this gentleman's amusing and interesting speeches. During the past winter he has been at work in New York, with Mr. Edison, upon the experimental lighting of some of the lower portions of the city. His first public manifestation since his arrival has been by way of a letter to *The Times*, on the vexed question of electrical measurements and charges. It is indeed high time that Mr. Johnson or some other practical electrician took up this matter, or it would be hopelessly muddled by the swarm of self-styled experts called into "mysterious" existence during the past year or two. Mr. Johnson contends that the only rational system is to charge for light, and not to vex the consumer with the terms in technical use among electricians. The consumer does not, and need not, trouble himself about electrical quantities, since the only effect he can obtain therefrom is the perfectly intelligible one of light. Consequently, upon the Edison system, a subscriber's account is rendered for (say) 48,000 candles of light. This amounts to 48 lamps, all of which are of 16-candle power, and taken note of the number of hours they burn. To finish he has 10 lamps burning 10 hours per day, or 1 lamp for 100 hours. This for 30 days gives 1000 lamp-hours, and multiplied by the Company's standard of 16 candles yields 48,000 candles; and thus, says Mr. Johnson, "he has proof positive "that the bill is correct." The simplicity of this method is unquestionably compared with the manner of measuring gas, the consumer know that every incandescent lamp gives the light of 16 candles? And do they never vary? The idea that sumer in the simplest fallacy, as gas-works officials know full well. If Mr. Johnson had ever been called upon to answer indignant inquiries, "How is it that my gas bill is so much more "than it used to be, when I have not had so many lights?" he would not be so confident in the matter.

Speaking of gas measurement, it should be noticed that Mr. James N. Shoolbred gave a lecture at the Society of Arts on the 4th inst., on the measurement of electricity. This lecture was a good *résumé* of what has been done in this direction, and the subsequent discussion was also instructive. We mention it for the purpose of commenting on a speech of Mr. W. H. Preece, who, for a man who never misses a chance of speaking in public, seldom commits himself. On this occasion, however, he ran a tilt against gas-meters, and in so doing damaged himself more than the objects of his attack. His challenged point was seen in the room to explain the mechanism of a gas-meter and describe its action, and then went on to say that it was a complicated machine in comparison with the apparatus mentioned in the lecture. It is not to be supposed that Mr. Preece does not himself know what a gas-meter is; but if he was speaking of his own ignorance, we might recommend him to visit the Crystal Palace as speedily as possible, and repair his deficiencies in this respect. It might be thought that if the mechanical attainments of his auditory were not equal to the comprehension of an instrument easily made by workmen with no pretensions to scientific culture, they could scarcely attempt the construction of electrical apparatus. It is more charitable to suppose, however, that while electricians know their own tools, they ought to be content to leave gas apparatus to those who understand it. It is scarcely fair to charge a butcher with clumsiness because he cannot handle a fuller's shears. As Mr. Preece and electricians generally are learned men, it will perhaps be more in their taste if we recommend them to bear in mind the old observation, *ne sutor ultra crepidam.*

The electric light has not yet obtained exclusive possession of the Houses of Commons, for the room occupied by the now Grand Committee for Bills relating to Law and Courts of Justice is lighted by sun-burners on Sugg's most improved principle. In addition to lighting the room, the sun-burners also materially assist the ventilation. Even the *Daily News* is fain to confess that this is a triumph of gas lighting, "quite putting in the shade the electric light in the dining-room and library adjoining."

THE EDISON LIGHTING ON THE HOLBORN VIADUCT.

Above is given a full report (to the Streets Committee of the Council, which referred the matter to the Edison Lighting Company) of the electrical lighting of the Holborn Viaduct. In our editorial notice last week, Dec. 4, 1882; and, after having had the lighting was commenced on the 25th of April, lighted on the Edison System, have remained in operation, continuously on the 25th of January of the present year, to continue the experiment until the Corporation were ready for the lighting contract to be entered into for a further term of twelve months from the last-mentioned date, or for such shorter time before the expiry of the present gas lighting should be changed. The Viaduct had been finished, on April 27 last, been lighted for a period of twelve months; and the Edison Company undertook to light it.

After describing at the commencement the period that the report dealt with, the report gives the number of lamps employed in carrying out the lighting, the kinds of lamps there were, the number of lamps in each kind, and the number of hours they were burned. Seven different kinds of lamps were employed, the total number of which was 2,250. Of these, 1,000 were of 8-candle power each, and 20 of 2-candle power each. Two hundred and forty of these lamps were placed in the majority of the ordinary gas lanterns, and were burned during the night hours only. Fifteen lamps were placed in the centre lanterns on the bridge. The lamps on the 6-light cluster lanterns were modified towards the end of August by the substitution of 8-candle power lamps for the 16-candle power therefore. The lamps on the 6-light cluster lanterns were also modified towards the end of August by the substitution of 8-candle power lamps for the 16-candle power lamps

ELECTRIC LIGHTING MEMORANDA.

The "unsound investment" held up for examination in last week's *Money* is the Maxim-Weston Electric Light Company. This is one of the electric lighting concerns of the day; started in the first flush of the speculating fever, with a showy Board and plenty of money, and the rights to half-a-dozen patents. There has never been the unanimity of dealing in this Company's shares which startled the City in the case of the Brush concern; yet its shares have reached 12, representing a gross value of £926,487, whereas they are now at 1 nominal—no dealers—or an apparent loss of £880,912. As a matter of fact, however, our contemporary hints that the "sound investments" have not even this small value. One of the objects of gibbeting these unfortunate Companies in this manner is avowedly to throw light upon the actions and motives of Mr. William Abbatt, the advertising stockbroker, in whose category of "sound investments" they have all appeared at various times, and have in this way been recommended to inexperienced investors all over the country. What must have been the result to confiding readers of these plausible advices need not be detailed. The Maxim-Weston is one of the electric lighting companies that still exist, and it has honestly tried to do business; but the Fates are against it.

The second annual meeting of the Faure Electric Accumulator Company has just been held, when the notorious M. Philippart, newly released on bail from his arrest on a charge of fraudulent bankruptcy, attended to give "explanations" to the assembled proprietors. There was, of course, no dividend; but the Chairman was able to describe how he had driven a tramcar in Paris by means of accumulators. Of course, the same thing cannot be done here half so well as in Paris. According to the majority of these speculative electricians, they can always do more wonders a long way off, and when nobody is looking, than before the coldly-critical eye of the world. Mr. Ayrton, on this occasion without his double, was on hand to tell us once more as to the infinite superiority of the Faure-Sellon-Volckmar battery for all purposes except earning a dividend. From statements made to inquiring *shareholders*, it would appear that the old Board of Directors left £120,000 in hand, which is all gone. The Company is hopelessly mixed up with a number of French Companies, in a way not explained in the report. The Chairman left the proprietors with the pleasing assurance that if he should be locked up again he thought their affairs in France would be on badly. It must be all for satisfactory, therefore, to reflect that they could not be much worse than they are now.

At length it is announced that the electric lighting machinery of the Fulmen Company is in working order, and the various courts will therefore be henceforth opened at night. As the *Iowa* is essentially a summer one, it might have been thought that the great cost of providing electric lighting machinery was unnecessary. Whatever may be the effect of the lighting—and, under the circumstances, it should be very good—the expense will be enormous. There is apparently no machinery on the ground to light all Kensington; yet the work has been delayed in consequence of a repetition of the usual fault of electricians in underestimating the power required for their dynamos. Thus it is reported that Messrs. Davey Paxman and Co., of Colchester, who supply the motor engines, have had to increase the available horse power by about one-half beyond the figure first stated, and that in any case their engines will be much over-driven to keep up with the work. It is therefore fortunate the exhibition is so successful that there will be no difficulty in finding money for this extra luxury of lighting.

The two latest and most remarkable additions to the list of electric lighting installations are Buckingham Palace and the Royal Courts of Justice. Messrs. R. E. Crompton and Co. have fitted up the latter establishment for the Swan Company; and it is to be hoped that the work has not been done in a manner "too scientific" for the Lord Chief Justice, who on at least one occasion had to call for some candles in his court. The lighting of the Palace is said to be very good; but as it is only to be used when State balls are given, it will not be visited many times a year. In both cases it may be supposed that expense has not been much considered; but the economising statement is promulgated that for the Law Courts lighting the "cost of maintenance and repairs will not exceed 25s. per hour, the cost of the gas lighting being said to exceed £2." This is an awful "way of putting it, for it will be observed that only the cost of "maintenance" of the electric light is given. Still, it will be something fresh to learn that electric lighting can compete with gas in a Government building, not usually regarded as the home of economy, while quite a different result is obtained everywhere else.

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June 3rd, 1883.

FAILURE OF THE ELECTRIC LIGHT AT THE "CITY TEMPLE."

A correspondent writes us that on the last night of the year 1882, just before the arrival of Dr. Parker's evening (about 8½) sermon, the forthcoming lecture of the Edison Company employed for lighting the "City Temple" suddenly went out, and it is needless to remember that nearly in less than no time crowded the fact that the 20 lamps played some "fantastic tricks" in the construction of the heavenly canopy, and were assembled in the "Temple," listening to the Rev. Arthur Dakeyne Dr. Stenciphone. The immediate cause of the failure of the lights then was a breakage of a wire at the end of the lecturer's library, and the current supplying the lamps being thus broken, the light went out, and attended by a startling, crackling, hissing noise, accompanied by a flash of blue flame. On the present occasion however, the effect was totally different, and the cause will have to be sought elsewhere.

The correspondent says: "It cannot be stated positively how the current broke—whether the wires became disconnected or the engine, broke down. The fact remains that the lights were all extinguished at the precise moment of the collapse of the electric lighting arrangements. There was one partial, but very feeble lamps at intervals going out in several parts of the building in the course of the evening; but fast Sunday evening the light was not so brilliant as on Christmas Eve, and nothing noteworthy occurred until the fatal moment, when, without the slightest warning to the building, suddenly assumed a peculiar reddish colour, very feebly portrayed to the assembly, made a sudden 'leap' in the direction of the ceiling, and expired with the waning year. At the time of the electric light mania Dr. Parker's then Manager contrived to catch the electric fever, and the building has been handed over to the Edison Company for their experiments in; but the stanchest advocates of the light have been disappointed in the present instance. Dr. Parker paused for a moment for a general feeling of distrust among the congregation; but the speaker was equal to the occasion, and the service was proceeded with. I am glad to record that the instantaneous turning up of the gas by the verger saved the building from a panic and confusion, and such timely service should certainly not be allowed to pass unrequited."

ELECTRIC LIGHTING MEMORANDA.

A letter signed by Mr. Henry G. Calcraft, on behalf of the Board of Trade, and relating to electrical supply licences, was published in the London newspapers on Saturday last. This official missive was addressed mainly to Electric Lighting Companies, who may be supposed to be mailing their representations at this time for next year's campaign. Observing the difficulties and delays of the Provisional Order system, some Companies appear to have thought of applying for licences, to begin with; perhaps with the intention of improving their position as time goes on. Mr. Calcraft points out, however, that licences cannot be granted for a longer period than seven years; which does not allow sufficient time for the full and commercial development of any system of electric lighting in large areas. The Board of Trade have therefore determined not to grant licences to undertakers (other than local authorities) for wide areas, such as the whole of a provincial town or a London parish. If speculators want to try their fortune in a large district, they must make up their minds to accept all the responsibilities of obtaining and carrying into effect a Provisional Order. They will not be allowed to play with the locality for a short time, to the exclusion of others who might be inclined to establish a more permanent business. This is a wise decision; but it will probably be loudly complained of by electricians, as another block upon their progress; especially by those who only want another excuse for subsiding into the embraces of an official liquidator.

Of all the frightful examples of the consequences of precipitancy in adopting electric lighting, there is none to surpass Hull. When the idea was first made popular in England by the unceasing efforts of interested persons, the local authorities of Hull rushed to the conclusion that they must have an Electric Lighting Act all to themselves. Consequently, before it could be put in operation it was found necessary to go to Parliament for a general Borough Act, in which the powers obtained a year before at such a cost could have been included for a mere trifle. As it was, they were mercifully before being utilized. After this second Act was passed the Corporation did not know what to do with the electric lighting part of it; and when, after many shines, the whole thing would have been allowed to drop. It was felt, however, that some steps should be taken to satisfy the natural expectations of the ratepayers; and consequently a contract was made with Messrs. Siemens Bros. and Co., Limited, to light a portion of the town—a very small portion, because it was not desired to spend much money upon the lighting, the permission for it having already cost so dear. The conduct of this experiment in the beginning was not satisfactory to the townspeople; and, after much negotiation with the eminent firm who were doing the work, the terms of the contract have been rearranged, and the time of the engagement is to be reckoned from the date when the lighting "is shown to be in accordance with the contract." This phrase does not mean the perfection of lighting; for it recently transpired, at a meeting of the Town Council, that several members hold the opinion that the lighting has never been satisfactory at any time, and never will be, although we may agree with the terms of the contract. One discontented councillor actually expressed a desire to know whether the Siemens system was really the best! These expressions of dissatisfaction received considerable strength from the fact that the street gas-lamps had been lighted every night, as usual, since the electricians began their work. At Messrs. Siemens's request, however, the gas is to be left unlighted henceforth, as an experiment. So that the present condition of affairs in Hull is not so much an experiment in electric lighting, as a trial whether the electricians can do without the gas-lamps.

The financial results of experimental street lighting by electrical supply companies is shown in the case of the Maxim-Weston Company and the Clerkenwell Vestry. Twelve months ago the Company entered into a contract for lighting Pentonville Hill, and began with incandescent lamps. Although largely advertised at the time as a success, this system soon had to be changed for arc lamps. The contract is now on the point of completion; and as the Company are drawing their responsibilities, they will not renew it at any price. However, they still cling to the plant to the Vestry for £9000, or half the stated original cost. Hence it may be judged how profitable the work has been to the Company. It is not at all likely, moreover, that the Vestry will agree to pay even that reduced price for plant which they can scarcely know how to manage. It should not matter very much to the Company whether they sell their plant for old metal or as a going concern, for the game is very nearly played out.

The electric lighting—or rather darkening—of Eastbourne is making the inhabitants and visitors of this pleasant town clamour for the restitution of the discarded gas-lamps. In this case the Local Authorities appear to have had more faith than the Town Council of Hull, for they freely removed the old lamps before convincing themselves that the new ones would work well. Unless we are mistaken, the Eastbourne experiment is under the experienced hands of some of the Brush people, although the peculiar territorial name of the undertaking has escaped us. It is a curious fact that while seaports and watering-places have been very liberal in trying electric lighting for their "parades" and principal thoroughfares, an air does not agree very well with many of the systems experimented with; for there have been more failures in such localities than anywhere else. There may be reasons for this, or it may be only a coincidence. It is at least a tolerably well-established fact.

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Aug. 21st, 1883.

THE ELECTRIC LIGHT COMPANY MANIA OF 1882.

Our contemporary *Money*, in a summary of the past financial year, says: "The year 1882 will be a memorable one for electric lighting companies and their expenses. We have, if for nothing else, at the electric lighting exhibition, a most remarkable instance of what "lights" really means. In this year only early in April that the total recalled the zenith of its ambition. Since then it has been gradually shrinking, and at the moment of writing, not more than 1000 lamps—at lighting strictly estimated. The completeness of the crush may be read easily enough in the following figures. On May 30, Brush 21 shares were quoted at. On May 1 they had fallen to 10½ and to-day (Dec. 23) are ranked 6½. Hammonds, £2 10s. paid, are to-day 1s. 6d. Swan rose up to £1; fell to 5 in November; and to-day are at 3½. The Anglo-American and other companies are at a discount, and generally unmarketable; and the whole of the speculative interest in the matter of the light itself, also deaths of the existing companies such as Edison. The companies have been started on a principle against which we have consistently protested. We have shown the billionaires of all rated companies. These applied a large capital they can show an out-of-all but a patent, which may be superseded or disputed; and that the process has the one disastrous object of enriching patentee and promoter at the cost of the shareholders."

ELECTRIC LIGHTING MEMORANDA.

THERE is a rich crop of electric lighting news this week, and it is almost a pity that the necessarily limited space which we are able to devote the these matters will only permit of the most cursory mention of the more striking items. To begin with, the report and accounts of the Anglo-American Brush Corporation—the English parent of all the Brush Companies—have been published. Our caustic contemporary *Money* thus ravaged these interesting documents in a spirit which may be understood from the simple mention of the fact that the startling phrase, "Founded on Rain," is the heading of its commentary. It appears that the Corporation has suffered a sudden check in its ordinary business of manufacturing and selling machinery; the value of its unsold stock and plant being about £80,000. From this or other causes it seems that the Directors have found it needful to make a call amounting to £80,997. It is pointed out by our contemporary that while at the close of the year there had been received the sum of £21,222 on account of this call, the cash at the banker's was at the same time only £20,588; hence the conclusion is drawn that but for this timely call the concern would have been in debt for cash to the extent of £2631. On the contrast for lighting the portion of the City thoroughfares allotted to them the Brush Corporation was debited with a loss of £1696, exclusive of establishment charges. These latter are enormous; the salaries and miscellaneous expenses being £21,520, while the Directors' fees amount to £25,997. For this outlay on management and staff there is shown a nominal net trading profit of £12,500, which is partly dependent on the realization of the stock. The disastrous Lane-Fox patents, or some of them, are to be resold to this ingenious personage; and it may be imagined that the Directors sincerely wish they had never touched them, for thereby an opening has been made for litigation of which no man can see the end. The general balance-sheet contains an entry of £192,950, being the assumed value, as an asset, of shares held by the Corporation in part payment for concessions. This asset *Money* cheerfully appraises at something less than "a threepenny-bit" in cash. Altogether, therefore, although it is acknowledged that the concern is not on its last legs yet, for there is a balance of calls unpaid, and others may be made, the Corporation are decidedly under a cloud. The *Directors* "pride themselves on the "extraordinary prosperity" of the early part of the year; but our contemporary sternly refuses them for taking credit for a brief good fortune that was seen the beginning of their end; and *Money* evidently thinks the parent organization will speedily follow them.

Not long ago the readers of *The Times* were informed, by the American correspondent of that journal, that Mr. Edison had addressed himself with perfect success to the problem of competing, with his incandescent system of lighting, against gas at ordinary English prices. We promptly discredited this statement, and felt at the time that it would not have been difficult to expose the real condition of the *Edison* experiment upon the Holborn Viaduct. All evidence upon this point is, however, met at once with the objection that this installation is purely experimental, and therefore does not prove that establishments similarly constituted on a scale will share its defects. At the same time its successes, such as they are, are not similarly limited; but the assumption is made, with great confidence, that all defects will disappear and all perfections be multiplied in large establishments. We are not likely to see one of the latter class of undertakings in England for some considerable time; but from New York, where something of the kind has been attempted, there comes a statement to the effect that Mr. Edison has not quite succeeded in competing with gas even at 8s. per thousand cubic feet. At a certain "down-town" printing establishment, seven Edison lamps were set up in place of five gas-burners. Owing, however, to persistent defects of the carbons, it has been necessary to light one and sometimes two gas-burners in addition to the electric lamps. Even under these circumstances the Edison Company's statement of account for light supplied from Oct. 10 to Nov. 10 shows that the total amount of light furnished was equal to 18,240 standard candles, for which, at the Company's price of 1 dol. per thousand candles, the charge would be 18·25 dols. This represents the work of one lamp during 1020 hours; whereas the charge for gas at the same time in other parts of the building was after the rate of 10·95 dols. for 1095 hours, or about 85 per cent. in favour of gas. To addition to this must be reckoned the cost of the gas-burner or burners used in aid of the incandescent lamps, which, though defective, are of course charged for as perfect. Under such circumstances the above "printing" office would be paying the Edison Company for the equivalent of gaslight at 18*s.* per thousand cubic feet.

Interest has been created by a letter from Mr. Coope in *The Times*, describing the process through which he was led to adopt incandescent electric lighting for his mansion near Colchester. It appears that he first obtained an estimate for a private gas-works, which would have cost altogether £1200. The electric lighting installation has cost £1470, showing a slight excess over the estimate for gas. The result of the experiment, so far as lighting is concerned, is described as satisfactory. Up to this point Mr. Coope stands upon the firm ground of facts; but he proceeds to give an account of the annual working expenses, to which the fatal word *estimate* is prefixed. We all know what estimates of electric lighting are, and how unaccountably they fall short of the reality. It would, therefore, have been better if Mr. Coope had waited until he had enjoyed his experiment for at least a year, and had then given us the actual cost, with any observations that riper experience might have suggested. As to the latter aspect of the question, another *Times* correspondent addresses an awkward question to Mr. Coope, as to whether he can, by the new system, have any light at all except at fixed times, and if the whole or a large portion of the machinery must not be set to work for a single light. Mr. Coope's reply to these searching inquiries, which, indeed, go to the heart of the matter, is more apologetic than reassuring. And he is badly supported by Mr. Sellon, who seizes the opportunity for advertising the secondary batteries in which he is known to be interested. In fact, Mr. Sellon damages Mr. Coope more than the openly sceptical correspondent already mentioned. Mr. Coope thinks he will get his 200 lamps alight for £150 hours for an annual charge of £292 15*s.* 1*d.* We hope he will write again a year hence, and say (with equal regard to the pence) how near this estimate is to the truth.

Some time ago Mr. Lane-Fox delivered a lecture, at the Royal United Service Institution, on "The Future of Electric Lighting," which has since been published. The lecturer has a vivid imagination, to which he gave full scope on this occasion, emitting prophecies which even *Engineering* shrinks from endorsing. Among his liberal promises was one to the effect that "we [*i.e.*, the electricians] could retail energy at "one farthing per hour per horse power; that is, we could actually produce the power and sell it at a profit at that price." And as he also said that 1-horse power would give light equal to 160 candles, it is superfluous to add that he demolished gas lighting there and then, and without hope of recovery. Unfortunately, Mr. Lane-Fox was only able to employ in one kind. He did not foresee what has actually come to pass, while the rest has not—that all the Brush Companies who took up his own valuable patents would soon get rid of them in the greatest hurry, and at any or no price. Last week an extraordinary general meeting of the Yorkshire Brush Company was held for the purpose of considering an offer for the repurchase of the Lane-Fox licence for £95,000 *in the Company's own shares*. The entire arrangement is a sorry farce, for the supposed purchaser is the Electrical Works Company, now in voluntary liquidation. The Directors conticence in question embodying a cash payment. The Diamond Company are, of course, mixed up in the transaction in some mysterious way. After desperately trying to get a little cash for the licence from the representative of the nominal purchaser, the unfortunate Yorkshire Brush proprietors were fain to "tip out" their property for the consideration already stated. These are some of the phases of that "future of electricity" which Mr. Lane-Fox did not anticipate.

Guyscer's Journal Sept. 1882

Electric Lighting for Domestic Purposes.—Progress in the arts in our age is often so rapid and so completely upsets old established industries and institutions that the public has grown accustomed to be very sanguine in its expectations of what new things will do. The telephone is an instance in which the most salient hopes of its inventors have been realized. The electric light has required and will require much more time for its successful introduction. When, three or four years ago, promising inventions in the conversion of power to light through the medium of electricity followed one another in rapid succession, public excitement ran high, and there were many who predicted that at an early date our gas manufacturers would be ruined by powerful competition. The happenings of the past few years have shown how far these sanguine predictions have come from being realized. The gas interest is as powerful and as prosperous as ever, and there are no signs that it will be soon crowded into a secondary position. The electric light has conquered a field which gas had never been able to fill satisfactorily, but it has not practically perceptibly invaded the territory of its older rival. For large spaces and for show, and possibly where power is cheap but suitable coal expensive, we now have the brilliant arc light, which renders many of our public places, streets, shops, and places of entertainment brilliant. In such cases, intensity of illumination and places of enterprise at greater cost. For domestic lighting, the brilliant and powerful arc is quite unsuitable, and even for the illumination of our ordinary rooms, the difficulty of attaining greater diffusion by increase of number and decrease of power of individual lights has not yet been overcome. Nor have we any positive proof that the electric lighting of streets is cheaper than gas, even at present prices of the latter. Since 1878, Mr. Edison has been experimenting with his incandescent light, which it will be cheerfully conceded has many special advantages when compared with gas. It is healthier, cleaner, cheaper, neater, and safer. The great and decisive question whether it is cheap enough is now to be tested on a magnificent scale, though it must be noted that there are special circumstances favorable to it in this case. Recently, a beginning was made to illuminate a section of the lower portion of this city, and it is expected that soon about to the thousand Edison electric lights will be in operation. It is, of course, too early to speak with any show of confidence on the point how far economies are of some dissatisfaction about the power of the lights, but this may be partially a disappointment after undue and unreasonable expectations. On the question of cost, we have no data that may be accepted as conclusive. By laboratory experiment, by a theoretical comparison of candle-power of gas against candle-power of incandescent electric light, we know that the latter is still beyond in the race. But it remains to be seen whether consumers are willing to pay for other advantages more than that difference in cost, as based on present prices of gas. As to the latter, though the gas companies have always maintained the closest secrecy as to their operations, we know that they could afford to reduce their figures very materially, and yet leave a very good margin for profit. Though the challenging public attention much less than its younger rivals, gas-lighting has during the past few years been much improved, both as to methods of manufacture and devices for burning, and a more liberal spirit has partially offered the measure of past high-handed action.

After a careful survey of the field, we can but believe that the light which has now begun in earnest will not help believing that the On the one hand, we have electrics and strong advantages in the way of better light; on the other, the powerful ally of lower cost. We would caution our readers therefore to look with caution on announcements of the undoubted and unqualified success of the electric light. They should bear in mind, too, that Mr. Edison hopes to derive much of his small profits in fact, it is stated that he looks for such a profit on this branch that he can afford to do the lighting at a reasonable loss. It is hardly necessary to say that such exceptionally good opportunities would not be offered anywhere else as in the business portion of this city.

ELECTRIC LIGHT

A DEPARTMENT OF THE

AVALANCHE

Devoted to the intelligent discussion of Improvements in Electrical appliances the publication of the News of the time in its sphere, and particularly to

ELECTRIC LIGHT

ROSS EDGAR RAYMOND, Editor, 46, TAVISTOCK STREET, COVENT GARDEN, LONDON.

Introductory.

Electric Light having become an accomplished fact, and its commercial existence being fully demonstrated, it assumes the relation to the world of finance of any other great business project.

The Electric Light and Power Companies that have been formed in Great Britain within six months have capitalized at the enormous figure of £25,000,000. Their shares are distributed with every class of investors, and their plans, as yet, for the most part existing only in the merit of the inventions upon which they are based, present unsettled points that may well have the careful consideration of promoters and investors. It will be the duty of the Electric Light Department of this Journal, to form the link between the two classes most interested, and to present the merits of all systems with the accuracy and reliability that belongs to the result of a careful unprejudiced investigation.

Unfortunately among the systems upon which are based some of the plans of many of the companies now clamouring for public attention are a number utterly unworthy of confidence. In some cases their patents are not properly made, in others they are unblushingly stolen from worthy inventors, and the shares themselves are being floated upon the representations of the prospectuses that have no foundation beyond the fertile imaginations of those who wrote them. In the mad rush of investors for Electric Light Securities, these companies have been able to bait their hooks so temptingly—and always at the expense of the solid institutions—as to secure as the reward of their effrontery large returns.

It will be the duty of this department to wage an aggressive warfare upon such pirates, and by the exposure of their plans to leave open to the reliable ones that field of profit which is legitimately their own.

A number of so-called electricians have recently succeeded in victimising capitalists, and have been the means of organising companies that cannot last.

It will be the duty of the Electric Light Department of this Journal to expose such men.

Just at this time the World of Science is directing more of its attention to the investigation of electricity than to any other subject: out of all this investigation will come nearly every day new and important discoveries.

It will be the duty of this Department to faithfully record these as they are made from time to time.

To the end that the objects held in view by this Journal may be attained, correspondence and expressions of opinion are invited. All communications will either be published or returned. Names and Addresses must accompany all material.

It is our intention to publish papers on Electric Light and Power subjects, from men of highest authority and eminence. So that end we have already secured articles from Mr. Edward H. Johnson, the Manager of Edison's interests in Great Britain, who will write on the future of Electric Power; the present holder of the Faure Electric Storage Batteries Patentee; H. S. Maxim, Herr Siemens, Lieut. Sprague of the U.S. Navy, a rising young electrician of America, who served as a juror in the late Electric Light Exhibition at the Crystal, Palace, and others. Further articles from equally eminent sources will follow. Each number of the paper will contain the quotations and range of Electric Light, and Power Shares, and a review of the market. In short, it is our intention to make this Department of this Journal a necessity to the class whose interests it will faithfully try to represent.

There will be a strong fight in Parliament over the Electric Light Bill. The Companies will resist the limitation of 15 years, and make a strong effort to get the time extended to 21 years instead. In doing this, they are only endeavouring to obtain less than was allowed to the gas companies in their infancy.. All the testimony elicited by the committee that framed the bill indicated how necessary it is that electric light companies should have ample time to get their undertaking well [illegible], and twenty years was named as the very shortest [illegible]od.

Revised Copy.

ELECTRIC LIGHTING.

A LECTURE

DELIVERED BY

J. W. SWAN,

BEFORE THE MEMBERS OF THE LITERARY AND PHILOSOPHICAL SOCIETY OF NEWCASTLE,

THE PRESIDENT (SIR W. G. ARMSTRONG) IN THE CHAIR,

OCTOBER 20th, 1880.

NEWCASTLE-UPON-TYNE:
MAWSON, SWAN, & MORGAN, 24, 26, & 32, GREY STREET.
1880.

THE "ELECTRIC LIGHT" AT ALTRINCHAM.

One of the most successful lectures of the series given in connection with the Bowdon (Literary and Scientific Club that has been delivered in the Literary Institute, Altrincham, on Tuesday evening by Professor S. P. Thompson, the subject of the lecture being "Domestic Electric Light." The apparatus, by means of which Professor Thompson performed his numerous interesting experiments, was kindly lent by Mr Charles Lever, of Oakbrook Hall. The large room in the Institute in which the lecture was delivered was lighted by three of that gentleman's improved arc lamps, and a number of others were placed over the doors in the building. Favourable notices of these lamps have already appeared from time to time in the columns of some of our London contemporaries. At the exhibition now being held at the Crystal Palace, Sydenham, they have attracted a large share of attention. The electric current by which the lamps were supplied on Tuesday evening, and during the experiments conducted, was produced by a Siemens and a Hefner-Alteneck dynamo placed in the yard adjoining, belonging to Mr Joseph Heginbottom. They were worked by a powerful steam engine on the premises, and were excellently well, under somewhat disadvantageous circumstances, and were the subject of general remark and admiration from those who attended the lecture, of whom there was a large number. The chair was occupied by Mr W. H. Tatton, Esq., and the chairman, in introducing Professor Thompson, said that gentleman's name was one of such world-wide reputation, and they as Altrincham had already so much interested in a previous lecture of his, that it would be unnecessary to do more than ask him to proceed with the lecture.

Professor Thompson, who upon rising was heartily received, then said that he once again invited his readers to come to Bowdon to say something to them, he was quite aware that the subject of a course from which an electric light might be expected, was not such as to go down well. Mr Charles Lever, as many of them knew, had been at work during the year long and laborious forms of an electric lamp. About that lamp he should have more to say presently. The subject of electric lighting was such a lively one to many people, and presented so many points that were not yet generally understood, that it might be well to start right from the beginning, even at the risk of telling what to some of his audience was old and stale stuff; and say how the electric light was first found out, how generated and distributed, and how and why they made use of certain properties of electricity for the purpose of obtaining a light. These large lamps were called arc lamps, and the smaller ones were more or less incandescent lamps. As there was a great difference between these two kinds, it would be well to explain at the outset what it was. The means used that night to get exciting the electric current, were to be found in a yard behind that building, where there was a steam engine and two of those wonderful generators known as dynamo-electric machines, commonly termed dynamos. These machines were of a totally different order to those little toys they were accustomed to in the south, and which consisted of a wheel of glass turned by the hand against a silk rubber. They were so powerful that he should not be surprised if some of his experiments failed, not because there was not enough, but because there was too much electricity; in fact, he should not wonder if it were to burn his apparatus. He would now endeavour briefly to give the history of the discovery of electricity as far back as 1800, was due to an Italian named Volta, who, in the year 1800, invented the Voltaic pile. This consisted of a number of zinc and copper plates, piled up and separated by pieces of flannel moistened with acidulated water. When the wires from both ends of this pile were connected a small spark was obtained. On the 20th of November, 1800, this Italian wrote a letter, addressed to a scientific assistant, living in the town from which he (Professor Thompson) came—Bristol—and one of these piles, after trying to get a spark he found that he could get a shock by touching the tip of the wire between his tongue and the other. That person was Sir Humphrey Davy. A year or two afterwards it was found that the pile was the means by which a current of electricity by this means, two metallic wires, say one of copper, for instance, were immersed in a cell containing acid and water, and this produced a current as soon as the two wires were not provided round the outside. In this case, however, the zinc was being consumed by the acid, and therefore impossible to obtain an electric current without the consuming of the zinc. There were various kinds of cells, some of which might, however, was sufficient to produce a current for lighting purposes, but which was [illegible] battery." Such a battery of 12 cells it was a comparatively easy matter to produce a powerful electric light. Of course, if more cells were taken a more powerful light was produced. Professor Thompson next showed how the light was generated. If, he said, he took two pieces of carbon in his hand, and passed a current through them, he could, by first joining and then separating them, get a spark between them. The separation must be rendered instantly hot, and they slowly burnt away. The points being gradually consumed, the space between them increased, and the wide that it offered too great an obstruction for the passage of the current, and the flame would go out. In order to obviate this, about 40 years ago a regulator was devised which could hold the carbons near enough to each other in their proper distance, moving them together and separating them when required. The carbons had to be made to touch; it was not sufficient to bring them near each other, because the current would not leap across the thousandth part of an inch. Then they must be separated by about the thirty-seventh part of an inch before it would leap across for the spark. When that was done they burnt, as they consumed, he gradually moved towards each other, so that there was never more and never less than the thirty-seventh part of an inch between them. That was the difficult problem to make a lamp which should fulfil these conditions. It was done, however, by a person named Duboscq, by means of a clock-work arrangement controlled by an electromagnet. This clock-work arrangement was not entirely successful, in consequence of its complication. It was apt to get out of order and go wrong in many ways; and it required continual attention and regulating. Being too fine an instrument for commercial purposes, it had simply remained a philosophical instrument, a modification of it being used in some lighthouses. Recently, however, Professor Thompson said that if the means he had already described had been all that had been discovered for lighting, lighting would not be in the position it was to-day, because the means of generating a current by a galvanic battery was too insufficient and far too dear for commercial purposes. The first improvement, therefore, was to get a cheaper and more economical source for producing an electric current. That cheaper and more economical source was not the consumption of any other kind of fuel in the battery. Coal was found to possess a greater power of heat than was required for producing a current, but coal could not work in a battery. It was of no use to make it into gas, because, in fact, it would not act at all in that sense. So the modern way of generating an electric current was to get it entirely different from the galvanic battery as a steam engine was from a good dinner. (Laughter.) When a year ago he had the honour of lecturing before them on the subject of magnetism, he showed how, by winding a coil of wire round a rod of wire, the very fact of moving it into the coil, or taking it out, generated a feeble current of electricity. This principle, which was the foundation of the first dynamo-electric machines, was discovered by Faraday. In these machines coils were made to rotate in a magnetic field. Steel magnets were found not to be strong enough; therefore electro-magnets for more powerful. Electro-magnets were therefore used. These consisted of coils of wire wound round soft iron, and through which a current of electricity was then sent. The lecturer next mentioned the different varieties of machine, and explained their several peculiarities. Among these were the Gramme, the Siemens, the Alliance, the Brush, the Edison, and the Burgin. In the year 1878 a new kind of lamp was invented by Mr Jablochoff, with all its machines required for regulating it. This, and this was known as the Jablochoff candle. This candle was not a very simple device, for, instead of having a clock-work mechanism to bring the carbons together, two pieces of carbon were placed side by side, exactly at the right distance from each other, and so could never be anything else. They were separated by a thin film of plaster of Paris, and as they consumed away the light gradually passed from one end to the candle. In fact, they were just like a candle with two wicks. But a current of electricity when it passed through carbon was a very long carried little bits of charcoal with it, and so both carbons did not burn equally. One burnt twice as fast as the other, and how to get over this difficulty was one of Jablochoff's further suggestions. That was a very satisfactory lamp in many ways, but it was [illegible] for lighting purposes, and could not be used [illegible]

lamp made on that principle was Gerard's. Amongst the more famous of those lamps was the Brush. There was no clock-work arrangement in the Brush lamp. Professor Thompson said that among other lamps, that who had invented a simple arrangement for regulating the cartons, by means of what was known as the "hair spring," was Sir Lloyd Sir Lever, whose lamps were being used only for them that night. (Applause.) He had also to say that he had not a photograph of the clock-work arrangement of Mr Lever's lamps, and therefore he could not describe it; and do the best he could in making a sketch of them. The various parts of Mr Lever's lamp were then sketched on glass by the lecturer, and projected on to a screen. It was impossible, said he, to imagine anything simpler, and therefore he considered that lamp the best, or, at the least, certainly one of the best ever invented, as being simple and efficient that he could not but think it had a great future before it. (Applause.) After referring at some length to the lamps Professor Thompson said that he had to deal with one kind of lamp only, he had yet to mention the smaller ones. Those he had been describing, beautiful as they were, were far too bright for ordinary use, but very large drawing-rooms, or likewise, though that were not fitted for such a hall as that, and for streets, they were most convenient and economical, as they got an enormous amount of light for their money. The smaller lamps, he said, had been adapted for household purposes, but he might not say that at present they were cheaper than gas on the other hand, perhaps they were dearer. After a lengthy description of the various kinds of incandescent lamps, including the Edison and Swan lamps, Professor Thompson said that the next question was, how were they supplied with light? The question was not, however, a very difficult, but could correctly of electricity by means of wires, and the manner in which the electric light was supplied was cheaper than gas when a great deal was required—that there was as yet no cost established where a comparison could fairly be drawn. For in no case except two, and those could not be taken into consideration, was there any instance of electricity being supplied at a price less than gas was charged. At Godalming, for instance, they were going to make a fair comparison, but they must wait a little longer. He (Professor Thompson) was a dynamo machine in his yard and the man who had in erect his own gasometer and meter and make his own gas. If a comparison were made in that way electricity was the day on the score of cheapness. As things were at present, they would be no more the galaxies than the men who had to get a set the meter and pay so much per so much per 1000 gardens. From every other point of view the electric light was far in advance of gas. Its brilliancy, the atmosphere was not polluted with it, and colours could be seen better than by gas. In conclusion, Professor Thompson said he would only add that he knew the electric light in general use before long, feeling sure it was only a very small part of a very great subject. We wanted electricity distributing for other reasons, leading motive power, and a hundred other purposes, for which electric engines might be used. He believed that the electric light would be followed as shortly for its use largely supplied by electricity, in fact, it would prove a most valuable ally, not only for the rich man who wished the luxury of a bright light, but to a poor man also.

On the motion of Mr Alfred Neild, seconded by the Rev. J. E. Odgers, a vote of thanks was accorded to the lecturer and Mr Lever, and the proceedings then terminated.

Menlo Park Scrapbook, Cat. 1018

No. 11H. "Electric Light"

This is the eighth of nine scrapbooks containing clippings about electric lighting. It covers the years 1881-1884. The book contains approximately 130 unnumbered pages.

1018

Electric Light-

11. St.

ELECTRIC LIGHTING MEMORANDA.

Some of the facts concerning the electric lighting at the Savoy Theatre are beginning to leak, notwithstanding the great secrecy that is maintained respecting the expenses. The amount of capital that has been sunk in the installation is still undefined, but it is well known to have been very large. It is to be regretted, from an engineering point of view, that the details of cost of the generating and distributing plant have not been made public, in order that an estimate might have been formed of the relation which these two divisions of capital expenditure bear to each other. It is believed that the distributing arrangements have been reorganized more than once, which would entail heavy additional expense beyond that represented by the miles of insulated wire actually in position. The machinery has also been running for sufficient time to at least indicate the allowance that should be made for breakdowns and wear and tear, respecting which we are yet kept in ignorance. With regard to the working expenses, however, it has been stated that the cash payments amount to about £27 weekly, merely to keep the establishment going, without reference to interest on capital, repairs, or depreciation. Besides this the gas-rental is reported to average £10 weekly; or a total for lighting of but little under £40 every week. The expense of lighting the building entirely with gas amounted to about £22, so that the comparison in this case is not very favourable to the electricians, who, be it remembered, do not pretend to receive a return for their outlay, but in the above account merely to charge the weekly cash out of pocket. It is impossible to escape the reflection that the Electric Lighting Companies, who called Dr. Siemens as a witness before the Select Committee on the Electric Lighting Bill of the Board of Trade, had ample justification for refraining for putting in evidence the facts of this unfortunate experiment. It is idle to pretend, as was there urged on behalf of the Companies, that the cost of electric lighting can only be ascertained from the working of great undertakings, having a capital expenditure of from £100,000 to £200,000 per square mile of town population. Why could not this Savoy experience have been cited in detail, with every item separated, and a statement made on the facts, showing the points (if any) in which a supply from a central station would be cheaper? This is the kind of evidence which the Committee had a right to expect from Dr. Siemens and the other eminent authorities who were called, one after another, to guess at the capital cost of electrical installations. Precise knowledge is to be gained sometimes by arguing from the known to the unfinally decline to follow, to their own discredit and to the perpetuation of confusion.

The tide of opinion respecting the relative prospects of gas and electric lighting is still setting strongly in the way indicated in these columns last week. Newspapers which have until lately indulged without stint in prophecies referring to the imminent pre-eminence of the new luminant, now find it expedient to pay some attention to the facts of the present. The *Pall Mall Gazette* of Thursday last, for example, contained a very temperate article in which the records of a number of experiments were adduced in support of the assertion that not one penny has yet been saved to ratepayers by any Electric Lighting Company, whereas most of them have added considerably to the expenditure for light. This was with reference to are lighting in public thoroughfares, although instances of railway stations and other large buildings were also mentioned. The sole exception admitted was the notorious South Kensington Museum example, where the lighting of the Lord President's Court is reported to have cost £250 per annum with electricity, as against £660 with gas. These figures have been paraded with such pride by electricians, in prospectuses and elsewhere, that it is worth while to insist here that what has been gained in expense has been lost in effect, and that the system of gas lighting adopted at South Kensington—the simple and effective design of running lines of burners round the rooms at the top of the walls—is, perhaps, the most costly arrangement known. At any rate, this apparent triumph of electricity has not been repeated elsewhere, and it is only employed to a very limited extent in the Museum. With reference to incandescent lighting, the *Pall Mall Gazette* admits that the facts are few; but it is said that the Edison system is reported, under certain conditions, to be cheaper than New York gas at 8s. per thousand cubic feet. Our contemporary confesses that it is doubtful whether similar results will be obtainable in this country. As to this we are enabled to state something from Mr. E. H. Johnson's evidence before the Select Committee on the Electric Lighting Bill. Edison lamps will be supplied on the Holborn Viaduct, for the benefit of those guileless persons on the Stock Exchange and elsewhere who never look beneath the surface of a transaction, at the same price as gas. Surely this will be regarded as securing the downfall of gas lighting in this country, even before a similar effect has been produced in America!

Journal of Gas Lighting &c
May 9th 1882

ELECTRIC LIGHTING MEMORANDA.

An estimate of the cost of an electric lighting establishment on the Brush system has been supplied by the Hammond Company to the town authorities of Peterborough. This establishment is calculated on the basis of 80 lamps, which are only supposed to be required for 1000 hours during the year, or rather more than 4½ hours nightly. The plant—comprising two No. 8 dynamos, 80 lamps, with four spare ones, wire, lamp-posts, and 40-horse power semi-portable engine—would cost £1691, on an estimate which is at any rate, not parsimonly full. Having started the undertaking on this basis, the working expenses are made up as follows:—Labour, £310; coals, at 3 lbs. per horse power per hour, £220; depreciation, at the rate 2 per cent. on dynamos, 5 per cent. on lamps, and 10 per cent. on engines, amounts to £258; and "sundries," at £30, neatly brings up the total to £1000 per annum. Carbons for the lamps form an admitted extra of £100, and it is noticeable that all charges for interest on capital, oil and water for engine, and other items which will, of course, at once occur to every user of steam machinery, are totally omitted from this statement. Every entry in the estimate of working expenses is distinctly illusory, not to use a stronger term. It is not our purpose, however, to correct this imaginary estimate as it stands; but it may be remarked, if the Brush system is making such wonderful progress in the hands of the Hammond Company, why do they not publish the duly attested accounts of some existing establishment—say Chesterfield—as a guide for future customers, instead of continually drawing upon the fertile imaginations of their staff?

Messrs. Compton and Gordon have written to *The Times* on the subject of the fire risks of electric lighting, and have appended to their communication the code of rules drawn up by the Engineer to the Phœnix Fire Office for installations of electric lighting in buildings which are technically regarded as "hazardous risks." These electricians appear to have had in view the pacification of the public mind on the subject, which might be disturbed at the rumour that the Insurance Companies have decided to charge extra premiums for buildings electrically lighted. They maintain that the now system of lighting is absolutely safe if properly managed; but that

It is naturally dangerous if left in ignorant and careless hands. It is not to be ignored, however, that at the Paris Electrical Exhibition at least six alarms of fire arose from the conduct of exhibitors who might have been expected to know how to manage their own affairs. The greatest danger in electrical fittings carrying intense charges of electricity is, moreover, the absolute want of warning of anything amiss until the damage has been done. A leak from a water-pipe is sufficiently obvious; and the same may be said of an escape of gas. Yet it is well known that the appearance of the right way of dealing with an escape of gas still prevails, notwithstanding the simple character of the precautions necessary to be observed. May it be hoped that the far more subtle dangers of electricity will be met in a more satisfactory fashion than has been experienced in the case of danger from gas?

A few observations which recently appeared in the City Article of the *Daily News* sufficiently indicate the character of the prevailing rage for electrical speculations. It is said that the trade in the shares of these concerns, which are brought out by the dozen every week, is so brisk as to attract many dealers from other and less active departments of the Stock Exchange. This simply means that the game is kept up smartly, as a matter of speculation. From the context it appears that the writer of the notice in question had in view mainly the subscriptions to the Brush Company and its numerous concessionary offshoots. He goes on to say that nearly everybody is of opinion that Brush shares will rule higher, yet that it is astonishing how little is known as to the profits on lighting by the Brush processes. The only explanation of this prevailing ignorance is that possibly those most intimately acquainted with the subject do not care to publish their information. The writer of the paragraph proceeds to observe that the market is getting into a state which would predispose it to a scare, were any rival enterprise to prove successful. The possibility of a scare, which would bring the shares of all similar speculations down to one hopeless level, is always to be reckoned upon under the conditions described. Here are subscription lists opened and filled up to the extent of hundreds of thousands of pounds, when it is acknowledged that little or nothing is known respecting the profits of the business in which the money is sunk. When the revelation comes, it may not be particularly welcome.

Journal of Gas Lighting &c
June 1881

THE ELECTRIC LIGHT IN THE HOUSE OF COMMONS.—At the close of the morning sitting of the House of Commons, on Friday, the experiment of lighting the House with the electric light was tried. Twelve square lamps for the electric light, and twelve for gas, were placed, one and soon after seven o'clock, when the House was closed, the experiment was made in fate operation. The effect was, *The Times* says, doubtful; there was no difference of opinion among the members and others as to which was, on the whole, the skilfully applied gaslight from the glass roof was not softer and less trying to the eyes than the electric light. It was conceded, however, that to one respect the electric light was an improvement on the gas, inasmuch as the rising temperature always noticed in the House after the lighting of the gas was not perceptible in the case of the electric light. The electric light was severely tested by the strong sunlight which streamed in before six o'clock, but it was thoroughly under control, and the House transacted the business of the evening, sitting under the new light. It is intended to make another trial on Friday next. Alterations will be made in the lights in the roof, and additional lamps will be placed under the galleries, where there are now gas-jets. The experiments were carried out in the presence of Mr. Shaw-Lefevre, First Commissioner of Works, and a large number of members and visitors.

ELECTRIC LIGHTING MEMORANDA.

The Leeds Corporation have had a report on the subject of electric lighting from a joint deputation from three of the Committees of the Town Council, which had been appointed to examine the matter with a view to the lighting of the new municipal buildings. The conclusion of the deputation, after they had visited the exhibition at the Crystal Palace, interviewed the managers of several electrical supply companies, and diligently made extracts from various contemporary journals (especially the latter)—is to the effect that the Leeds Corporation should wait and see what further improvements will be made in electrical apparatus; and not adopt any existing system. This is commendatory caution and sufficiency; and the Council should be grateful for such a sensible report from members of their body, who may be credited with impartiality, notwithstanding the interest which the Corporation of Leeds hold in gas property. The deputation collected a great deal of useful information as to the prices of electrical apparatus and lighting estimates; but it might have been wished that more discrimination had been observed in the selection of authorities on certain points. For example, the charge for the Brush lighting in the City of London is put forward as an imitation of the cost of working the system, when it is notorious that the Brush Company have repeatedly declined to take other contracts on the same terms. The ridiculous estimate of cost which recently appeared in the *Engineer*, and which was criticized in our pages at the time, is also drawn upon for data. On the whole, however, the deputation seem to have possessed a remarkable power of coming to a wise conclusion upon questionable statistics.

The game of floating Electric Lighting Companies goes merrily on—new ventures appearing every day, while the shares of the older speculative Joint Stock Companies still hold their own. It will be remembered that a short time since concessionary "Dale Coffee" Companies for every division of the civilized world were formed from a parent association, which had not at the time made a pound of "coffee," or paid a shilling of dividend on its own account. Similarly, all points of the compass are drawn upon at the present time for titles for Electric Lighting Companies, formed to take up concessions from a single organization, which has declared one dividend supposed to be earned by selling machinery at an exorbitant price. Meanwhile new systems are being exploited at the cost of hundreds of thousands of pounds; the latest—we write under correction, for the prospectuses flow in so fast—being the Gülcher Company,* with a capital of £800,000, not less than £75,000 of which is to be devoted to paying the happy inventor whose name is borne by the enterprise. The Stock Exchange just now is indeed a "happy hunting-ground" for electricians. High-sounding names can be had for directorates for the mere asking; and the money flows in, or appears to do so. Meanwhile gas shares continue to mount in value, and so everybody is pleased.

Earnest attention is now being directed to the valuation of the fire risks of electric lighting, and there was a large gathering of fire insurance authorities at the rooms of the Society of Arts on Wednesday last, when Mr. Jas. Dolas discoursed on the subject. Much of his address was wide of the point at issue, although interesting as an exposition of some of the rarer phenomena of ignition and combustion. The lecturer introduced a code of rules for electric lighting installations, which had been prepared for the Phœnix Fire Office by Mr. Heaphy. These regulations are calculated mainly with a view to ensuring ample size and separation of the combuting wires, and the avoidance of danger from the sparks of carbon which drop from arc lights. Mr. Dolas suggested that complete by-pass arrangements should also be provided, together with other precautionary measures which need not be described in detail. He also stated that, when suitable precautions are taken, the dangers incident to electric lighting are no greater than those incident to gas lighting; and that one point in favour of electricity is that it is only liable to effect ignition, and not feed the flames like a melted gas-pipe. On the other hand, the lecturer did not mention the danger to life which

* The correctness of three, if not four additional Companies have been advertised since this paragraph was in type.

might be incurred by firemen in the act of hurriedly cutting off a circuit wire with an axe, if it were observed to be setting fire to woodwork. The lecturer, of course, performed the smashing it, in order to prove the harmlessness of the incandescent lamp. This is a pretty toy-experiment, but sufficient lamps have already been sacrificed in its performance, since nobody dreads fire from this quarter. What is more to the purpose is to fairly state the conditions under which fires are really imminent, and to show that they can be avoided in a satisfactory manner. The last word has not yet been spoken on this subject; and neither has the last fire occurred from this cause.

June 14, 1881.

"As a curious instance of how New York deals of FIRE insurance Underwriters, the subject of unheralded nocturnal light mines came up for discussion. One or two accidents have occurred from an electric light wire coming in contact with a telephone wire. It was suggested that the electric light companies to insulate their wires. Any building in which the mode of lighting is used will be rated as specially hazardous unless the insulation of the wires be perfect.

Dr. Paget [the author of "The Electric Light in its Practical Application," and for years a member of the Council of the Laboratory of the celebrated Wheatstone, is reported to have made some important improvements in electric lighting. Apparently the novel feature in the invention is that in the use of an infinitesimal arc; that is, the distance between the poles of the lamp is so slight as to be scarcely perceptible. It is said that the lamps, which vary 7 or 8 of Swanne's gas cells, will give a light of 40 candles. The Doctor is also reported to have overcome the difficulties experienced by M. Faure in storing electricity.

ELECTRIC LIGHTING IN THE CITY.

On Thursday night last the long-promised exhibition of electric lighting in the City of London commenced. It may be remembered that as long ago as last August the Corporation determined to institute an experiment in electric lighting for several of the principal thoroughfares of the City, including the three City bridges over the Thames. It was decided that the district devoted to this exhibition should be divided into three parts, which were to be separately contracted for. Messrs. Siemens Bros. taking the line of streets from London Bridge, past the Mansion House, to the Guildhall; the Anglo-American Electric Light Company (the Brush system) following with the remainder of Cheapside, through St. Paul's Churchyard and Ludgate Hill, to Blackfriars Bridge; and, as originally arranged, the Electric and Magnetic Company (the Jablochkoff system) were to have taken up the lighting of Queen Victoria Street, including the cross street to Southwark Bridge. Eventually, however, the last-named contractors dropped out, their place being taken by the Company working the Lontin system—the change causing such delay that the thoroughfares in question were not included in the scene of the display of Thursday night, which, therefore, consisted of the Siemens and the Brush lights in their respective districts. We have already described how the Siemens lights are divided into two classes, the one being composed of large lamps, nominally of 2000-candle power each, suspended on signal-posts eighty feet high; and of the other class consisting of smaller lights ranged in the ordinary way along the footpath upon posts about twenty feet high. The large lights are in clear glass lanterns fitted with umbrella-like reflectors, and the smaller lamps are in frosted globe globes. It must be said at once, after careful inspection of the examples in the City, that the lofty lighthouse system does not recommend itself for street use. The so-called large lights are no more than the well-known regulator-arcs, and possess the old defects of unsteadiness, glaustiness, and of casting dense sharp shadows. It is difficult to see what is gained by hoisting these strong lights up so much out of the way at the comparatively open spaces where they are placed. Much of the light is wasted on the upper parts of the neighbouring buildings, while by the time the light reaches the roadway it is greatly enfeebled, without having any other advantage. If the electric arc-light must be moderated or diluted in some way before it can be used for street lighting, it is evident that this object may be better attained by the use of globes which at the same time help to diffuse the light, than by retaining the well-known disadvantages of the naked arc, modified only by passage of the illuminating rays through space. Messrs. Siemens' small lamps are more successful, but do not attain to perfect steadiness, neither are they altogether satisfactory in point of colour. Still they are greatly superior in both respects to the Jablochkoff candles as exhibited on the Victoria Embankment.

The Brush lamps are of that can be desired in illumination of this kind. There can be no question of their superiority to the Siemens lamps, as there is no doubt of the advantages possessed by the latter in comparison with the Jablochkoff candles. The Brush lamps are fixed alternately on each side of the pavements, on pillars about thirteen feet high, the rather small frosted or opal globes containing the light being covered by an oblong reflector. The light afforded by these lamps, said to be of about 2000-candle power each, is of good colour, well diffused, and very steady, offering a pleasing contrast in these respects to any other arc-light of which we have present knowledge. It would, of course, be premature to pass judgment on the whole exhibition until an opportunity is afforded of seeing the remaining portion lit up by the Lontin lights, when—including the Brockie light at the Cannon Street Station—five different methods of lighting by the carbon are will be visible in London in close proximity to one another; but at the present time it must be acknowledged that the honours fall to the Anglo-American Company for the beauty and steadiness of their light.

All that has been said above must be considered as the preliminary observations which any careful observer of the present exhibition would make before attempting to decide upon the import of the whole thing as illustrating a possible means of lighting the busiest thoroughfares of a great city, in substitution for gas. As our epigrammatic neighbours across the Channel have aptly put it, illumination is one thing, lighting is another. It has been decided in Paris that the electric light, as there shown, is illumination—splendid, dazzling it may be—but not lighting. Upon careful consideration of the necessities of foot and vehicular traffic through the crossed streets of this City, it must be granted by an impartial observer that the present experiment in the line of thoroughfares from Blackfriars to London Bridge affords further proof of the truth of the French saying. The quality of street lighting must be valued by the amount of light received in the darkest part of the road. The fairness of this principle can scarcely be called in question. This being granted, we are fred to maintain that, as far as can be judged without precise measurement, the amount of light available on the footpath in Whitehall, between the new gas-lamps recently erected by Mr. Sugg for The Gaslight and Coke Company, is equal, if it does not slightly exceed, the degree of illumination to be observed in a similar position with reference to either the Siemens or the Brush electric lamps in the City. Small and not particularly clear print of a type one size smaller than is ever used in the JOURNAL, is readable in both cases, and therefore it may be conceded that such lighting is quite good enough for streets where, as in this country, people are not in the habit of sitting or standing to read the newspapers. But if gas and electric lighting are to be judged with equal power under these circumstances, further consideration of the method in which the power is in each case supplied points incontestably to the superiority of gas. It will not be denied that, for all purposes of vision, an area dimly but uniformly lighted is preferable to one dotted over with powerful lights, at such intervals that no part of the field illuminated is absolutely darker than the darkest of the former. So in a thoroughfare lighted in its darkest parts equally well by gas and electricity, the strain on the eyes of a passenger, caused by the latter passing momentarily between a space of light and semi-darkness, is much more distressing than when, as at this time in Whitehall, the same wayfarer may walk from one end of the street to the other without being made painfully aware of the means by which his steps are lighted. From the point of view of omnibus drivers and others, who, while passing along a street at a quick pace, must, in our narrow streets, and from their elevated position, be continually exposed in an especial degree to the worst effects of electric street lighting, it is very easy to believe that the experiment in the City may not be hailed as an altogether unmixed blessing. But considerations of this kind can only be fairly weighed after a duly prolonged experience of the advantages and disadvantages of the new system. The experiment is now fairly launched, and must be allowed to go on to the appointed end. If we were so fond of prophesying as some of our electrician friends, we might be more fully disposed than we really are to indulge in anticipations of the end. We are more inclined to wait for results than to predict them, either on the promptings of our hopes or fears. In any event, the termination of an experience in methods of street lighting, as we hope and believe, will not be an occasion for either undue exaltation or despondency on the part of those who, while looking on street lighting as an important branch of business, yet draw the greater portion of their revenue from other sources.

Journal of Gas Lighting &c
April 5, 1881.

NOTES FROM SCOTLAND.

(FROM OUR EDINBURGH CORRESPONDENT.)

EDINBURGH, Saturday.

At last there has been a stirring of the pool in Edinburgh with respect to public lighting, and it only needs one agitating electric light company would rush in, as one could foretell what would happen, in order to get a company as well as to the public. It may appear strange that the announcement that two members of the Corporation have had the temerity to move a motion, which will be discussed at its next meeting of the Council, that a remit be made to the Cleaning and Lighting Committee to consider, and report upon, the question of applying the electric light to the thoroughfares of the city, with a view to make such preliminary inquiries as they may deem necessary; but to the uninitiated it will be plain that it is not at all unlikely that the motion will be carried. It is not let it be supposed for a moment, however, that the interest centres in the Council, or in anything relating to electric lighting. Such a view would be erroneous. That the remit been to report upon the expediency of adopting parafin, it would have received an (quasi) welcome; because in many of the less frequented streets and closes of the city that fluid is really constitute the bulk of the public lighting, as I have had occasion to remark on a former occasion, and as the newest applogies for gas. The Gas Corporation is not to blame for this, for I see, by the last published statement of the shareholders, that the gas supplied, that that of the Edinburgh Company was equal to 32 candles, and supplying gas, I understand the Companies have nothing to do with the lamps. If the Corporation of Edinburgh, either bodily or individually, have any objection to the introduction of electric lighting companies, I could easily understand why the lamps of the city should have been allowed to continue in such a disgraceful condition as they have been, but under what direction it comes, will be heartily endorsed by a large section of the community; and if the Committee's opinion be taken in favour of experiments with the electric light, I have no doubt that a report will be favorable to the long benighted city. The contrast will be the greater that gas, in everything relating to the matter of expense, will fall into comparative insignificance. While the Corporation Committee will be considering the question, the Gas Company will have the superintendence of the lamps, but they will be carefully overhauled; that all unworkable governors—and they are legion—will be removed; and that a good or fair amount be spent in cleaning the glass of the most improved burners. With these alterations, a light of 32 candles can really be obtained from the hourly consumption of 14 cubic feet of gas, which is the allowance for each lamp, would be obtained, and there would be no necessity for new leases for the introduction of any other method of public illumination. An experiment at the east end of Princes Street—at the Register and Post Office—has proved that better lamps, has been such a success as to warrant the extension of the system. Were these, or other lamps of similar construction, substituted for those in the western end of Princes Street, an effect would at once be produced which would be a credit on the city, and show off to some advantage the natural beauties of a street of which every native of Edinburgh is proud. In this way, too, the community would have an opportunity of comparing the relative merits and expense of the two systems of lighting.

THE CITY OF LONDON WITHOUT THE ELECTRIC LIGHT.

This late severe weather caused a considerable amount of trouble to gas manufacturers and their customers; but either the climate or something else has had a much worse effect upon the proposed illumination of the thoroughfares and bridges of the City of London by various systems of electric lighting, of which we heard so much last year. This scheme hangs fire in a remarkable manner. At first it was to have been inaugurated last autumn; then it was announced that the 1st of February would see a gorgeous vision of tall lighthouses strung along the side walks, and superseding the gas-lamps. Now it is said that the 1st of March was intended for the commencement of the new system, but that the late snowstorm and frost have so obstructed the preliminary work, that it is yet uncertain when the electric lamps are to make their appearance. Meanwhile, the streets and bridges continue to be lighted by the doomed gas-lamps; for, with an amount of discretion for which they are not always credited, the City authorities have not given the Gas Company positive orders to turn off the gas from the street lanterns on a fixed date, although, of course, unless they wish to go on paying for gas and electricity as well, the day will come when the services of the Gas Company will be dispensed with—for the time being. The Corporation do not appear desirous to hasten the electric lighting contractors, who, we may hope, will give the public a good show after keeping them without it for so long. Perhaps, however, these anxious persons are calmly waiting for summer previous to lighting up, in order to get settled to their work before next winter. There have not been any symptoms of popular discontent with the existing state of things, or of a yearning after a better arrangement; but the Commissioners of Sewers should bestir themselves and get their experiment well forward before Mr. St. George Lane Fox, or some other electrician with equal experience in street lighting, brings forward a new system in order to upset Messrs. Siemens, Brush, and Jablochkoff together.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.
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THE EDISON SYSTEM OF ELECTRIC LIGHTING.

A certain quantity of electricity passing through a good conductor produces no physical effect on the conductor; but a constriction in the conductor or an interposition of a material that is not so good a conductor causes an effect analogous to that of a large quantity of water violently forced through a small pipe—an crowding of the particles, causing friction and consequent heat. Upon this simple principle all electric lights operate. In both the arc and incandescent lamps there is a resistance present at the point of illumination, and heating occurs.

It is our purpose in what follows to briefly describe the recently inaugurated Edison system of electric lighting as now in operation in this city.

The Edison Electric Light Company was organized in October, 1878, with a capital of $300,000; this has been increased on two occasions until it is now $720,000. The company owns the patents of Thomas A. Edison, and under them its operations are carried on. Although the lamps and dynamos of Mr. Edison have been extensively used both in this and foreign countries, nothing was tried in the way of general illumination from a central station until the dynamos were started in this city on the 4th inst. This district embraces the area bounded by Wall, Nassau and Spruce streets and the East River; the dynamos are located at Nos. 255 and 257 Pearl street. During the early part of the present week we visited the general offices of the company at 67 Fifth avenue, the central station, and also many of the users of the new light.

THE STATION.

The boiler room is located in the basement of the building. There are now in place four Babcock & Wilcox boilers and four others are being prepared, which will give an aggregate horse-power of 2,000, working under a pressure of 120 pounds. The four boilers are arranged in pairs facing each other and at a sufficient distance apart to permit the fireman to attend the furnaces. The coal is received in bins placed under the sidewalk, and is then shoveled into a trough in which works a screw, and which leads over the first set to the space between the boilers. The ashes are thrown into a receptacle under the flooring and conveyed out by the same plan. A Sturtevant blower furnishes the blast needed by the boilers, fresh air for ventilation and for the dynamos, as will be mentioned later. Two smoke stacks, one for each set of boilers, extend up through the centre of the building to the roof.

The first and second floors of the building were removed and an iron superstructure erected entirely independent of the walls of the building, and resting on separate foundations. On this the dynamos are placed. We could not obtain a satisfactory explanation to our query as to why the heavy machinery in rapid motion was elevated and the dead load placed on a solid foundation in the basement.

THE DYNAMOS.

There are six dynamos now in position (this number will be doubled as soon as the equipment is completed), the armature of each being driven by a Porter-Allen engine having a cylinder diameter of 11 ¼ in. and a stroke of 10 in. These are directly connected and are expected to make 300 revolutions per minute.

The armature is of the Siemens pattern: its foundation, or core, which is built upon the shaft, consists of a series of sheet iron discs, separated from each other by layers of thin paper and bolted firmly together. This method of constructing the armature, while it has all the advantages of solid iron, prevents the great loss of power which is produced or local currents, which would be present if it was one piece. The face of the armature is made up of heavy copper bars, having a trapezoidal cross-section, their dimensions being ⅝ by ⅞ of an inch. To insure a perfect insulation, each bar is wrapped in Japanned paper and separated from the iron core beneath it and from its neighbors, by an air space.

There are the same number of copper discs as there are bars, one half being at each end of the core. Each disc has two projecting lugs, one on each side, these lugs being placed nearly but not quite diametrically opposite to each other. The discs are bolted together so as to form, with the iron discs constituting the core, one solid mass. Each end of every bar is connected to one of the lugs.

Air from the blast enters horizontally opposite the center of the armature, and, as the space above mentioned permits of a free circulation through the parts, all liability of the accumulation of heat is prevented and the capacity of the machine greatly increased. In order to resist the centrifugal force developed by the high rate of speed, the bars on the armature are wound with piano wire at certain places.

The commutator in these dynamos consists of 40 bars of copper placed longitudinally on the shaft and separated from each other by an insulating material and connected with the armature bars. So, each bar on the commutator forms the terminus of a continuous loop or convolution through the copper ribbons on the armature.

The brushes are composed of certain layers of fine copper wire and plates soldered together.

The armature is 27.8 inches in diameter and 21 inches in length; the armature shaft is of steel, 2½ inches in diameter and 10 feet 8 inches long; the commutator is 12¾ inches in diameter and 18 inches long; the journals are 6¼ inches in diameter, 10 inches long, and have bibbitted steel rings in pillow blocks of the box pattern. In order to prevent undue heating by friction, constant lubrication is provided for and there is a continuous current of water flowing beneath the boxes.

The magnet is composed of two large pole pieces of cast iron, having semi-cylindrical faces, between which the armature revolves. These poles are 49 inches wide and 61½ inches high. To these poles are attached twelve cylindrical cores of soft iron, wound with coarse copper insulated wire, through which the electric current passes. Four of these cores are attached to the lower pole piece and eight to the upper. The twelve cores are 37 inches long, the eight upper ones having a diameter of 8 inches and the four lower ones 9 inches. There are four soft iron keepers, 11 by 9 inches securely bolted together and attached to the cores.

The current from one of the mains of the commutator passes through the wire wound upon the nearest middle core, thence to the one directly above; then to the one beneath; from here it takes the same course through the other three vertical cores in succession. Before entering the other main the current circulates through a resistance which increases or diminishes the magnetic attraction as may be needed by the demands.

A safety catch is placed on each dynamo. This consists of a break in the conducting wire which is filled with a piece of metal having a low fusion point. Should any undue heating occur, this metal is fused, and a break thereby caused in the circuit, and the main and lamps saved from any possible injury.

Each of the six dynamos weighs as follows:

	Lbs.
Armature and shaft	1,500
Two pillow blocks	1,440
Magnet, complete	33,000
Pole pieces	980
Total	44,810

The copper used in construction is distributed as follows:

	Lbs.
Armature bars	1,200
Armature discs	1,200
Magnet wire	1,500
Total	3,400

The magnet rests upon insulating bases of cast zinc 3 in. thick. The dynamo and engine are mounted on a base plate of cast iron, made in two parts for convenience, and bolted together.

This bed plate is 14 ft. long, 8 ft. and 9 in. wide, and weighs 10,300 pounds. The entire weight of the steam dynamo is as follows:

	Lbs.
Dynamo	44,810
Engine	24,450
Base plate	10,300
Total	80,570

After leaving the dynamo the current passes through a circuit-breaker, which consists of two sets of copper plates, the upper set being so arranged that it can be raised from the lower or depressed, so that the plates will overlap and insure a perfect contact.

The electric current from all the dynamos is led into a common main, from which branch the various feeders leading into the street and supplying the district.

A test line leads from the dynamos to a room upstairs, upon one wall of which are grouped one thousand lamps, so arranged that any number of them can be placed in the circuit. The current from any one of the dynamos can be sent through the test line to the lamps and its power thereby ascertained, and its real working condition or capacity obtained.

Each of the dynamos has the nominal power of a 1,200-light machine at 16 candle-power incandescence. This can be readily increased to 1,400 lights of the same power without heating the armature or in any way heating or burning the brushes or commutator. This result is accomplished most economically, and is due to improvements in the lamp itself.

The mains, which may be said to collect the current from the several dynamos, lead along one wall of the room to the front where the connections are made with the feeders. At this point a piece of low fusion metal is inserted in each of the lines of the feeders in the same manner and for the same purpose as already described.

In the room above is an indicator for keeping the electro-motive force within certain defined limits. The current passes through an electro magnet, before the face of which is an arm held back and away by a spring. The power of the magnet depends upon the electro-motive force passing through the coil. A too powerful or too weak current is shown by the lighting of a red or a blue incandescent lamp. Watching these lamps, the attendant, constantly at hand, throws in or removes resistance coils as the case may require.

THE DISTRIBUTING SYSTEM.

The word "distributing" may be aptly applied to the method of placing the electric current at the disposal of the patrons. An iron pipe is laid underground through the streets, and protects two heavy semi-cylindrical bars of copper, which are perfectly insulated both from each other and from contact with any outside object. At the station each of these bars is connected with the mains from the machines as already described. These bars enter an iron box at every place where it is desired to "tap" the current, and wires are attached leading into the house. Low fusion metal is here again inserted. The box is then filled with an insulating compound and the caps securely bolted in place.

METERS.

Each consumer is furnished with a meter consisting of a bottle containing sulphate of zinc, in which is immersed two bars of zinc, kept at a constant distance apart. An infinitesimal portion of the current passes through the meter, causing a decomposition which increases one of the zinc bars and decreases the other. At stated times these bars are taken to the station, and the difference ascertained. As a certain quantity of electricity will produce an invariable effect—in this case decomposition—the quantity which passed through the meter can be readily computed, and as this bears a known ratio to the current entering the premises, that can also be found. One most decided advantage in this arrangement is that the consumer pays only for what he uses. "An inferior 'quality' of the illuminant will never affect the reading of his meter."

THE LAMPS.

The lamp consists of an exhausted bulb of glass, pear shaped, and containing a loop of carbon made from bamboo, and of a thickness a little larger than a horse hair. The ends of the loop terminate in two platinum wires passing through the ceiling, and so situated that when the lamp is placed in its socket these wires will form contact with those leading from the street and carrying the current. By turning a key the current can be shunted from the lamp. An accident to one lamp has no effect upon any other in the same circuit. Each lamp is provided with a portion of the low point fusion metal so often alluded to.

FIRE PRECAUTIONS.

It is one of the laws governing the action of dynamic electricity that an absolutely complete circuit must be established before we can obtain at any current and upon the occurrence of this circuit in any point all effect instantly ceases. As stated in the beginning of this article, heat will be developed where there is any undue resistance. Owing to these reasons Mr. Edison has adopted the most effectual means for breaking the circuit and destroying the current before any dangerous amount of heat could be developed. A metal with a low fusion point, or one which will open the circuit at a low temperature, has been placed between the several points of the conductors at every point where the guardian powers were deemed desirable. In case of the destruction of this metal at any place it can be easily and quickly renewed after

ence cause has been ascertained. No danger is possible from the lamps themselves, as the fracture of the globe destroys the light instantly.

Interior illumination by incandescent lamps may be considered one of the institutions of this city, and judging from the favor with which it has been received, its growth is only a question of time—a short time at that. The economy, safety and brilliancy of the light commend it for almost any purpose, and its absolute freedom from noxious vapors will endear it to all lovers of pure air.

[NOVEMBER 11, 1882

THE ENGINEERING AND MINING JOURNAL

The Electric Light in Cotton Mills.—A series of very interesting figures on the cost of electric lighting in cotton mills in New England, as collected by Mr. G. J. H. Woodbury, the agent of the Manufacturers' Mutual Fire Insurance Company. It is difficult to make a comparison between the various methods of illumination, because a change of light in always made an excuse for more light. Most mills are lighted with gas made by the destructive distillation of petroleum and of about 80 candle-power, which is generally reduced to 60 candle-power by using air mixed with it. The annual cost of 40-gas per burner is from 75 cents to $1; in all these estimates, interest at six per cent forms one item, and in the large corporation, with exceptional privileges, makes the coal-gas at an annual cost of 69 cents per burner. Another corporation, however, makes gas at a cost of $1.19 per burner. Of two large mills in the same manufacturing similar goods, the more modern one consumes gas at an annual cost of 70 cents per burner, while the older one consumes coal-gas at $2.05 per burner. The longer time the light is required, the lower the cost, the average cost, because, with the addition of operating expenses, the interest on plant, being a fixed amount, becomes a smaller proportion of the whole cost. A dark mill, that is, one of which the interior walls are not whitened, requires about twice the number of lights that are sufficient in a white mill, and the light, almost one hundred hours a year more, 600 hours per year is the average. The cost of arc lights in several steam mills running 3,000 hours per year is 6½ cents per hour, of which 1¼ cents are for carbons, 2½ cents for attendance, coal, depreciation, and interest. In a weaving room, on very fine work, arc lights have been used, the arc-foot gas burners, which consume 2.62 c.h. This foot per hour; therefore, are light represents the consumption of 17272 c.h. feet of gas per hour. A careful estimate shows these arc lights to be costing 6¼ cents an hour; therefore this new lighting system represents gas at 39 cents per 1000. A similar installation in another mill gives the annual cost of gas $2188, and electric light at $1135, or 52 cents per 1000. The annual saving in fuel will in lighting expenses by the use of electricity makes a profit of from 10 to 20 per cent on $17,716, without making mention of any improvement in work or production due to that light. In the case of incandescent lights, the cost is more difficult to estimate, because they are run at all degrees of brilliancy, affecting both the power and the life of the lamp. Both the Edison and Maxim lamps are guaranteed to average 600 hours; yet in the New York Post-Office, the average record is 1,200 hours; 14 lamps started to be 1800 hours on September 1st, and 13 lamps had already burned 3400 hours. The ferry-boat Jersey City, belonging to the Pennsylvania Railroad, is lighted by the Edison lights, and their record has been given to me as averaging 1645 hours, and the lamps are burning. In the Merrick Thread Company's mill at Holyoke, the monthly cost of lighting by gas furnished by the city was $228. By substituting Edison incandescent lights, the cost was brought down to $53.62 per month. The Holyoke Water-Power Company furnishes water-power very cheaply; and as a result of the use of the Edison lights was to bring the cost of lighting a mill to the equivalent of gas at 67 cents per 1000 feet. Charles W. Lippitt, of Woonsocket, R. I., said that the Globe Mills had been supplied with the electric lighting system, which was much preferred to gas. For the seasons of 1881 and 1882, the company had used 177 large lights, running them for 807 hours, at an actual cost of $237.83. Those took the place of 220 gas burners, which, burning four feet of gas per hour for 807 hours, cost $710.40. The saving in favor of electric lights was $425.77, or an actual saving of 57 per cent. In another mill, oil-gas is used, and although it can be supplied at a lower cost, its results are not so good as coal gas. The cost of running 220 burners of oil-gas for 307 hours is $478.11, which still leaves a margin of $145.38, or 31 per cent in favor of the electric lights. Col. Thomas Livermore, of the Amoskeag Mills, said that they had 5000 lamps lighted with 465 electric lights, which had during the last eight months consumed 91,000 carbons. The average cost of each lamp per hour is 2·80 cents. He had found that one arc lamp could take the place of twelve gas burners, supplying 12 lamps with light. His mills manufactured colored goods, and a stronger light was found necessary to distinguish the colors. They had supplied fifteen sewing and spooling rooms with the lights.

N.Y. Scientific Times & Mercantile Review

THE KEITH ELECTRIC COMPANY.

Now Introducing the Keith System of Electric Lighting—The Advantages Thereof.

There has been more rapid progress made with the electric light within the last three years than with probably any other invention that was ever brought out in any part of the world. What scientific men, here and in Europe, not long ago declared to be impossibilities are now accomplished facts, and electricity looms up as the great and wonder-working force of the age.

Among the newer candidates to public favor in this direction is the

KEITH ELECTRIC COMPANY,

who have just opened an office at 201 Broadway and 52 Nassau street, this city. They are manufacturers of electric machines, lamps and other apparatus for electric lighting and power. The company are operating under the patents taken out at different times by Prof. D. E. Keith, one of the ablest of the many scientists who have given their attention to the study of the capabilities of electricity. A reporter for the Scientific Times called at the above address yesterday and interviewed Prof. Keith, who exhibited the light invented by him in practical operation. It is whiter, stronger and steadier than any other electric light yet seen in New York, and the company will undoubtedly prove to be a powerful competitor to those already in operation. They are ready to give estimates for lighting streets, public and private buildings, steamships, wharves, etc. Prof. Keith has invented a system for the storage of electricity, a full description of which the Times hopes to be able to give in a later issue.

It will be in order to refer here briefly to the electrolytic process for refining and separating the gold-containing base bullion—a process that is rightly looked upon as one of the great discoveries of the age. Even the "Wizard of Menlo Park," Thomas A. Edison, declares that it will be a commercial success, and there is no doubt entirely such matters that he.

Base bullion is a product of the mines of Nevada, Colorado, California, Utah, Arizona, New Mexico, and various other States and Territories. The yearly production of base bullion now exceeds 100,000 tons, and is rapidly increasing with the discovery and development of new mines. It is the product of nearly every silver reduction by smelting furnaces, and otherwise, the rock and other worthless matter having been removed, leaving only the metals, to wit: Gold, silver, lead, copper, antimony, and other metallic substances as originally in the rock. About 90 per cent., upon the average, of the base bullion is lead.

The problem is to extract the lead from the base bullion, with the lowest possible expense. Before the bullion can become bullion, it has to pass through a refining process for the elimination of the antimony, copper, and other metals, which are more or less injurious to the quality of the bullion. The refining process is a very simple one, and is carried on in reverberatory furnaces, which are heated by the combustion of coal. The bullion is placed in the furnace, and the heat is applied until the bullion is melted. The antimony, copper, and other metals, which are more or less injurious to the quality of the bullion, are then skimmed off, leaving the bullion in a pure state. The bullion is then cast into bars, and is ready for the market.

LIGHTING A GREAT CITY BY ELECTRICITY.

Doctor Siemens, in his usual practical and lucid style, has given some figures on the cost of lighting the planet proposed for the lighting of such a city as London by building main stations and establishing electric mains in the shape of copper rods of good thickness, with branches wire-drawings in all directions. Doctor Siemens is averse to such a plan, and by way of illustration, takes the parish of St. James's, London, which has a population of 29,865, contains 3018 inhabited houses, and has an area of 781,000 square yards. Assuming that the task of domestic lighting resembles to the gas companies, and that the electric light is introduced into private houses only at the rate of 12 incandescent lights per house, the parish of St. James's would have to be provided with electric energy sufficient to work 36,180 lights, or 362 horse-power effective. The cost of building a large underground chamber, to contain the machinery, the cost of boilers, engines, and dynamo-machines necessary would be £140,000. The quantity of copper for conductors in the entire system would be nearly 185 tons, and would cost £15,125. The iron pipes would require £37,500 additional, which would carry the total to £177,000 for providing for one quarter of the consumption in lighting the parish of St. James's alone. Dr. Siemens goes on to say: The large aggregate of dwellings comprising the metropolis of London covers about 70 square miles, 30 of which may be taken to consist of parks, squares, and sparsely inhabited areas, which are not to be considered for our present purpose. The remaining 40 square miles could be divided into, say, 110 districts, slightly exceeding a quarter of a square mile on the average, but containing each fully 3000 houses and a population similar to that of St. James's. Assuming 20 of these districts to rank with the parish of St. James's (after deducting the 600 shops which I did not include in my estimate as central districts), 50 to be residential districts, and 40 to be comparatively poor neighborhoods, and estimating the illuminating power required for these three classes in the proportion of 1 to 1½ to 2, we shall find that the total capital expenditure for supplying the metropolis with electric energy in the ratio of 28 per cent of the total lighting requirements would be say £14,000,000, without including underground and internal fittings. To extend the same system over the rest of Great Britain and Ireland would absorb a capital exceeding certainly £100,000,000, while a total capital expenditure of £250,000,000 would be required to work the United Kingdom. Some of us may live to see these figures realized, but the end would be attained, I feel sure, only in more tentative and by the more interesting appliances to produce work representing this value of machinery and power, and economized by the breath of many years of practical experience.

The amount of the working charges of an establishment comprising the parish of St. James's would depend on the number of working hours in the day and on the prices of fuel per ton. Assuming the 81,000 lights to increase for the hours a day, the price of coal to be 20s. a ton, and the consumption 2 pounds per effective horse-power per hour, the annual charges under this head, taking eight hours' being enough assumed to about £19,800, to which would have to be added for wages, repairs, and sundries, about £9000; for interest with depreciation at 7½ per cent, £13,500; and for general management say £3000; making a total annual charge of £11,000, or at the rate of 12s. 2½d. per incandescent lamp per annum. To this has to be added the cost of renewal of lamps, which may be taken at 5s. per lamp of 16 candles, lasting 1200 hours, or 4s. 6d. per annum, making a total of 20s. 2½d. per lamp for a year. In comparing the results with the cost of gas-lighting, we shall find that if taken 5 cubic feet of gas, in a good argand burner, to produce the same luminous effect as that obtained from a 16-candle incandescent lamp, consuming a burner every day, for six hours on the average, we obtain an annual gas consumption of 10,950 cubic feet, the value of which, taken at the rate of 2s. 8d. per thousand, represents an annual charge of 29s., showing that electric light by incandescence, burning 1200 hours, or 6 hours per annum, making a total of 20s. 2½d. per lamp for a year. In comparing the results with the cost of gas-lighting, we shall find that if taken 5 cubic feet of gas, in a good argand burner, to produce the same luminous effect as that obtained from a 16-candle incandescent lamp, consuming a burner every day, for six hours on the average, we obtain an annual gas consumption of 10,950 cubic feet, the value of which, taken at the rate of 2s. 8d. per thousand, represents an annual charge of 29s., showing that electric light by incandescence, burning 1200 hours, or 6 hours per annum, makes

"ELECTRIC LIGHT."

THE JOURNAL OF ELECTRIC LIGHTING,

AND RECORD OF INVENTIONS, IMPROVEMENTS, AND CURRENT EVENTS IN CONNECTION WITH THIS BRANCH OF SCIENTIFIC INDUSTRY.

No. 1. Vol. I. MAY, 1882. [Price 6D.

INTRODUCTORY.

The general adoption of electricity as a lighting agent, not only for public but for private purposes is daily drawing nearer. The streets; various institutions; places of amusement; the establishments of the wealthy; many of these are already lighted by this agent—or, to speak more correctly, by the new methods of developing and utilising its powers. The list of users of Electric Lighting, too, is daily increasing, thanks to the sustained efforts of scientific men and practical mechanicians, and to the inventions and improvements which have been introduced by this means. In a very few years it may be said that we are within a reasonable distance" of the time when Electric Lighting for all purposes, and under all conditions, will be the rule, and the use of all other artificial lights the exception.

In these circumstances it has been felt that the time has arrived when a journal, dealing with the subject of Electric Lighting, may be usefully and profitably established. It will be the object of this journal to supply users of Electric Light—both *in use* and *in posse*—with the latest intelligence in that special branch of scientific industry, and, as far as possible, to give some account of each improvement in Electric Lighting as it may be introduced; to chronicle the progress which the light is making, both in public and in private; and generally to afford a means of obtaining the latest and most varied information on the subject. In addition to this, papers having for their subject-matter the lives and labours of electricians of eminence will be published. Descriptions of the various existing systems will also be given, and all passing events having any connection with Electric Lighting will be duly recorded; correspondence will be invited, and, in short, every effort will be made to make "Electric Light", truly The Journal of Electric Lighting, and a useful and agreeable organ for the large and rapidly increasing number of persons who are directly or indirectly, interested in the subject.

We desire to have one or two points clearly understood. This Journal will not be, in any sense, the advocate of any particular system. Each, with its most recent developments and improvements, will be described and criticised from time to time without fear or favour. We desire, also, to assure our readers that descriptive notices of any system, or of any machinery or appliances connected therewith will not be—to use plain terms—given in exchange for advertisements. Finally, although in dealing with scientific matters, the use of technical terms is hardly avoidable, it will be our object to avoid them as far as possible; to turn, wherever practicable, the language of science into the language which shall be "understanded of the people."

With this brief explanation of its object and character, we commit our venture to the kindly consideration of the public, in the hope that it may deserve and obtain their support and goodwill.

TO ADVERTISERS.

Whether this journal stone can, of course, only time can tell. To advertisers are, however, invited to note two points. Each month we shall publish the certificate of a public accountant, who will testify to the number of copies which have actually been circulated—not merely to the number of copies which have been printed. And—as we have hinted above—it is not our intention to give laudatory notices of the productions of those who advertise with us, and to ignore or to decry the productions of those who do not. We hope, of course, to have advertisements, and plenty of them; but we hope to obtain them without the aid of wild and exaggerated statements as to our circulation, and without the aid of "notices." In a word, while we desire that our journal may prove a legitimate and successful undertaking—surely a legitimate ambition—we aim at effecting this object by making it a means of conveying valuable or interesting information, and not a mere trap for catching advertisements.

THE GOVERNMENT BILL.

The provisions of the Government Electric Lighting Bill are before the public, and it must be admitted that in their general principles they are good. In detail it is possible that modifications may be necessary, but the strong committee to which the Bill has been referred, together with the criticism which will be received in both Houses before it becomes law, will doubtless suffice for this. It should never be forgotten that the real owners of the electric light are the public, and consequently that the interest of the public should be paramount consumers or users of the light, should be paramount consideration. To say that nothing over every other consideration. To say that nothing in the shape of a monopoly should be allowed to be created, is of course, only to say the same thing in different words, for monopolies, and the public interest are, and will ever remain, in direct opposition. It is satisfactory to note that the framers of the Government Bill seem to have recognised this, and to have not the least intention of repeating the folly of granting perpetual monopolies to any person or persons. Details upon the Companies in these columns that they would be wise in their own interest to take steps

THE "OPERATOR" AND "ELECTRICAL WORLD."

The Edison Installation at Haverly's Theatre, Chicago.

For some months past the Western Edison Electric Light Company has been engaged in installing the Edison light in Haverly's Theatre, Chicago, on an extensive scale, and on April 9 the first exhibition was given under the direction of the engineer of the company, Mr. F. D. Johnston. Gen. Anson Stager, president of the company, being among those present. There are in the theatre 637 lights in all, operated by three dynamos—one for the vestibule and entrances, one for the stage, and one for the auditorium. There is not a gas light in the house now, every jet having been replaced by the Edison globes. There are forty movable bunch lights for use on the stage and forty footlight lights. Then there are five sets of border lights above the stage, two of which contain thirty-five lights each, and the other three twenty-five lights each. The chandelier in the centre of the auditorium, which was manufactured at a cost of $500, bears seventy-four burners, and there are 160 others distributed through the auditorium. In the vestibules and entrances there are fifty-three lights, and the dressing-rooms and stage are also lighted.

Below the sidewalk in front is the new engine, built expressly for the plant, with 200 revolutions per minute. Connected with it are lamps which denote the candle-power used throughout the house. In the first right stage entrance are twelve switches and six resistances for the regulation of the lights. By means of these the lights in any part of the house can be lowered, raised, or entirely extinguished. In the dressing-rooms the lights are independent and can be turned on and cut the same as gas. Each burner is warranted for 600 hours, and will last three or four months in a theatre under ordinary use. Of course the light does away with all danger from fire.

The light given is a soft and mellow one, resembling daylight. One of the actors, who has sung in the Savoy Theatre, London, where the electric light is used, was asked if it spoiled the appearance of the "make-up," and said the same lights were in the dressing-rooms, and if an actor "made up" by the light he would look all right on the stage. The expense of putting in this light has been $15,000 to Manager Haverly, but he was determined to do away with gas, and he has done so. There is no doubt but that the light will be a great success, and every one is enthusiastic over it.

American Gas Light Journal
Oct 16 1882

ELECTRIC LIGHTING TEST FIZZLE.—And now comes the intelligence that another proposed test of the electric lighting apparatus of prominent companies has fizzled out. Our readers will remember that a test was proposed of the apparatus of the companies exhibiting at the Chicago Railway Exposition, which should have the value of the highest expert examination, and upon their award the medals should be given. A jury composed of Prof. Henry Morton, of Stevens Institute of Technology, Hoboken, N. J., Prof. B. F. Thomas, of the University of Missouri, Prof. Charles R. Cross, of the Massachusetts Institute of Technology, Boston, Mass., E. P. Lyon, Editor of the *American Machinist*, and Prof. James Dunton of Stevens Institute, was appointed to make such tests.

The companies signing an agreement to enter were the United States, the Thomson-Houston, the Fuller, and the Western Edison. The latter made its signing conditional upon the approval of the parent company, and this approval was not given for the reason, as the Edison Company states, that sufficient tests have already been made. The Brush Company refused to enter at the outset, and the Thomson-Houston Company states that they are too busy to go to the trouble and expense of such a test, and do not wish to spare Prof. Thomson for the purpose. We have not learned the reason of the Fuller Company.

Electrical World
Apr 21 1883

The seventeenth building of the Edison Electric Light Company is an interesting and complete exhibit of the surprising growth of the electric light in the short distance in the public favor all over the world of the Edison light in particular. The arrangement of the plants in this country are given in detail, including a description of plants for village lighting and in a good many newspaper offices. It is stated that in the first district of this city the company is lighting 306 houses, viz: for 247 lamps; it is also interesting to learn that the building of the Western Union Telegraph Company, Dey street, Broadway, is to be lighted from the Pearl street station by a special conductor running down John street, and connected with the net-work of conductors in the first district, at Nassau street. The building is being wired for 845 lamps, but for the present only about 285 will be used, distributed somewhat as follows: Associated Press room, 6; operating room 107; second floor 55; halls, 6; first floor, No. 3 Dey street, 15, and second floor, 30; third floor, 30; total 285 lamps. In England the Edison plants installed or in process of installation by the London company number 4,661, and by the Manchester company 5,000—a total of 9,448 plants. The company is also lighting the Holborn Viaduct, the first instance in that city of a public thoroughfare being lighted by incandescent electric lights. On the continent of Europe the machine works of M. Lobaziez, at Nantell, Spain, are now lighting 1,000 lights are now being made to light the depot and Post-Office at Stuttgart, Germany; while at Avignon, France, the Edison Company is just establishing a central station. At Ivry-sur-Seine the Edison factory is employing 200 workmen, and the portion of the factory which is devoted to the manufacture of lamps is turning out 400 lamps a day, to say nothing of dynamos and other apparatus. During the recent court ball at Vienna the imperial palace was also illuminated by the Edison light. In Cuba the office of the *Diario de la Marina* (newspaper), in Havana, is lighted by the Edison system, as are also several sugar estates on that island, while in South America several mills and private houses are lighted from the central station at Santiago, Chili. There is also an interesting account of the engine "Lawrence," which in March last performed the unprecedented feat of running at a speed of 350 revolutions per minute for 17 days without stopping—a number of revolutions which is a tremendous one, and would have been equal to a journey around the world. The last paragraph in the pamphlet serves to show to what perfection electric lighting apparatus has been brought, while the entire bulletin demonstrates the popularity of the Edison incandescent light.

Electrical World
Apr 21 1883

Amalgamation of the Swan and Edison Companies.—The Swan United Electric Light Company have issued a circular intimating that an agreement has been arranged to be entered into between the Edison Electric Light Company for the sale to and to be made with the Edison Electric Light Company for the transfer of the Edison Company, of certain of the business, goodwill, patents, rights, privileges, and other property of the Swan United Electric Light Company, &c.

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Electric Lighting.—XXIII.

ARC LAMPS.

The problem of "feeding the carbons" in the production of the voltaic arc is one which has received even more study than that of generating electricity by means of dynamo-electric machines. From the year 1844, when M. Foucault brought out his erratic hand-regulator, to the present day, that field has fairly teemed with invention, as can be judged from the records of the patents granted in various countries for arc lamps. It is within the few years which have just elapsed, however, that the types and modifications of arc lamps have multiplied most wonderfully. Some inventors have also ventured to experiment on a dozen different kinds of arc lamps in this brief period, and in the multiplicity of kinds which prevails, all attempts to classify are lamps according to distinctive features that must necessarily be involved in confusion. These few years also mark the dawn of the industrial era of the dynamo-electric machine as well, and while the growth of invention or discovery, has similarly repeated itself in more than one instance. Not to go further, we can allude to the principle of automatic regulation of the length of the arc by the action of a shunt, or derived circuit, from the arc circuit itself, an improvement of much importance, as utility that we may consider the success of the arc light in industrial applications, to date from its introduction in the arc lamp. Several claimants came forward as the originators of this idea, and not less than three appear to have really conceived it and worked it independently, or at least about the same time, when all of a sudden a fourth among many others came forward as the discovery of claimants, who anticipated those by nearly a quarter of a century. Invention, construction or the adaptation of mechanical devices, these artificial lamps of ours, and sometimes the ingenious have been found in some of the most unexpected places, while the unexpected has also come to attract much attention, and which have long since passed into oblivion. There, may be found the germ of many a valuable idea which has perhaps again become current in the public mind, by the efforts of some later inventor, who conceived it anew, apparently without the slightest knowledge of its antecedent, for it is only within a couple of years that the history of the art has been accurately traced. . . . Many of these old ideas possessed more or less value, and show a large amount of inventive skill; they may look to us from our present perfection, and doubtless more than one of these pioneer electrical inventors would have received fame and fortune had he lived in the present era of electric lighting, and would have benefited from the present knowledge of the science.

As it was, in the main, the clock-work escapement, or governor or eccentric, the electric light was attended to with more attention by any other scheme than that of curiosity, for it was scarcely more than a curiosity of mechanism, and for lack of any arrangement one after the other of these ideas, many of which might have led to invention, the inventors were passed by and neglected, until they had become entirely forgotten. Some were to have been more particularly the case in England, where the electric light generally was attended to with more attention, strangely enough the number of inventions relating to the practical application of electricity to lighting, at the same time. In France the attention received more attention from physicists and chemists, and some of the types of regulators which were then devised received at least the benefit of a trial, and some few of them improvements were carried out—although a superior degree of perfection had been attained. Three lamps have been thus identified with the early days of the electric light, viz., Foucault's, Serrin's, and Dubosco's and, if we look at the question from its practical side, they are in fact about all that deserve mention in detail, for it is only since the advent of the Gramme machine, and of its various modifications, that the arc lamp can be said to have really entered on its career of development. All of the lamps which have come into use, the world over, have been produced since this period, and, in fact, within a few late years.

But, although these three lamps were about the only ones that received the sanction of practical use, it may be interesting to glean some brief reference to a few of the more original inventions. It would be superfluous to attempt to refer to all of these earlier ideas, since many of them do not possess much value, and, besides, the principles involved in the regulation of the arc can be well enough understood from the consideration of a few of the representing the space for the many modern types, which we will have occasion to refer to, as we take up each particular system in turn.

The first regulating mechanism appears to have been produced by one Thomas Wright, in England, in 1845. The device consisted in a series of discs touching each other at their circumference, and which were separated from mutual contact after the current had been established, the discs being rotated by clockwork. As a part of the discs formed one pole and the remainder formed the other pole, a small arc was established at the edge of the discs.

It need scarcely be said that the device is infinitely practical, and for reasons quite obvious. Even if the impossibility of keeping the discs from wearing unevenly could be removed, the shadows cast by the discs themselves would interpose too much light.

In 1847 Mr. W. E. Staite produced an arc lamp in which a clockwork mechanism acted on a thread around the circumference of the carbons. This lamp, although ingenious and ingenious, was not as practical as a single thread to the right distance for instance, had it been composed of too many turns of wire, it would have been difficult to pull the carbons far enough apart to break the arc before the weakening of the current in the general circuit, in consequence of the lengthening of the arc, would have caused the . . . attractive . . . sufficiently . . . to make a balance between it and the weight, while, . . . a two . . . weak solenoid, on the contrary, the action might have been insufficient to cause the separation

Brush Electric Light Companies" Convention.

As announced in the March 17 issue of THE OPERATOR AND ELECTRICAL WORLD, an important meeting of representatives of the various Brush electric light companies in different parts of the country was held at Cincinnati on the 10th instant, pursuant to a circular issued a few weeks ago. In this circular, which was issued by the S. W. Brush Electric Light and Power Co. of New Orleans, it was stated that the Brush sub-companies having given or contracted to give nearly one-half of their capital stock to the home company, for the privilege of using the inventions of Mr. Brush, find that although possibly the purchase of franchise may some time in the future prove a profitable investment, they cannot safely assume the burden by complying with the demands of the Brush Company, which expected the sub-companies to pay a large cash bonus for the right to use the Swan lamp. We have no guarantee, the circular goes on, "that the Swan lamp will always be the most desirable offered for sale. Another year may reveal a lamp every way as satisfactory as the Swan, the manufacturers of which will be satisfied to sell at a profit of 100 or 150 per cent., without asking the customer, in addition, the enormous royalty for the privilege of having. In the preface to the recent work on electric illumination, by James Dredge, he remarks:

"That some of the companies have a useful and profitable career before them is not open to question, but it is vitiful whether few, perhaps if any, of the patents thus are worth the money demanded and paid for them. In me cases because the invention has but small intrinsic erience, in others because its originality, and therefore validity of the patents protecting it, is open to question. All or nearly all cases, because with the rapid arch of invention in this direction, toward which so many ple minds are turned, progress is so constant and so uick, that whatever appears almost boundless in its ingeiosity and utility to-day, is rendered obsolete by an vention of greater ingenuity and wider usefulness to-morrow."

If we purchase a franchise, and have no protection gainst infringements, many soon come to have any value. Knowing these facts, several lighting companies ave refused to consider the proposition of the Swan Company, and have so notified them. The Swan Company ave made a large number of such a lamp. If Brush companies act in concert, the Swan Company must make ome concession as to a basis of fair profits on lamps, ome other payment for privilege of buying the same, r the Swan Company will not make fair terms with us. Brush companies act for you, to meet with us in the ity of Cincinnati, April 10, 1880, for the purpose of ecuring an understanding on terms to pursue, and so secure a oncert of action in this matter of common interest."

The following were among the delegates present, Brush companies being represented: Alexander Seitz and R. P. Orion, secretary, East Saginaw, Mich.; D. Howard Tuttle and David E. Evans, Baltimore, Md.; W. J. Port, Toledo; E. M. Avery, Cleveland; George O'Connor, New Orleans; C. M. Bullock, Chicago; S. E. Shelleville; J. L. Bayuer, Louisville; C. W. Hoskit, Memphis; S. A. Duncan and John E. Baldell, Pittsburgh; Superintendent Wolleslager, Cincinnati, O.; Samuel Hipp, Galveston, Texas.

The proceedings were not made public, but we learn that Mr. T. J. Montgomery, of New York, was present to represent the Swan Company, and seemed disposed, if possible, to arrange the matter to the satisfaction to the sub-companies. Other incandescent lamps were discussed, and the claim of the Maxim and Edison companies that any incandescent lamp other than their own infringes their patents, were also briefly considered and voted not worth considering. The common report that the parent company held or was seeking the control of the Swan light was not discussed, as it has been shown that its holdings of Swan stock were trifling as compared with its interest in the success of the Brush companies, forty-eight per cent. of whose stock it holds and to whom it expects, besides, to sell large numbers of storage batteries, which it manufactures.

The upshot of the discussion was that an agreement perfectly satisfactory to all parties—as was evident by the smiling countenances of all concerned on adjournment at midnight—was arrived at. The Swan light was adopted on terms which are not to be made public, and a permanent organization of the Brush Lighting companies was effected with the following officers:

President—M. C. Bullock, of Chicago.

First Vice-President—S. E. Bell, of Nashville.

Second Vice-President—F. P. Baker, of Topeka.

Secretary—J. P. Baldell, of Pittsburgh.

Treasurer—Lewis Sessongood, Cincinnati.

An executive committee of five, consisting of the first four officers named and Mr. Geo. O'Connor, of New Orleans, was also elected.

Mr. G. W. Stockley, vice-president of the parent company, at Cleveland, and holder of one-fifth of its stock, was present, and assisted at what seems to have been a happy settlement of affairs. The adjournment was to meet at the call of the executive committee.

Gen. Dan Sickles'old ally Edison Systems.—On the evening of April 16th, ex-President Diaz, of Mexico, with his wife and the members of his suite, were initiated to a limited extent into the mysteries of Edison's system of electric lighting. The party was conducted on its tour of observation by Thomas A. Edison and his assistant, Mr. F. Hastings, Secretary of the company, and Col. Sherman, who represents the company in South America. The first place visited was the house of Edison, No. 32, in John street, which is fitted with the Edison light. The house is one of the best residences in the city, and the record of its company is shown by a handsome library presented to the members by Goodwin & Co., for delivery shown in entering a building stored with powder and other explosives, at No. 208 Front street, July 18, 1860, and extinguishing a fire. There are the most automatic appliances, and in addition Mr. Edison has constructed an arrangement, by which an unknown with them by which the lights are turned on the instant the electric bell rings. When the visitors arrived Capt. Joseph F. McGill had the lights extinguished and his men were sent to the trunk-room on the second story. The quiet that pervaded the house was broken by the sounding of the electric bells. Lights were turned up, firemen came from their beats in the adjoining yards, and in four seconds, according to time kept by Gen. Diaz and his party, the horses were harnessed to the engines and were ready to start on a run. The exercise was repeated a half-dozen times, and each time was practiced with applause, in which Mrs. Diaz led. Gen. Diaz also joined in the cheering which greeted the performance, and expressed himself as much gratified, saying the performance surpassed those he had witnessed in Boston. After leaving the private house the party visited the First District works, in Pearl street, and then the machine shops in Goerck street, and Mr. Edison's laboratory, at Seventeenth street and Avenue A. Elaborate explanations were made by Col. Sherman, who is an old friend of Gen. Diaz, which were listened to with much apparent interest by the members of the party.

THE ELECTRIC LIGHT IN THE CITY.

WE gave on pp. 209 of Vol. XXXII. a short account of the experiment to be made in the City of London with the Electric light—an experiment which it is grounded will have an important effect on the progress of the "new" system of lighting. It will be remembered that one hundred were accepted from three companies working respectively the Brush, the Siemens, and the Jablochkoff systems; but only two of these have been carried out, an arrangement having been granted to the London Company who have taken up the contract for the Jablochkoff system. As we pointed out in the article referred to, the choice of the authorities might well have fallen upon any other system than the Jablochkoff, which has long been tried on the Thames Embankment, and though Crompton's is not substantially different, we may be satisfied that there will be no needless trial of an already well-tried system. The Brush system extends from the Surrey end of Blackfriars Bridge, along New Bridge-street, Ludgate, and the north side of St. Paul's Churchyard, to King-street, Cheapside, where it meets the Siemens system, which extends from the Guildhall along King-street, Cheapside, the Poultry, Bank, King William-street, to the Surrey side of London Bridge. The relative cost of the two systems is seen by the following figures:—

	Working.	Fixing.	Total.
Brush ...	£509 ...	£710 ...	£1,219
Siemens ...	2,779 ...	1,455 ...	4,234

The total cost of the other system which is to light the line from the Surrey side to the Guildhall, besides going down Queen Victoria-street to Blackfriars Bridge is to be £2,230 in the first days during which the experiment is to last. The Siemens lights are worked from a central station in Old Swan-lane, the Brush from a similar one in Bridge-street, Blackfriars, each with its separate steam-engine, and a third engine in reserve. The machinery supplies current for six powerful lights, carried high into the air on a mast at a height of 80ft., but so arranged that the lights can be lowered with ease, besides the 28 smaller lights, supported on iron standards, which are to be placed at the Government. The cabinets in all the lamps are fitted with copper, those in the large lights being 20in. long and 7½in. wide, and those in the smaller 14 inches long and 5½in. wide. The other lights being worked by alternating currents, the arcs are both of the same size, being 3mm. long by nearly 2mm. (12mm.) in diameter. As to the photometric results of the experiment, it is for the small lights 2000 candles; for the larger as much as 8000 candles. Each of the large lamps has its own dynamo machine, while the smaller lights are worked by two alternating current machines, each supplying 14 lamps in two groups of seven each—that is, the lamps are so arranged that they are alternately in the same group—an arrangement, which, in the event of anything going wrong with one set of lamps would still leave some of them alight on the line of street occupied. The lamps carried by the fifty-foot masts are hauled in position by the workmen in fitting the carbons and rest on a platform about 10ft. from the top of the ground. The cables are carried in trenches, the mains being made from iron box level with the pavement. The cables used are those well known as the Silvertown make, but their large conductivity and the very large insulation resistance, 100 megohms per mile, are specially noticeable. The cables are carried in iron pipes, and the connections are made in iron boxes, which are filled with a composition which will be found of a peculiarly useful nature. We shall no doubt be able to test the efficiency of the electric light in fog; the effects, if any, of lightning will be witnessed; and last, but not least, we shall learn whether the passage of powerful electric currents in the lighting cables has any inductive influence upon the telegraph and telephone wires which may happen to be in the vicinity. Finally, the cables being, already laid, it remains to be seen whether they cannot be used for other purposes in addition to the electric light, as, for instance, the carrying of telephonic messages, or the transmission of power to enable a small engine to work the dynamo machine. The lamps are all surmounted by shades, which are to be used when any fog prevails, in order to utilise those rays which would otherwise serve to illuminate the sky. London Bridge has nine of the smaller lamps, two at each end, and a more brilliantly illuminated than Blackfriars, which has seven only of the Brush lamps, now being placed at the Middlesex end. The longest circuit on the Siemens system is that supplying the large lamp in front of the Guildhall, which is 2,500 yards in total length; but the resistance does not exceed a Siemens unit, or a trifle less than one ohm. The lattice-pole near the north end of London Bridge is more than 120ft. high, its base being fixed in Thames-street. In this case the top has been stayed by fine wires attached to neighbouring buildings.

The Brush system, unlike the Siemens, is all conducted in one circuit, the current for the 32 lamps being generated in the Bridge-street station by two-street, Lambeth, which is a little to the west of Charing-cross railway bridge. Hence the cables pass along embankment, and through Whitehall Bridge to near the corner of King-street, Cheapside. The total length of the circuit is not much short of 7,000 yards, and the resistance is about 2 ohms. At present the current is supplied by two of the ordinary eight Brush machines, coupled in series; but it is intended, before long, to work the whole circuit with one machine, which will be driven by a Brotherhood engine on the same bed-plate. For several reasons the experiment with the Brush system is regarded with more interest, as when the doubtedly splendid results achieved by the Siemens Company; for, in the first place, the cost of working, £509 for the year, is not much more than one-quarter of the cost of gas-lamps which the electric light replaces, and has been stated that the company tendered at that price for the sake of the experiment, and that it would be prepared to change from gas to electricity is a decided improvement, and if that be obtainable at the same outlay of money, there can be no question as to the value of electricity as an illuminating agent for the public streets. In addition to the suggestion above referred to, we may mention that the Government and they will be able to show a profit in regular working, especially if the system is extended. In the second place, the lamps are of very powerful lights of 8000 candles by the ordinary standards, to which extensive have been tried in order to raise the lights to a height of 100ft. from the pavement. The lamps are, however, found to be not only capable of burning for 16 hours. Some of these are inclosed by clear glass globes, some by frosted glass, so that the effects of the lamps can be fairly tested. The arrangement of medium-power lamps, carried by comparatively low posts, is believed to be better adapted for the illumination of streets, than the use of very powerful lights at greater elevations; but whatever may be the result of the present experiments, the Brush machine has the advantage, that it can be used for varying either a number of lights of series or for producing a highly concentrated beam with one pair of carbons. Should the twenty days for which the experiment is to

THE DAILY NEWS. MONDAY, SEPTEMBER 10, 1883

THE VIENNA ELECTRICAL EXHIBITION.

(FROM OUR SPECIAL CORRESPONDENT)

Vienna, the third year in which a great International Electrical exhibition has been held, the first Exhibition in 1881 the labours of a few pioneers in the field of electric science were collected together, and an impulse was given to the further development of it. At Munich in 1882, and now at Vienna in 1883, the interest has increased, the progress which has been made during the last twelve months is very great indeed. It may say at the outset that I think there is much of interest yet there is little or novelty in the Exhibition. But the novelty is not in the Exhibition and the number of novelties are greater than at any previous show, for the reason being that the people in the Electric Supply have had no previous opportunity for testing what has been done in the practical application of electricity. An instance of the feeble light consists of three distinct parts—the source of power, the generator of electricity, and the electric lamps and other apparatus for using the electricity. These parts, such as conducting wires, galvanometers, switches, safety plugs, and so forth, are the details of the various machines. This was the first time that these parts were made by distinguished scientific men. From these tests we have learned that none of the devices proposed have led to any marked increase of electrical efficiency. Out of the host of modifications of the Siemens ring there are only two which stand out as improvements in a suitable way, and these two do so chiefly for their mechanical rather than their electrical merits. The first important fault of the Gramme ring is that mechanical fault of the Gramme ring is that it is unsound as a ring. The coils have been through which the spindle passes, and when the current of a single coil, or of a group of coils is broken by the brush, or handle, apparently of equal brilliancy, the whole ring tends to injure the ring. And this were only to make visible the darkness in the distant ring. Accordingly, should the brush fail, the one point of inferiority of the unsoundness in the ring, though upon that score not to be respected, expresses no opinion. The electrical qualities of the former to exhibit which its name would rather lead us to expect it possess in a high degree the quality of diffusion in which magnetic is unrivalled. It is very likely that means will speedily be devised to overcome the tendency of the electric light to flit during shadows, should that be found a troublesome defect. When our correspondent says that the electric light supplied by the Edison Company is such that one can work or read without being conscious that he is so occupied by using that splendid illuminant in its highest possible praise. The danger of electrical contact in the electric light is fortunately very well understood by the number of persons accepting for public favour. On the whole we may, therefore, hope that the day is not far when we may all read and work and walk the streets by the light afforded by the electric light, for, or, whatever it is, and forget that the source exists between us and the sun. Of course, I have spoken of the electric light which the machine is made. It is satisfactory to find that rules of thumb are being supplanted by accurate formulæ and scientific calculations. I ought to mention that the remarkable machine of Messrs. Siemens and Halske, called the unipolar machine, is not exhibited here. A contrary statement which has been made in England, is erroneous, and, it may prevent disappointments, I to assure to know, before leaving here that this machine will not have the opportunity of seeing that most interesting machine. I have little to say about the class of machines called alternate-current machines, of which the most notable examples in England are by Siemens, Ferranti and Thompson, and J. H. E. Gordon. There is a feature of this class by Gaus and Company rivalling in size the Gordon machine. Its total diameter is 10ft., the revolving part having a diameter of 6ft. It has a fine engine attached directly, to the spindle. There is nothing new in the principles of its construction, and it serves to feed only 1,200 incandescent lamps of 16 candles. Still it would make the latter too long and tedious work I to describe all the details of electric lamps, are and incandescent, which are shown here. As yet I have not seen no great novelty. The Brush Company has a new method of mounting incandescent lamps for street lighting, which is effective. A neaty flat disc of porcelain is supported horizontally by a bracket on a post, its slightly convex surface is grooved. In the centre is a hole through which the incandescent lamp protected by a glass cover descends. In this way a pleasing effect is produced. Siemter and Lamoier have two lighthouse lamps and, several of Swan's and Mandin's large lamps with lenses. There are some finely furnished rooms lighted by incandescent lamps and the lamps relief (sunlight) which are worthy of a visit. The United States Electric Light Company had two lion heads like signal posts, similar to those set up by Messrs. Siemens in the City. Each of these supports a globe with five sets of lamps, which, so says, and were of Viennese manufacture. They were blown down in the gale of Sept. 7, leaving a few fragments. The Austrian Government commission of experiments has to report upon 30 arc lights and eight systems of incandescent lamps.

In writing this letter my object has been to direct attention to the most interesting features of electric lighting in the exhibition, and I have not attempted to give any part of mine- lamps of the different exhibits. Consequently there are many names which I have not had occasion to mention equally deserving of credit with those which have served to illustrate my

London, 1883

The Edison Formula, Sept. 1883.

THE LIGHT OF THE FUTURE

Our special correspondent, who is consulting at the Northeast remote from an exhibition, says: "Undoubtedly the last Edison ever what he has seen and handled in connection with the exposition for lighting New York City with the Edison incandescent light. When a critic both sober-minded and competent is able to say with as much confidence, the time his come to congratulate ourselves and our readers that the days of gas, with their noxious fumes, and, in summer, uncomfortable heat, are drawing near thereof. It would be ungrateful, though, to pass up again that has done so good service for mankind at gas. Those that are old enough to remember the days of tallow candles and thereabouts by the gas jets will regard the latter, however, as a great boon, and should they live to see it superseded in turn. But the world moves, and there can be little doubt that the discovery of the method of lighting by gas will hereafter mark out stage of the ascent by which science is leading us up to the regions of perpetual day.

Our pioneers may always grow all you obviously discerned ideas in preceding articles of light that the least amongst these are the simplicity of the process by which it is made available so far as the user is concerned, and the economy with which it can be delivered to and utilized, and stolen. Perhaps the chief essential by means in the wonderful power of diffusion of light possessed by a very low degree of incandescence, expresses no opinion. The electrical qualities of the former to exhibit which its name would rather lead us to expect it possess in a high degree the quality of diffusion in which magnetic is unrivalled. It is very likely that means will speedily be devised to overcome the tendency of the electric light to flit during shadows, should that be found a troublesome defect. When our correspondent says that the electric light supplied by the Edison Company is such that one can work or read without being conscious that he is so occupied by using that splendid illuminant in its highest possible praise. The danger of electrical contact in the electric light is fortunately very well understood by the number of persons accepting for public favour. On the whole we may, therefore, hope that the day is not far when we may all read and work and walk the streets by the light afforded by the electric light, for, or, whatever it is, and forget that the source exists between us and the sun. Of course, I have spoken of the electric light which the machine is made. It is satisfactory to find that rules of thumb are being supplanted by accurate formulæ and scientific calculations. I ought to mention that the remarkable machine of Messrs. Siemens and Halske, called the unipolar machine, is not exhibited here. A contrary statement which has been made in England, is erroneous, and, it may prevent disappointments, I to assure to know, before leaving here that this machine will not have the opportunity of seeing that most interesting machine. I have little to say about the class of machines called alternate-current machines, of which the most notable examples in England are by Siemens, Ferranti and Thompson, and J. H. E. Gordon. There is a feature of this class by Gaus and Company rivalling in size the Gordon machine. Its total diameter is 10ft., the revolving part having a diameter of 6ft. It has a fine engine attached directly, to the spindle. There is nothing new in the principles of its construction, and it serves to feed only 1,200 incandescent lamps of 16 candles. Still it would make the latter too long and tedious work I to describe all the details of electric lamps, are and incandescent, which are shown here. As yet I have not seen no great novelty. The Brush Company has a new method of mounting incandescent lamps for street lighting, which is effective. A neaty flat disc of porcelain is supported horizontally by a bracket on a post, its slightly convex surface is grooved. In the centre is a hole through which the incandescent lamp protected by a glass cover descends. In this way a pleasing effect is produced. Siemter and Lamoier have two lighthouse lamps and, several of Swan's and Mandin's large lamps with lenses. There are some finely furnished rooms lighted by incandescent lamps and the lamps relief (sunlight) which are worthy of a visit. The United States Electric Light Company had two lion heads like signal posts, similar to those set up by Messrs. Siemens in the City. Each of these supports a globe with five sets of lamps, which, so says, and were of Viennese manufacture. They were blown down in the gale of Sept. 7, leaving a few fragments. The Austrian Government commission of experiments has to report upon 30 arc lights and eight systems of incandescent lamps.

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Evening Gazette,
CEDAR RAPIDS, IOWA., JAN. 6, 1883.

Amalgamation of the Edison and Swan Companies.—An extraordinary general meeting of the Swan United Electric Light Company (Limited) was held on Tuesday at the Westminster Palace Hotel, to consider the terms of an agreement about to be entered into between the Edison Electric Light Company, and a trustee on behalf of a company to be registered under the name of the Edison and Swan United Electric Light Company (Limited), "being a conditional agreement for the sale to the last-mentioned company of certain of the business, goodwill, patents, rights, privileges, and other property" of the Swan Company, and to empower the directors to take all necessary steps for carrying the agreement into effect. Mr. J. S. Forbes presided, and explained the position of the affairs of the company they suggested the possibility and the wisdom of bringing together the interests on the new and somewhat difficult enterprise they had become engaged, and there was a very large amount of feeling on the part of the shareholders as to the introduction of such a course. The directors had therefore carefully met the matter in view. He thought that both companies had acted prudently, before considering an amalgamation, in making to see what the terms would be upon which they would proceed under Acts of Parliament or provisional orders—steps at which, he said, they had now happily arrived. He hoped the wisdom of the principle of trading two interests like these and them would be admitted without much discussion. With regard to the terms, he had the satisfaction to present to them a resolution for considering whether the Edison Electric Light and the Swan Company had not a considerable price for the interest of the two companies, but over and above the Edison business the Swan Company had paid a considerable price for designs and original patents, and as the Edison Company did not present a similar asset, the Swan Company had reserved these patents from the agreement now under consideration. He moved the resolution, which was seconded by Mr. Swan, and after a brief discussion the resolution was carried unanimously.—An extraordinary general meeting of the Edison Electric Light Company (Limited) was also held on Tuesday, at the Gaiety Hotel, Mr. John Stewart in the chair, in the absence of Sir John Lubbock. It was considered advisable in the terms of an amalgamation with the Swan United Electric Light Company (Limited). After explaining the details of the proposed agreement, which entered the Electric Light Company to exercise the powers conferred upon it by the shareholders, the chairman proposed a resolution approving of the agreement submitted by the Board.—Mr. E. K. Blyth seconded the resolution, which was carried unanimously, observed that a great improvement in the success of electric lighting would be secured by the fusion of the two companies, as the Swan Company was practically the only dangerous competitor with the present company. The chairman stated that the company had been doing a fair business, the electric lighting business during the past year, the turnover during that period equalling that for the whole of the previous year, and during the first week of January, observed it might be interesting to know that the first ship in the world which had been entirely electrically equipped with the Edison system was the Guion Line Oregon, which was to sail on Saturday next. This vessel was fitted throughout by the Edison system.

The Edison Incandescent Light.

For some time reports have been current that Cedar Rapids was to be favored with an Edison System of Light plant, and we are now pleased to announce that the preliminary steps have been taken to that end. About a year ago a committee went from this city to Chicago to examine into the merits of the Edison system, and while they were much pleased with the light itself, it had not at that time been introduced under a central station into any town or city, and it was decided to postpone action. Since that time, however, results have been worked out and with a number of installations made in the eastern and New England states, which are now in successful operation. A few days since a meeting of the same gentlemen was held, and it was decided to secure an option for the franchise of this city, and to at once investigate the progress made during the past year. In order that the merits of the light might be definitely determined, Mr. Edison, at the request of these gentlemen, sent an expert electrical engineer, Mr. C. H. Cooke, who spent last week in making a careful survey of a proposed lighting plant, covering all of the business streets and all of the residence portion of the city north of Seventh avenue and west of Twelfth street. From the field notes and many estimates made, and with the number of lights required, rooms, etc., then this investigation has been conducted, it shall be found that this is a feasible enterprise in this city, and if so, a company will undoubtedly be formed and a plant installed.

This is a move in the right direction, and we trust that we shall soon have more light.

THE EDISON INCANDESCENT ELECTRIC LIGHT.

We give on this page illustrations and brief description of this valuable system of business and home lighting, which is being introduced very successfully throughout the States. These have companies already been formed in two of the cities of this State for the purpose of introducing this system into stores, public buildings, halls, churches and dwellings. This is evidently the coming light for domestic use; it being safe, economical, without heat and without danger, as it blackens and avoids the liabilities incident to other modes of electric lighting. This system is well worth the careful study and attention of our business men and of those who desire such a light in their business offices and houses. As Nashville is now starting on an era of reform and improvement and soon will have uniform time furnished by electricity, we trust such arrangements will be made

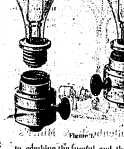

Figure 1.

to combine the fuse of the motive power, necessary to the use of this light, in the producer by introducing this neat, cool, safe and beautiful system of lighting the houses of Nashville the present and growing center of the new South.

There are two systems of electric lighting, namely, the Arc and the Incandescent. The arc is a light of great intensity, concentrated in one small spot, constantly changing in color, and very trying to the eyes. It is now used in streets and public buildings only. The incandescent is a small soft, steady, white light, of a brilliancy of 16 candle power gas jet of the best quality, and is especially adapted for domestic and industrial purposes. These systems of lighting are radically distinct, a fact which must be borne in mind when comparing the Edison incandescent system with the arc light.

The Edison Incandescent Lamp, of which Fig. 1 is an illustration, consists of a pear-shaped, glass globe about 44 inches in height, exhausted of air, into which is sealed a filament of carbonized bamboo slightly thicker than a human hair, which, when it becomes incandescent by the passage of the current, or electricity, through it, emits a beautiful, soft, white light, absolutely steady and constant, and entirely free from flickering or fluctuating. If desired, the illuminating power of a gas jet of the best quality.

The lamp is screwed into sockets, which are similar to those used in the ordinary gas fixtures, and is turned on or off by the same key. The lamp, when screwed into the socket, needs no further attention or care until the carbon burns out, when the old lamp is unscrewed from the socket and a new one screwed in, the work of a few seconds. The lamp may be left burning for hours which they will burn, but their average life, at 16 candle power, exceeds 600 hours of actual burning. Each light is entirely independent of the others and may be arranged and controlled singly, in pairs, or in groups of any desired number, and may be placed in any position whatever, inverted or otherwise.

The Edison lamp gives out but little heat (less than one-fifteenth as much as gas), may be grasped by the naked hand without inconvenience, is absolutely free from odor and poisonous or noxious gases, and neither heats nor vitiates the surrounding atmosphere. The most delicate fabrics are not exposed or injured by being wrapped around the lamp when burning. It is internally intensely. The lamp does not explode, and even if the glass is broken by any accident, the carbon is instantly consumed, and the light is put out and harmlessly. Besides being unequalled when delicacy, protected by the inclosed lamp, but the "current" is so introduced in the system that from any of the three sources above named, or from any source whatever, is absolutely impossible. The lamp is now in use in a large number of factories and dwellings, as no fire has ever taken place in the Edison system.

The light, besides being available for dwellings and factories, is also especially adapted to the lighting of steamboats. The cleanliness, absence of disagreeable odor, ventilation, freedom from danger by fire (no matches being required), and economy, make the light better for steamboats than any other known illuminant. The lamp has also been

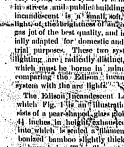

Figure 2.

found of the greatest value for the examination of ship's propelling machinery, as fully under water.

The lamp is also used for lighting mines. Mr. Edison has invented devices for protecting the lamp from breakage, even from the hardest handling, and for making the light absolutely safe from explosion or fire, even if the lamp should break in the damp.

The Edison system of power supply as well as light. By use of this dynamo, power may be transferred from a source of power to distant points for use, or from one portion of a factory to another. This invention affords not only the cheapest method, in many cases, of transferring power, but also facilities for minute subdivision and complete control. Among the many uses made of the electric power are the following: The running of lathes, printing presses, sewing machines, other small machines, elevators, and printing wafers. The current can also be applied for telephones, call bells and burglar alarms.

The Edison system for lighting large cities is modeled on the existing gas system. The current is generated at a central point, is distributed through subterranean conductors laid under the streets, connections are made with houses by means of branch conductors, and the current thus delivered, after passing through a meter in the cellar, which registers with perfect accuracy the quantity consumed, is then distributed over the house for use either for light or power. Houses are so wired that not only is light supplied, but by means of a device known as an electric motor power is also furnished for both industrial and domestic purposes.

The economy of the Edison incandescent light, as compared with gas, is beyond question, no matter whether the gas be used through the ordinary distribution system, as in cities, or is manufactured on the premises of the consumer by a portable gas machine. In estimating on the subject, the item of light in an hospital element to be considered, as the illuminating power of gas in different localities varies. The average of gas burner does not, even in best gas companies, give a light of over 12 candle power, so that in order to obtain the same amount of light as that given by the Edison standard lamp (16 candle power), a 7-foot gas

burner must be used. Even then, the whole light of the gas burner cannot be utilized in a work bench or desk, because it can neither be inverted or entirely locked by a shade, while, on the other hand, the whole 16 candle power of the Edison lamp is effective. Inasmuch as it may be inverted, or otherwise directed to any desired spot.

Assuming that "incandescent lamp" should be drive the dynamo is already present, the hourly cost of running 60 Edison lamps of 16 candle power each is as follows:

1 horse power 9 months of winter hour per horse power at $1 per	.12½
Depreciation on machines at 7 per	.01
Attendance, oil, etc.	.02
Interest on investment	.01
60 lamps, renewals, repairs per hour	.10
	.16½

The above lamps would replace the same number of gas jets, the hourly cost of which is as follows:

60 gas jets each burning 7 feet of gas per hour at $1 per 1,000 feet at 20 per cent.	.84
Interest on investment	.01
	.85

This shows a saving, by the use of the Edison light of 68 cents per hour of the Edison light, the cost of gas being more than four times as much as the Edison light.

Add to this pecuniary economy, the health influence of the light as compared with that of gas, its freedom from odor and from danger by fire, its steadiness, adaptability, completeness, and beauty

Continued on page 517.

Mr. Medespiel's Evening Gossip

THE ARTISAN: NASHVILLE, OCTOBER 25, 1883.

AMBROSE WAGNER,
n and Brass Founder,
MANUFACTURER OF
gs, Hollow Ware, Grates, Fronts, Mill Castings,
Fencing, &c.
CHATTANOOGA, TENN.

DU QUOIN, ILL.,
Manufacturers of
Steam Pumps
For all purposes.
Send for Catalogues.
Mention The Artisan.

SMITH, GIFFORD & CO.,
Contractors and Builders
of Flouring Mills.
Estimates and plans furnished. All kinds of mill supplies kept for sale. Mill machinery of all kinds repaired, remodeled, &c. Saw and Planing Mill Machinery.
Nos. 324 & 326 Market st., Nashville, Tenn.
Mention The Artisan.

Westinghouse Engines.
HERMAN FLETCHER,
GENERAL AGENT,
No. 826 West Main Street, Louisville, Ky.

MANUFACTURERS' AGENT
For Standard Machinery for Wood and Iron Working Purposes, Saw Mill and Mill Machinery, Steam Engines and Boilers, Electric Light Dynamos and Engines, Electric Motors, stores and factories Shafting, Hangers, Pulleys and Couplings of the line of Machinists' Supplies, Files, Emery Belting, Rubber Belting, &c. Call and see figures. Mention the Artisan.

THE NATIONAL WORKS
OKLAHOMA, KANSAS
MANUFACTURE THE
BEST SHELLS MADE,
Made from Best Wire Rod. Warranted to Shoot Strong and Clean.
OLD SHELLS RECUT
Made better than new at half the cost. Send for Price List.
LONG HANGING EAVE GUTTER.
Made from Best Charcoal Iron. Send for Price List.
Address, NATIONAL WORKS,
Oklahoma, Kansas.

E. E. GARVIN & CO.,
Improved Power Grinder.
ADVERTISERS
Can learn the exact cost of any proposed line of Advertising in American Papers by addressing Geo. P. Rowell & Co's Newspaper Adv'g Bureau, 10 Spruce St., N.Y.

NASHVILLE
Boot and Shoe Manufactory,
(Wholesale, Retail and Custom)
100 Union st., Opposite Stief's Jewelry Establishment,
NASHVILLE, TENN.
Ladies', Misses' and Youths' Custom Work a Specialty.
W. HARRISS.

PATENT WELDLESS
COLD DRAWN STEEL TUBES.
Smooth Inside and Outside.
For Rollers, Spindles and all purposes requiring Strength, Quality and Finish.
Send for circular and price list.
JOHN S. LENG,
Importer of and Dealer in all descriptions of Engineers' Stores,
3 Fletcher street, New York.

New Vertical Drill Press,
Manufactured by
S. FREEMAN & SON,
Harlem, Wis.
Dimensions are:
Height of Table, 30 inches.
Size of Cone, No. 3.
Size of Table, 12 inches square.
Weight, 300 lbs.
Send for circular and price list.

Hollenbeck & Miller's
Wire Works,
47 S. Illinois st., Indianapolis, Ind.
Manufacturers of Every Description of
Wire Cloth and Wire Goods,
Bank and Office Railings, Window Guards, Wire Signs, Ore Screens, etc., etc.
Estimates furnished on application. Send for illustrated catalogue.

BROWN, FLETCHER & SHAPP CO., LIMITED
1527 Pennsylvania avenue,
PHILADELPHIA.

DONELSON & RODES,
Manufacturers and Dealers in
READY-MADE CLOTHING
Gents' Furnishing Goods.
HATS, CAPS, BOOTS AND SHOES.
MILLINERY.
South Cherry Street, Nashville, Tenn.

MANUFACTURERS OF
PORTABLE Power Drill Presses.
PORTABLE Power Reaming Tool
PORTABLE Power Punching and Shearing Machine.
For Boiler and Bridge Work.
Send for Catalogue and Prices.

[Continued from page 515.]

and there can be no doubt that the Ruhmkorff coil has immensely increased the range of electrical experiment, and has thus rendered it more valuable for scientific research.

The highest possible award obtainable at the recent Electrical Exposition at Paris was a Diploma of Honor, while that was higher than a gold medal." The juries awarded fifteen Diplomas of Honor and two gold medals. The full Congress affirmed this award, and gave to Edison exclusively a Diploma of Honor for an incandescent light.

Persons desirous of seeing this safe and beautiful system of lighting in practical use will find the National Manufacturing Co. (Cotton Mills) in North-west Nashville lighted thereby.

Figure 3.

THE GREAT DISCOVERIES OF ELECTRICITY.

L'Electricite: We extract the following few interesting passages in regard to the rapid progress made in electrical science, from a learned discourse pronounced on Dec. 16 last, by Prof. Ch. Maudrin, on the "Great Discoveries made in Physics since the End of the Eighteenth Century":

"Franklin was asked, precisely a hundred years ago, what ought to be thought of the balloons that the brothers Montgolfier had just invented. 'Can you foresee,' he answered, 'what will become of the child that has just been born?' This wise answer tells us that at the birth of a discovery we are unable to prognose the extent of the benefits that it has in reserve for us. Had any one foreseen, a few years after this answer, the importance that the invention of Volta's pile was going to acquire?

"This discovery of the finest instrument of modern physics, which marked the last year of the eighteenth century, was brought about by circumstances which, although generally known, it is proper to recall briefly in this place.

"Galvani, a professor of anatomy at Bologna, discovered in 1786 that the hind members of a frog, freshly prepared, underwent a contraction when a metallic arc established a communication between the muscles and lumbar nerves of the animal. Struck by so singular a fact, Galvani studied it, with all that sagacity with which his was endowed, in order to explain the phenomenon, which caused great sensation in the scientific world, he supposed the existence, in the nerves, of an animal electricity, or vital fluid, and presumed in likening its action in that of the electric pile—"that most marvelous instrument," says Arago, "that man ever invented, not excepting either the telescope or the steam engine."

Volta made his discovery known to Sir Joseph Banks, President of the Royal Society of London, in a letter dated at Como, March 20, 1800, and in another to Le Methérie, a French savant.

"The importance of Volta's invention was at once appreciated, and great honors were bestowed upon him, particularly by Bonaparte, who invited him, in 1801, to come to Paris, and who caused assisted at the meeting of the Academy at which the men of genius repeated the experiments that had been the starting points of his admirable invention.

"The discoveries of the decomposition of water, salts, and alkalies were made by means of the electricity of the pile, and were accomplished with a single liquid pile, which presents the great inconvenience of giving current whose intensity rapidly decreases. We must not forget that it was Bonaparte, again, who established the principles upon which is based the arrangement of the constant current pile, or those employing two liquids, and that it was in 1829 that he made known the first element of this kind. In the year following, in 1830, the English physicist, Daniell, invented the couple which bears his name, and which became a very practical apparatus. This invention obtained for its author the Copley medal. It is the predecessor of all those different kinds of electrical batteries we have at present, and that are applied in telegraphy, electro-metallurgy, and in a multitude of works that have made the pile so common an instrument in shops as well as valuable in laboratories.

"The letter from Volta to Sir Banks, which figures in the 'Philosophical Transactions' of 1800, is very lengthy, and is written in French. In it Volta describes, under the name of 'Artificial motive apparatus,' the ordinary instrument, and the Carrington-Bowes.

"The name of 'pile' given to Volta's apparatus soon prevailed, because the couples of the two metals are piled up vertically in its columns one on top of the other. Volta's invention is described in the *Journal de Physique* of the year 1800, under the name of 'electric pile' (vol. lvi, 1801).

"The letter to Le Methérie figures in the *Journal de Physique* of the same year.

"Volta was born at Como, on the 18th of February, 1745, and died at Como, March 5, 1827. His fellow citizens have erected a handsome monument to the inventor's memory, the place where he is buried is marked by one of the principal columns of the temple of Minerva, and a pile of Bolognian stone, in the honor of erecting a statue to Galvani, who immortalized his name by his great discovery. He died on May 4, 1798, one year before the invention of the pile, at Bologna, where he was born on Sept. 9, 1737.

"When Volta came to Paris, Bonaparte, who was a member of the Institute des Sciences de l'Institut, proposed that the latter should decree to the inventor a gold medal for his invention. The proposition was unanimously carried. The following year, the First Consul, who had presented Volta with a special gift from the State funds, created two pensions of 3,000 francs, for his experiment made during the course of each year on the nature of the fluid, and one of 6,000 francs, for the person who, through his experiments and researches, should succeed in decomposing galvanism as much as Franklin had done with lightning. Foreigners of all nations were admitted to the competition. The prizes were presented, in 1809, to Ermann, of Berlin, in 1806, to Davy, in 1807, and then to Biot, Gay-Lussac and Thenard in 1809.

"Napoleon the Third having in 1852 instituted a prize of 50,000 francs in favor of the author of the most useful applications of the Volta pile, the money after several competitions without result, was conferred in 1862 to Ruhmkorff for the invention of his induction coil.

"The foundation of the Volta prize having been maintained, it was decreed, in 1866, to Graham Bell, of Boston, for the invention of the telephone."

During the same year in which Volta announced his invention in England, Carlisle and Nicholson decomposed water by means of it. Also Alexander Cruikshank, who gave it the form of the trough battery, invented some salts, and W. Henry some acids. But it was the remarkable labors of Berzelius and Hisinger, in 1803, which, at this epoch, opened the new question of the decomposition of salts by the pile; by showing the law of the carriage of their elements to the electrodes. Davy made it still quicker by his method of the application of the pile to chemical decomposition, by inventing, in 1807, by the aid of a powerful pile, potassium, sodium, and other metals. In 1808, Berzelius and Pontin made their illustrious discovery of the amalgamation on the electric light that having been realized in 1837 by Foucaut, in terms of very great interest for keen investigation of calcined charcoal placed very close together.

"It was Faraday, who later on, toward 1832, established the basis of the laws of decomposition by current."

Berzelius, that celebrated Swedish chemist, was born on the 20th of August 1779, and died on the 7th of August, 1848, at Stockholm.

Davy was born at Penzance (Cornwall) on the 17th of December, 1778, and died at Geneva, on the 29th of May, 1829.

M. Gallepel, in a French chemical journal, asserts that copper can be inserted in all enamel and especially in wheat, so that when, upon analysis, bread is found to be charged with a certain amount of cupric salts, it must not be supposed, that such salts have been introduced for the purpose of making the bread whiter (said a suspicion has existed that bakers have used sulphate of copper for this purpose), but they must be regarded as natural ashiluents.

SHELBYVILLE NOTES.

To The Artisan:

Shelbyville, Tenn., Oct. 12, 1883.

I think you can indulge error in commenting on the correspondence about Shelbyville from our friends in Pittsburgh. Evidently South Pittsburg is our own State was meant, and not Pittsburgh, Pa., but I may be mistaken. (Which you are.—Ed.) Shelbyville has taken up the general movement of improvement and progress. Several new buildings have been erected, and others are in course of construction. Among the latter is a large addition to the woolen mills and the erection of a new factory for the manufacture of furniture, the capitalists, real, living at this late day, that the quality of the wool grown here is equal every foot here, ought, by rights, be manufactured right here.

The two woolen mills here are doing an immense business, running night and day, this county having more sheep than any other in the State, the mills are supplied with good wheat.

The shelbyville Mfg. Co. is rapidly coming to the front—is under full headway, turning out blankets in excellent style, having received large orders from the East and South for their wares where they now pronounced the best. Also a large lot of jeans, which is one of any grade is wanted is marked. A notice quite an accumulation of raw material on the yards, and yet the machinery shuts down (!!!).

Daily shipments of cotton goods from the splendid new "Sylvan Mills" are steadily increasing, showing a healthy state of business in that locality, but they are what everybody expected under the able management of Sully Shapard.

Yours truly,

THOS. TESS, Jr.

ELECTRICAL MATTERS.

A BUDGET OF NEWS AND NOTES CONCERNING THE DEVELOPMENT OF THE SCIENCE.

AMERICA'S ELECTRICAL EXHIBITION—AN EFFORT TO ENCOURAGE APPARATUS AND BY-HEIR THAT PROMISES TO BE IMPORTANT AND INTERESTING.

[Written for the Manufacturers' Gazette.]

The Electrical Exhibition, proposed to be held during the Fall of 1884, under the auspices of the Franklin Institute, at Philadelphia, is making considerable progress. The ground, fronting on the north side of Lancaster avenue, and extending from Thirty-second to Thirty-third street, the property of the Pennsylvania Railroad Company, has been leased to the Institute from Dec. 1, 1883, to Dec. 31, 1884, at a nominal figure. Col. Charles H. Banes, the chairman of the Electrical Exhibition Committee, thus states that the list of ground will give them a net exhibition space of 70,000 square feet. The treasury, department, 5 short time ago, provided the admission of articles intended for exhibition, duty free, under special regulations. On the part of the Institute it was agreed to raise a guarantee fund of $50,000 to be set apart for the contingencies of the occasion, and of this, $30,000 has been so far subscribed.

The most important work performed so far has been the formulation of sub-committees of the Institute, which have prepared rules and regulations for the government of the several classification of the various apparatus. The result that this arrangement of the exhibits is to be held will be greatly more instructive and comprehensive than either the Paris or Vienna electrical exhibitions. A table of the classification adopted and under the various articles thus over many subdivisions, which are numerous:

Sec. 1. Apparatus for the production of electricity.

Sec. 2. Electric conductors.

Sec. 3. Measurements.

Sec. 4. Applications of electricity.

A. Apparatus requiring comparatively small power.

B. Apparatus requiring large power.

Sec. 5. Terrestrial physics.

Sec. 6. Historical apparatus.

Sec. 7. Educational and biographical.

As may be judged from the above, the exhibition is intended to be exhaustive of present knowledge of electricity. Under the heading of apparatus for producing electricity are frictional machines, induction coils, Leyden jars and condensers, and a number of like character known as electro-motors; then follow electrical apparatus for producing voltaic electricity, or that produced by chemical action; then that produced by heat, or thermo-electricity; magneto-electric machines, used in blasting or exploding; then follow in great variety the machinery with which we are more familiar by common report, the dynamo-electricity, produced from electro-magnets, and largely used for illuminating purposes; these embrace arc and incandescent lighting apparatus; field magnets, armatures, commutators, brushes and all specific forms developed by the needs of the machinery in actual working. In addition, are mechanical motors, such as steam, gas, water, heat and wind engines. Of electrical conductors, the paraphernalia of telegraph wires and cables, electric light circuits, underground conduits, sub-marine cables and insulating materials will be shown. These items are but the inclusive heads of a long list of articles which illustrate the conductors of the electric current.

The section devoted to measurements is probably one of the most interesting to scientists, and the least known to the public at any of the displays. It is the purpose of the committee to make a notable and an, in not giving any medals or diplomas. The reports of the judges of each department will be given after the fashion of the days, and also, speed, force, energy, resistance, and any other points of the exhibit that may call for guess work. Instruments of precise measurement will be used by the committee of judges, and the conclusion reached will be a record of the judges. By a special arrangement with the treasury officers, instruments of precision as are not to be had in this country will be admitted free of duty, on the bond of the Institute being given that they will be kept for the sole use of the Institute at the exhibition. Under the section of the "application of electricity," the apparatus requiring small currents are divided from those requiring large currents. Thus, under small currents are all the legion of sound-transmitters and receivers, fire and burglar alarms, annunciators, clocks, registers, signalling machinery, medical and dental apparatus, and appliances of warfare, as torpedoes, gun signals and targets.

It arrangements can be made by the committee for an unbroken water front on the Schuylkill River, the submarine department of the United States Navy may make what would undoubtedly be one of the most attractive side features of the exhibition, to-wit: To place an electric light of 100,000 candle power in the bed of the river, and thereby illustrate the method used for discovering torpedoes or other engines of modern warfare under water in harbors and along coasts. Besides these apparatus are those for mining, for spinning and weaving; for pneumatic purposes; for writing and printing; electrical toys and miscellaneous applications too minor things. Among these revolving large currents are set forth electric illumination, and the appurtenances of the lighting, and electro-metallurgy, whereby coins for newspapers are rapidly produced, and electro-deposits of metals are made speedily and thoroughly on metals, pottery and textile materials, batteries and accumulators, and numbers of other things that the public rarely learn of. In terrestrial physics, the apparatus will be shown for measuring the electricity of the air, magnets of natural kinds and the apparatus used for weather signals.

This brief mention may outline the comprehensiveness of the exhibition. About 3000 circulars have been sent abroad, and about seventy-five applications for space have been filed, principally from Germany and France, and from some of the largest cities of those countries. The circulars for America will be sent out shortly, although applications are already in from some quarters in advance of the efforts of the committee. The purposes contemplated in this exhibition are, of course, principally educational. It is anticipated that schools and colleges from neighboring cities will take advantage of such an exhibit of electrical matters, as best to make excursions, that they may comprehend, by actual inspection, how far the science of its use has advanced, and thereby greatly enlarge their intelligence and facilitate their studies on the subject. There will doubtless be, during the exposition, lectures, scientific and intended for unscientific people, on the subject, methods and work of electricity, by those thoroughly competent to deal with the subject. These and many other features of interest promise to make the exhibition of enterprise worthy of the greatest energies of the association projecting it, as well as fully meriting the attention of American people.

NOVEL INCANDESCENCE—THE ELECTRICALLY LIGHTED CHRISTMAS TREE AT THE PORTER EXHIBITION.

The adaptability of the incandescent light for general illuminating purposes is well known, and its utility requires no justification; but all previous wonderful effects produced by the Edison system are eclipsed by its latest application, the lighting of the Christmas tree at the Foreign Exhibition. From whatever direction one enters Washington hall the attention is at once arrested by the sight of a very large pyramid shaped piece of evergreen, the lower branches having a diameter of twenty-five feet from tip to tip, rising forty-five feet into the air from the centre of the band stand in the middle of the floor, and covered with thousands of such things as red bronze cornucopias filled with candy, sugar plums, fruits, branches of silver and purple, red and blue, grapes, variegated glass balls, bells, and beads, dolls, etc., skeins of silver and golden threads trailing from the branches, while upwards of nineteen dozen small flags and bannerettes of all nations and numbers of Chinese lanterns and comic heads are artistically disposed over the tree, depending from the branches of which in all angles are red, white and blue glass balls of the Edison light. The railing, sheathing and balustrade of the band stand are tastefully festooned with unique designs in evergreen, the work of Mr. G. Chevalier. The stairway and floor are covered with cotton batting sprinkled with salts, which sparkles and glistens under the electric light with rare brilliancy, thoroughly conveying the idea of a frost like or snowy surface in the forest. Santa Claus fills the band leader's niche on the eastern side of the stand.

The following is the distribution of the 160 lights, which comprise 10 and 16 candle lamps: 46 whites, 32 lantorns, 14 comic heads, including caricatures of prominent citizens and others, "Humpty Dumpty," clowns and other grotesque figures, 12 reds, 24 blues, and the balance, embracing the three different colors, emerging from the centre floor and crowning the circular, frosted railing. The current which feed the lamps are brought from the dynamo room in the basement by mains which run into the circle under the band-stand, whence they radiate over the tree-trunk and branches by several flexible wires from a table, fitted with switches, "cut-outs," etc., two large main "cut-outs" governing all the lights on the five circuits, and three series of smaller cut-outs controlling eight lights apiece, the lamps being run in parallel circuits.

One switch governs the white lights, one

SEPTEMBER 6, 1882.

THE STANDARD.

DOMESTIC ELECTRIC LIGHTING.

(FROM OUR CORRESPONDENT.)

NEW YORK, TUESDAY NIGHT.

Mr. Edison's system of providing an incandescent electric light for domestic use in a given district has just been put to a practical test in the city. That district selected occupies an area of nearly a square mile. Only one source of supply is provided, and that the enormous illuminating power for sixteen thousand lamps, the electric current passing through eighteen miles of mains. The result is that the severest demands which the consumers have been able to make upon the new system have been satisfied.

The *New York Herald* is using in its business premises an isolated plant on the same principle; and the managers assure me that they are satisfied in respect to the commercial aspect of the question.

No new obstacle has presented itself to the success in practice of Mr. Edison's theory; and the public seem will be interested to know that this first practical experiment demonstrates the possibilities of the inventor's application of the multiple arc system, pure and simple, as distinguished from the series system, or the combination of the arc and series systems.

Throughout the entire district lighted as described each lamp was independent of all the others. Mr. Edison, who is President of the Commission of the British House of Commons, Dr. Siemens and Mr. Preece impossible to apply electricity for domestic lighting, from one source, over a great area unless it be upon quarter of a mile. Last night, although only five thousand lamps were lighted, they were distributed over the entire district of the square mile. In the district there are fifteen hundred consumers of gas, of whom eleven hundred have subscribed for the electric light.

THE PRESENT POSITION OF THE BRUSH COMPANIES.

The important interests involved, and the variety of rumours which have no sufficient reasons for our discussing the question in a special manner, holders, although we believe that few have been induced to part with their investments. This refers, of course, to the real investor and not to the speculator. As to the latter, it is impossible to predict what "bears" or "bulls" on the Stock Exchange may do, what means they may employ to achieve their ends, or what success may attend their machinations. To those who have carefully studied the question and who are able to judge of the validity of the patents possessed by the Brush companies, and of the excellence of their system as now perfected, the certainty exists that the bears will be cruelly caught in the end.

Before we enter more particularly into the controversies now going on we will pass briefly in review the results achieved by the Brush system of arc lighting. In the United States—its birthplace, its success has been marvellous, notwithstanding the competition of other prominent systems originating and competing in that country. The Brush lamp, being as near perfect as chiefly adopted to the lighting of streets and public places, as well as stations, large warehouses, shops, hotels, manufactories, etc., and is excellence for such purposes has ——— been declined. In April, 1881, there were in operation in the United States over 5,000 Brush lamps, of which 1,500 were used for street lighting. Since then the number has increased to an enormous extent, and indeed this system in the States seems to have carried all before it.

As to foreign countries, it may be stated that the Brush light has found its way to the most distant parts, that not only in France, Germany, Austria, and Spain, and other parts of the Continent, is it making rapid progress, but that it has already achieved success in many cities of South America, South Africa, Australasia, and especially in India and the East, where it is being most energetically developed.

We now come to the progress made in the United Kingdom. It is difficult to estimate the relative proportion of Brush lamps in use to those of other arc systems; but it has been stated to us that 40 out of every 50 arc lamps in regular work are Brush lamps. In the manufacturing districts in the North, especially in large iron works, the Brush system seems to have been established entirely adopted, and to have given the greatest satisfaction on account of its reliability and economy.

It has, however, been introduced into this country for only a comparatively short period. Indeed, in the commercial success we must turn, to the United States, where it has been longer in operation. There, during last month, the American Brush Company is stated to have sold no less than £600,000 worth of dynamo-machines and lamps, and to have on hand this year with some months' orders on hand; and the original 100 dollar shares of the company are now quoted at a thousand dollars each.

In incandescent lighting the subsidiary Brush companies have, until now, undoubtedly, remained in the background, as the Lane-Fox lamp, the licence for which they acquired through the parent company, the Anglo-American Brush Electric Corporation, had not been sufficiently perfected. This brings us on debated ground, the much talked of origin of exclusive use of these inventions. We confine ourselves to stating a few facts and leave our readers to form their own opinion. A licence is in existence of the Lane-Fox Incandescent Lamp to the British Electric Light Company, which was accompanied by an agreement made on the same day, under which the latter company bound itself not to use the name of "Lane-Fox" in any way with reference to this incandescent lamp, nor to do anything which would prejudice the rights of the Edison stations it is necessary, in order to regulate the light, that an attendant should continually and carefully watch the hand lamp and regulate the current by hand. Under the storage system it is possible to turn out part or all of the lamps, or to light them again without

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the rod, one the 'size, one the batteries and one the cranks, heads, and as the currents are turned on and off in unison with music from the band on the grand stage, the action may hardly be termed piano-like, the whole operation being highly enchanting. Indeed, the resemblance to fairy land and scenes in the garden of the gouli is not remote, for, as the whirling carriages of the 'A' and 'B' sets enliven fields, lanterns and heads alternately flash to and out of the recesses of the tree, illuminating the dark green foliage, lighting up the fairy streamers, enlivening the expressive features of the "combs," bringing out the rich coloring of the lanterns, and evoking the snow, qualities of the glinting cotton and tinsel, the illusion is complete.

It is impossible to light this or any other tree with any illuminant other than the incandescent light, without danger of fire, for although gas might be pieced at the ends of branches in such a way as not to come in contact with adjacent limbs, the interior of the tree would be lighted, as often from the heat, and gas ignited, and the illumination, if it could be so completed fashion.

There is nothing like the illumination of this tree to present, upon the first display, to the public mind, such the Christmas tree of the Continental Exhibition, at the Hideout Conservatory, of New York, in its pattern of YULE SEASON.

The novelties and mechanical effects of the Foreign Exhibition tree were made under the immediate supervision of Mr. L. Bel-ringer of the parent company, an acknowledged expert in fancy electric lighting and fixtures, he having designed and had the charge of the Johnstown Electric Illumination Co., etc. Mr. Silsringer also had the charge of the Parent Company's improvements at the Centennial of the Louisville Exposition, where, 4000 incandescent lamps were operated. It is safe to say that no other electric light company could have undertaken, or could have carried out such a piece of work as continually surprised the curiosity and the admiration and appeals to the marvellous of the spectators of the Electric Exhibition. The arrangement and effects of this Aladdin-like Christmas tree. The Edison Company has scored many triumphs, but this latest achievement in electric lighting certainly surpasses all their previous efforts. The Electrical Ration Department has just reason to be proud of its work, Mr. Silsringer having been sent on here at its request. It is needless to say that this tree, which will remain until the close of the fair, and which is lighted daily at 7pm and 8.30 P. M., is a source of great attraction, and should not be missed.

Other than the lights of the tree, the decorations have been made under the superintendence of Mr. Alexander, who has evinced artistic qualities.

NEW RUSSIAN RAILWAY ELECTRIC LIGHT.

An exhibition of the Chesswright railway electric light took place a few days since at London. The novelty in this light is that it wholly dispenses with steam engine and furnace for its supply, and depends solely on the old voltaic battery, with certain novel combinations of elements. Six incandescent lamps of about 6 candle power each were supplied from a battery, of nine cells, and they gave an excellent, steady light. A number of gentlemen interested in the lighting of railway carriages, which is the leading object of the patentees, were present, and expressed decided satisfaction with the steadiness and brightness of the light and the extreme simplicity of the apparatus. It was stated that all right. On the table in front of him is a whose weight of the battery would not exceed 2½ hundredweight, easily carried beneath the vehicle, and that a single charge would last from twenty to twenty-five hours. The current can be switched on and off with ease, so as to light or extinguish all the lamps of a carriage, or if connected, of a whole train instantaneously. A single installation for a railway carriage would cost from £12 to £12 (£250 to £60), which is said to be not more than that of the first cost of gas. It is claimed further by Mr. Zelrath, the engineer in charge of the apparatus, that the elements employed can be sold after they have done duty in the battery as chemical compounds for almost as much value as they cost in the first instance, and that the price of working would be not more than that of gas, and for a superior light. This light is now experimenting upon by the Great Northern railway, and carriages are being fitted for it on the Southwestern and the Great Eastern lines.

SAFETY OF ACCUMULATORS.

Hugo G. Du Bois writes from Washington to the *Electrical World* as follows: From observation I have noticed that the general impression among those who are not familiar with accumulators, or secondary batteries, is that they were very dangerous things to apply. It was stated in one of our leading papers, the other day, that secondary batteries were unfit for commercial purposes, because of the great danger attending their use; that if any person should happen to touch one of the wires attached to them she should receive a severe shock. Having had seven months' practical experience with them, I can prove that, on the contrary, the secondary battery is the very embodiment of safety. I have worked around them in every possible manner, at times standing on the wet ground, my hands wet with sulphated water, handling the wires connected with the poles of a series of twenty or thirty cells, yet never have received a shock sufficient to give me the slightest injury. Just only the other day, to comfort was I of the safety of the secondary batteries, that I connected two wires, 10 electric light wires to a number of cells, which gave out an E. M. F. of about two volts; then taking the bare ends of these two wires placed them on either side of my tongue, and received no harm whatever. The sensation produced was about like that from a small Faradic battery.

LIMITED USE OF STEAM-ENGINES AT WORK.

Electricity has been applied abroad to lighting the interiors of steam boilers at work, so that the actual operation under given conditions can be seen. It is easy to understand, says the Mechanical Engineer, ... This will prove, in careful hands, a very great addition to our knowledge of what is taking place in boilers of certain types. Experiments made by competent parties would tend directly to economy of fuel, in that it could be seen by the condition and direction of currents whether the distribution of heat was uniform or whether it was irregular. The result of firing could be seen, as also the effect of opening the doors at certain periods: in short, the application of the electric light to boilers at work promises great results; but what action will be taken in this country regarding it remains to be seen.

TELEGRAPHING WITHOUT ARMS

At the school for telegraphy in Ann Arbor, Mich., one of the students has not the use of his arms, yet he sends and receives messages at the zenith of his power for indicting misery upon his fellow men! Somebody ought to invent an automatic dog which will smile approvingly at the gentleman who carefully closes the door but will take hold of the first who leaves it open and give him a good shaking.

It is very amusing to watch the little folks during the few days which precede Christmas. Their anger expectancy as to what they will receive is only equalled by the pleasure which they take in keeping the secret of what they are going to give. What a lot of surprises there will be Tuesday!

The Papyrus Club had a most brilliant "ladies' night" Saturday. Among the guests were Henry Irving, Miss Ellen Terry, Mrs. Frances Hodgson Burnett, Miss Louise Alcott, Miss Nora Perry, Mr. Henry Calne, Lodge, Rev. Brooke Herford and other well known in the literary world.

Illness are treated here, even seriously im-

Longinet Perry Aug 19th 82

ELECTRIC LIGHTING NOTES.

At the ordinary general meeting of the Crystal Palace Company, the chairman stated that they had purchased nearly sufficient plant to light the palace by electricity.

The electric lighting of the Thames Embankment is to be suspended for a few days for the purpose of replacing the former engines, lifferent situated in the wooden structure under the Charing Cross Railway bridge, by a new one.

We learn from an American contemporary that Mr. Montgomery contests the position for the Brush accumulary battery for the entire world outside the United States, and that he is preparing for an extended tour to establish agencies and effect sales.

The Maxim-Weston Electric Company, Limited, have, at the National Eisteddfod, at Cardiff, lighted the buildings and adjoining grounds in which the ceremonials and concerts were held. The building which has been erected by the Taff Vale Railway Company for locomotive sheds, and was lent by that company to the Eisteddfod Committee, was lighted by four Weston Universal arc lamps of three thousand candles each extended outside the building to the different approaches and grounds, as well as on the top and floor of the Taff Vale Railway. Thirty four lamps, each of one thousand candles, were used, dividing the huge circuits in the building into three, and driving one of the dynamos from an independent engine, the chances of total darkness, even for a moment, were reduced to almost all, but we are glad to be informed that the light during each night was most perfectly satisfactory, and the arrangements left little to be desired. The Fine Art Galleries were lighted by Maxim incandescence lamps of 50 candle power, driven off a Maxim machine; the lamps when driven up to its full candle power gives very pure light, which is particularly well adapted for pictures, and was very much admired by connoisseurs. The installation has also been used for the concerts, and for two dinners given to the engineers of the Taff Vale Railway, held in the same building.

Electric Light

Orange Grove

the slightest disturbance, thus greatly increasing the durability of the lamps.

The Brush high tension dynamo-machine will send the current many miles, and accumulators can therefore be charged from it at long distances. This arrangement has the further advantage that any power (for instance water power) can be used at the place where the machine is fixed. Two of the Brush sub-companies having the advantage of highly intelligent engineers,—Messrs. Breeman, Taylor, and King,—who have just succeeded in perfecting a system of incandescent lighting by means of improved lamps and accumulators to which we referred already in last issue, and which comes very near perfection. The system is called the B. T. K. system, and from the different apparatus which we had an opportunity of inspecting, and the success of the installation already established, we must consider it a most important departure, and one which is likely to prove a source of great revenue to the companies.

With regard to the new dynamo-machines, of which so much has been lately made, it may be stated that neither the Ferranti, Sir William Thompson, nor the Gordon dynamo-machines, being alternating, can be used for charging accumulators, while it must be considered as an objection to *large dynamos that to use* them for direct incandescent lighting would be running great risks. If such a machine were to get out of order, a large number of lights would be suddenly extinguished. It would therefore be necessary to have a similar machine in reserve, which would have to be kept going at low pressure, so as to be ready for immediate use. Steam engines in duplicate would therefore also be necessary. We have not the slightest wish here to detract from the merits of the new dynamos, which may doubtless offer certain advantages; but we think that it is sufficiently proved that *the Brush system properly developed* and *applied* has nothing to *fear from them.*

We may further state that several of the Brush Companies are prepared to undertake the lighting of large districts or towns on the express stipu*lation that their maximum* charge for arc, as well as incandescent light, will *not be higher than* the present rate for *gas, taking light* for light—say at *from* 4d. *to* 6d. per thousand, while even the lower *figure would leave* a considerable profit to the Company. This statement has been most authoritatively made to us. That we are on the eve of a very large extension of the electric light in this country is certain, and few as yet realize the vastness of the field. All that is now required is that obstruction on the part of the local authorities should be removed. Once systems like the Brush obtain the licence for lighting large districts—and it is a fact that whatever the local authorities may do in some districts, the licence will be granted to the companies in a number of others—there can be no doubt of an unprecedented development of the electric light with proportionate profits to the companies. When once the operators on the Stock Exchange realize this fact considerable commotion may be expected. In the meanwhile shareholders in the Brush Companies will do well to keep their shares and bide their time. We feel assured that the result will amply repay them.

The Electric Light.

The leading questions upon this topic for over two years so far as New York city is concerned have been, "When are we to have the Edison Incandescent Lamps?" and "Why all this delay?" To the first question we answer that by the first of August proximo that portion of the city bounded by Spruce, Nassau, Wall street and the East river will be ready. The second question may be fully and correctly answered by saying that as Mr. Edison never set a time for turning on the light, there has not as yet been any delay. Very few people have the remotest idea of the magnitude of the task Mr. Edison assumed, when he undertook to perfect a system that should give New York the best light of any city on the globe. That system is now perfected and the first district already described is practically ready for the greatest electrical triumph ever achieved. But little remains to be done; the street mains are all laid, the principal connections are all made, leaving little but testing to complete the conducting apparatus; the large engines and dynamo machines are in place together with their boilers of several thousand horse power awaiting the word, all ready, go! when a new era for New York city will begin, to soon be *followed* by lighting the second district, which is already under way. This is reliable though not official.

N.Y. Nov. 1882

THE MECHANICAL NEWS.

AN INGENIOUS STORAGE BATTERY.

In December, 1881, Henry Sutton announced to the Royal Society of England that he had devised a storage battery, which consisted of a long strip of lead and another similar strip of sheet copper, separated by a layer of sheet rubber and wound together into a roll. This roll was placed in a glass jar four inches deep and four inches in diameter, and filled with a solution of sulphate of copper—common blue vitriol. The sheets of lead, copper and rubber were perforated to allow the free circulation of the liquid, and all crystals of the blue vitriol excluded from the solution. The copper being made the positive electrode, the solution, which is highly blue, loses its color. When the cell is fully charged the solution is colorless. During the discharge of the storage battery the solution assumes its original azure hue. This change of color forms a beautiful means of telling where the cell is charged; it is a veritable charging gauge. The power of the battery is very great and very constant. It can be made to last for hours, time being dependent upon the quantity of sulphate of copper decomposed.

This form of battery was in turn improved upon by Charles E. Buell, of this city, who employed common lead shot, coated with mercury, and placed in a porous cup. He put this cup in a glass cell and surrounded it with a coil of copper wire cloth which served as the positive electrode. The employment of shot and wire cloth furnished the greatest surface in a given weight and constitutes a form most easily made.

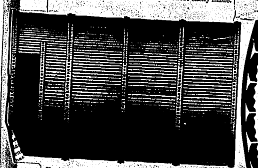


FIG. 8.—THE CASE, AND END VIEW OF SAME.

Mr. Buell verifies the published statement of Mr. Sutton that a cell four inches high and four inches in diameter will keep a No. 28 iron wire at red heat for two hours; that it is more constant, and does not polarize during discharge, as does the Faure battery. It weighs very much less, occupies less space and costs less than the Faure battery of like force, and is untrammelled by patent rights.—[New Haven Register.

AUGUST 4 1882

THE GLASGOW NEWS. FRIDAY,

THE ELECTRIC LIGHT AT PAISLEY.

The town residence of Mr. Archibald Coats, Woodside, Paisley, has just been fitted up with Edison's incandescent electric light. The experiment of introducing electric light to a private dwelling-house in lieu of gas has proved highly successful. Edison's system has none of the drawbacks usually associated with electric lighting, such as intermittent shadows and unsteady and fitful illumination. There is emitted a well-diffused light which, though brilliant and luminous, is not so intense as to be offensive to the eye. On the contrary it is a mellow, pleasing, and steady light, without heat or smell. The work of introducing the necessary apparatus to Woodside has been in course for some time, and is now completed in a manner which is likely to give great satisfaction to Mr. Coats. The wires for conveying the electric fluid are laid underneath the floors and inside the walls, in the same manner as the gas-pipes previously in use. The chandeliers and gas brackets are retained in their places, and have been found perfectly suitable for the change that has been effected from gas to electric lighting. The engine is 12 nominal horse-power, driving two dynamos each supplying seven A lamps. There is also a regulator for increasing or diminishing the candle power of the lamps. The A lamp is equal to 10, and the B lamp to 8 candles illuminating power. The A lamp has been introduced throughout the commodious and elegant mansion, and the B lamp is used for illuminating the greenhouses. There are, in all, 200 lamps in the house, though the engine power is only capable of supplying a current to 150 of that number. The carbon contained in the lamps will, it is calculated, burn constantly for a thousand hours, after which a new set will be necessary. The system within the house is very complete, and so perfect that by an arrangement of switches a whole suite of rooms may be brilliantly lighted or the illumination may be reduced to a single jet. An ingenious safety invention has been introduced by means of which all danger of accident is averted. Last evening the new mode of lighting Woodside was in operation, and the visitors, to whom the workings and the apparatus were explained by Mr. George H. Stout, were very much pleased with the brilliant and satisfactory display.

Manchester corporation, "is the whole of the city of Manchester." "Cursed with the burden of a granted power" would indeed be the words which the unfortunate corporation that was saddled with, such responsibility. It would become the prey of every electric light speculator in the country, nor would even the colossal profits of the corporation gasworks suffice to meet the expense of laying down installations on such an extended scale.

There is an element of unreality about the whole scene which becomes apparent when as the proposals of the companies and the counter-proposals of the corporations are closely examined. According to the rules laid down by the Board of Trade, the applicants for a provisional order must forward a memorial to the Department on or before the 21st of December, giving "a general description of the works" which are proposed to be executed, and specifying among other particulars what capital is proposed to be expended and employed in connection with the undertaking and the mode in which such capital is to be provided." As the Board of Trade intend rigorously to insist on that rule, most of the applications for a provisional order will be ruled out of court at once. According to Dr. Siemens's calculation, the installation necessary to supply a quarter of a square mile with the electric light will cost £1,177,000. Suppose that it only costs one half that sum, or £600,000; supposition—a very extravagant supposition—that no single installation exceeds a quarter of a mile in area. What corporation in the country has made any preparation for raising any such sum? It is not too much to say that hardly a single vestry or municipality has contemplated raising any capital for the purpose. They are applying for provisional orders solely to keep the companies out; and the only result of this gratuitous saddling of themselves with a most onerous and even ruinous obligation will be to the companies an open door in their own terms. But the companies are in an equally absurd plight. With a capital of fifteen millions they are proposing to execute works which would cost fifty. No provisional order can be granted except in cases where the applicants have given proof that they are able and willing to execute the work in a reasonable period. In numerous cases in many cases no such proof can be forthcoming. The companies are newly formed. Electrical engineering is only in its infancy. There are people the men not the money to carry out the proposals of electricity. It is much more likely that not a dozen provisional orders will be granted next session than that one-half of those now being applied for will be acted upon. The companies can well afford to wait. It is sound policy for them to hustle the corporations into the position of undertakers, for then they will have the municipalities at their mercy. At present the companies are at the mercy of the corporations, and we can only marvel that the latter, abandoning their position of vantage, should have fallen so blindly into the trap which was laid before their eyes. Possibly the Board of Trade will intervene to save them from themselves.

ELECTRIC LIGHTING PROJECTS FOR 1883.

THE Electric Lighting Act of this year has borne plentiful fruit in the shape of an immense multitude of applications for provisional orders, particulars of many of which occupy much of our space to-day. Hitherto the electric light has exerted itself in an experimental and frequentsey way. With really large schemes for the introduction of electricity as a public illuminant we are now making practically the first acquaintance. If the notices which are placed before the public to-day had appeared two or three years ago they would undoubtedly have produced another panic among the shareholders in gas companies. The experiments which cause the panic of 1825 were merely, to use Mr. Gladstone's famous simile on occasion, "like burning a farthing candle at Dover to show a light at Calais" in comparison with the gigantic schemes which are now being projected. To the alarmed imagination they amount to prospective the abolition of gas as a public illuminant. But the gas companies are not alarmed, nor have gas shares fallen in the market. If familiarity has not bred contempt, it has enabled them to recover confidence. The purveyors of the electric light, it must be admitted, are contributing to the confidence of the gas companies by the impracticable nature of their proposals. If all the schemes which are now on foot—at the instance both of local authorities and of the electric lighting companies—were to be carried out, a capital of, probably, £30,000,000 would be required, whereas the whole of the capital of the various electric light companies, exclusive of those whose business is with the Colonies and abroad, only amounts to about £1,800,000, of which, perhaps, one half has been called up.

The passing of the Electric Lighting Act has brought the screw companies into competition between the companies to a climax. Since the days when was caricatured in Professor Ayrton's story of the Glenmuckrikin Railway there has been nothing at all resembling the "splash" which has been made by the electric light companies during the last month or two. At the time for publishing the parliamentary notices has approached, there has been a gradual return to calmness and reason. Companies which had designed to apply for provisional orders in respect to every moderately sized town in England have decided to await further development, and other companies which had schemes for the lighting of the whole of the metropolis have determined to confine their efforts to two or three districts only. The provisions of the Electric Lighting Act stipulate that the projects of the electric light companies shall bear some reasonable proportion to the amount of their capital; and there is no the least likelihood that any company will obtain concessions the terms of which it cannot prove its ability to execute. The applications for provisional orders which will cover the whole of the lighting districts of the metropolis by some hundreds than they are at present if no stamp of the determination to get local boards, and parish vestries had not exhibited a determination to get or to keep the public lighting in their own hands. The City of London and the corporation of Birmingham have decided to make no application for licences or provisional orders, but to offer to grant licences to selected companies for the experimental lighting of given areas. These companies are the Swan United Company in London, the Brush Company, and the Jablochkoff Company, which has been followed by the vestry of St. George's, Hanover-square, and the local authorities of West Bromwich, Smethwick, Willenhall, Walsall, Wolverhampton, Rotherham, and Belfast. The town councils of Salford and Doncaster have contented themselves with a policy of direct opposition to the companies, without applying for powers to supply electricity themselves.

The antipathy of the great towns in the north have decided in favour of applying for provisional orders "in order to keep the companies out." Among those which have adopted this course are the London vestries of Kensington, Chelsea, and St. James's; Edinburgh, Glasgow, Newcastle, Liverpool, Manchester, Sheffield, Darlington, Stockton, West Hartlepool, Nottingham, Chesterfield, and Todmorden. Here (Brighton) the decision inclined to apply for a licence, and Grimsby has decided to proceed by private bill. It will not be possible to publish a complete list until the end of next week. Although most of the larger provincial towns are displaying readiness to adopt the electric light, if only in order to play the part of the dog in the manger, London will assuredly have the great bulk of experiments. The proposals of two or three of the companies cover almost the whole of the metropolis. As a rule, however, applications are confined to districts in which there are special advantages. Thus the parish which includes Regent-street is an object of most particular desire. The vestry of St. James's has received notices of application for provisional orders, or proposals to grant a lighting a licence, from no less than nine companies, among which are included three of the largest in existence. It is estimated that the lighting of the parish would cost £120,000, and among the applicants are companies whose capital is only £100,000. In many cases, however, it is proposed to raise local capital in the districts supplied, though it is obvious that a company, on showing what it proposed to expend, might obtain a concession without afterwards being able to raise the capital on which it had counted. No provisional orders, however, are likely to be issued on so slender a basis as the possibility of raising the needed capital in this fashion. As the licence can only be applied for with the concurrence of the local authority there is always a certainty that where this is granted a concession will be made, while, if it is refused, the same result would probably have followed on the expenditure of a couple of hundred pounds in the attempt to procure a provisional order. In many cases, however, the application for an order is absolutely necessary. Some of the districts proposed to be lighted intersect four or five parishes, for each of which a licence would be required, and, as London parishes seldom agree as to local works, the task of using all these one after another would be too much for the patience of any company that ever existed.

The parish of St. James's, which most of the companies had proposed to make a centre of operations, has determined on keeping the lighting in its own hands, and with that object is about to enter, or has already entered, into contracts with one of the larger electric light firms. The other proposals made for lighting the metropolis will be shown in the statement appended :—

METROPOLITAN BRUSH ELECTRIC LIGHT AND POWER COMPANY.

The Metropolitan Brush Company has a capital of £1,000,000, of which £500,000 has been issued in shares of £5 each. It has the supply of the Brush and Lontin patents for the cities of London and Westminster. It gives notice of application for provisional orders which will cover the whole of the leading thoroughfares of the metropolis. In the Paddington district it proposes to place lines "in, over, or along" all the chief streets and squares, including the Harrow and Edgware roads, Uxbridge-road, Kensington Palace-gardens, Westbourne-street, Pelesh-road, Hyde Park-square, and Hyde Park-gardens. The application for the district of St. George's, Hanover-square, confines the lines along Dublin-ground, and sides in Oxford-street, Regent-street, and Old Bond-street, continuing through Belgravia, down Vauxhall-bridge-road and Grosvenor-road to Victoria Bridge. A third notice of application covers the district between Oxford-street and the Albany in one direction and between Regent-street and Soho-square in the other. The other districts in respect to which the Metropolitan Brush Company proposes to make applications are—the St. Giles's-in-the-Fields, St. George's, Bloomsbury, and Holborn; St. Martin's-in-the-Fields and Westminster; Kensington; the Strand—including the Adelphi, Covent-garden Market and the Victoria Embankment; Chelsea, from Fulham-road to Brompton-road; Marylebone; Camden-town and Kentish Town, including Fernhill-Belsize-hill, and Clipham-rise; East London, including Sutton Dwellings, Newcastle, Commercial-road, Mile End-road, and the Stella Docks; Shoreditch and Islington through Highbury; and St. Pancras, in which are included such great thoroughfares as Euston-road, Tottenham-court-road, King's-cross-road, and Hampstead-road. The City, Clerkenwell, and St. Luke—that is, an area stretching from Hyde-park Corner to Upper Thames-street, and from Seven Dials to Blackfriars-bridge; Hackney, Edmonton, and Stoke Newington; Hornsey, Highgate, and Southgate; Tottenham; Acton and Ealing; Hampstead, Willesden, Hendon, and Finchley; Fulham; Chiswick, Battersea; Kensington, St. George the Martyr, and St. Saviour's; and Wandsworth and Wimbledon. The proposals of the Metropolitan Brush Company, in fact, enhance every part of London and the suburbs on which electric lighting, through the brightest prospect of becoming profitable, can be brought to bear.

THE EDISON ELECTRIC LIGHT COMPANY.

The Edison Company has a capital of £1,000,000, privately subscribed. It will compete for the lighting of the City, where it is already in possession. It will also apply for provisional orders covering some of the best of the London districts. Holborn viaduct is already lighted by the Edison Company; but the supply of electricity is to be increased by a new 1,200 light machine, which, it is stated, will be in operation before Christmas. This company proposes to establish a central station in High Holborn, the inhabitants being the large hotels and "public buildings." The company proposes to apply for provisional orders affecting the Strand district, Westminster, and the neighbourhood of the clubs, Kensington, and the region round Covent-garden Market. The Edison Company had proposed to apply for provisional orders for all provincial towns; but the Corporation may require it, as it has abandoned this project in favour of private negotiation with such corporate bodies as decide to keep the electric light under their own control.

SWAN UNITED ELECTRIC LIGHT COMPANY.

Like the Brush and Edison Companies, the Swan United has a capital of £1,000,000, £300,000 of which has been issued in £5 shares. This company has the Crompton and Gilt and the Swan incandescent lamps. It is confining its applications principally to the West-end, and more particularly to the districts round Hanover-square, the Strand, Victoria Station, and South Kensington. The area comprised in the applications in some cases includes portions of several parishes. The Swan Company is not at present applying for provisional orders for any provincial town or city, but is dealing privately with some of the corporations.

THE JABLOCHKOFF ELECTRIC LIGHT AND POWER COMPANY.

This company has a capital of £300,000, of which £150,000 has been issued in £5 shares. It is applying for licences in all the London parishes, and also in all the large provincial towns. It proposes to raise special capital for the carrying out of local contracts. By the Jablochkoff system the arc light can be used on the same circuit with the incandescent light.

FERRANTI, THOMPSON, AND ECE.

The capital of this company is £250,000. It entertained the idea of moving for provisional orders for all the London districts, but it has confined itself to asking for licences in two. These are the district of Chelsea, from the barracks along King's-road, and the Hampstead district, including Tonsley Park, Belsize Park, and Tyndale's-avenue. The company proposes to use a powerful incandescent lamp in the lighting of the streets, and to raise local capital in each of the districts lighted.

THE LONDON AND PROVINCIAL ELECTRIC LIGHT COMPANY.

This company has a capital of £200,000, in 40,000 shares, the whole of which have been issued. It proposes to make application for the lighting of the City, and also for the districts, "in and about" St. James's, St. Giles's, Bloomsbury, and Holborn.

WEST MIDDLESEX ELECTRIC LIGHTING COMPANY.

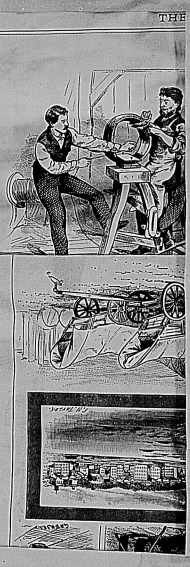
The West Middlesex Company has a capital of £100,000, in £1 shares, 50,000 of which have been issued. Some years ago it obtained a provisional order for the lighting of Hammersmith and Putney, but has not yet commenced operations. It has applied for a licence to the vestry of St. James's.

Although most of the companies named in the above list are the owners of patents for special varieties of the electric light, such of them as obtain concessions must be prepared to supply any kind of light that the consumer may desire, provided that it will not by its nature interfere with the general supply. A provisional order will empower the companies to supply and store electricity; to break up roads, streets, and public places; to interfere with sewers, watercourses, pipes, and telegraph and other wires; to purchase or take on lease any land that may be necessary; to make, hire, and sell all necessary lamps, machines, and fittings; to enter upon any buildings or premises necessary for the supply; and to collect rents and charges.

THE ELECTRIC COMPANIES AND THE METROPOLIS.

In London the districts affected and the companies which make applications connected therewith are briefly these :—

City, Clerkenwell, and St. Luke's	Brush, Jablochkoff.
Hackney, Bethnal-green, and Shoreditch	Brush, Jablochkoff.
Hornsey, Highgate, and Southgate	Brush, Jablochkoff.
Tottenham, Edmonton, and Leyton	Brush, Jablochkoff.
West Ham, East Ham, and Wanstead	Brush, Jablochkoff.
Fulham, Chiswick, Acton, and Ealing	Brush, Jablochkoff.
Hampstead, Willesden, Hendon, and Finchley	Brush, Jablochkoff.
Thornsbury and Rotherhithe	Brush, Jablochkoff.
Kensington, St. George's, and St. Saviour's	Brush, Jablochkoff.
Battersea and Wimbledon	Brush, Jablochkoff.
Camberwell and Penge	Brush, Jablochkoff.
Lambeth	Brush, Jablochkoff.
East London	Brush, Jablochkoff.
Lewisham and Lewisham	Brush, Jablochkoff.
St. Pancras	Pilsen Jost, Brush, Jablochkoff.
Paddington	Brush, Jablochkoff.
St. George's, Hanover-square	Edison, Swan, Brush, Jablochkoff.
St. George's, Bloomsbury	Brush, Jablochkoff.
St Anne, Soho	Brush, Jablochkoff.
St. Giles's-in-the-Fields	Pilsen Jost, Brush, Jablochkoff.
St. George, Bloomsbury	Brush, Jablochkoff.
St. Martin's-in-the-Fields	Brush, Jablochkoff.
Westminster	Edison, Swan, Brush, Jablochkoff.
Kensington	Edison, Swan, Brush, Jablochkoff.
Strand	Edison, Swan, Brush, Jablochkoff.
Chelsea	Ferranti, Thompson, and Ince, Brush, Jablochkoff.
Marylebone	Brush, Jablochkoff.
Holborn Viaduct	Edison, Pilsen Jost, Brush, Jablochkoff.
Hampstead	Ferranti, Thompson, and Ince.
Hammersmith and Putney	West Middlesex.



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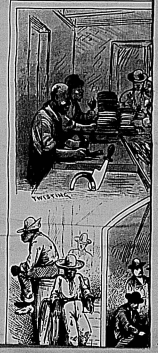

THE FULLER ELECTRIC LIGHT.

[SEE ILLUSTRATIONS ON PAGE 2.]

The development of the art of electric lighting is advancing to a greater extent, perhaps, than any other feature of the industrial progress of the age, the thought, skill and persevering effort of inventors, manufactory we have illustrated on the second page of this issue, is one of the pioneers in this field, and has brought the processes and appliances of electric illumination to a high degree of perfection. It was originally incorporated for the purpose of introducing the patents of Mr. J. B. Fuller, whose name it still bears; and after the death of Mr. Fuller, in 1870, it continued the work already begun, extending its researches and experiments and combining new patents with those already held, until the present complete result was attained. The company is now proprietor of the Fuller, Wood, Keith and Holcomb patents, and is a member of the Gramme Association.

Their improved Gramme Dynamo-Electric Generator, as now constructed, fully meets the severest tests to which such machines can be subjected. Its frame consists of the cast-iron side-plates, which are connected by the bars, or field-of-force magnets. To those magnets the poles, which almost entirely enclose the armature, are bolted, and are rigidly connected with each other by non-magnetic composition plates, thus preventing vibration or change of position of the poles. By this construction of the frame the greatest possible amount of magnetic force is attained. The armature, in which the electric current is generated, is a soft iron wire ring, closely covered with coils of insulated copper wire, firmly secured to its hub by a series of keys. The collector, commonly called the commutator, is composed of narrow copper sections, insulated from each other, and mechanically so arranged that any section can be removed without changing any other part of the machine. The brushes are narrow strips of copper, held in position by a brush-holder which prevents them from vibrating, and holds them in contact with the collector by a screw attachment. The current regulator is attached to an index-wheel on the front end of the frame. By setting this wheel upon its graduated scale, the number of lights desired are provided with the requisite current. Any less number than the maximum capacity of the generator may thus be maintained in operation, reducing the power required to drive it according to the number of lights in use.

The generators are constructed of all dimensions, and require but little care. Any of the parts can be readily replaced, as they are so made as to be interchangeable, and the construction is so perfect that no liability of derangement exists in their ordinary use.

The single lamp consists of a hollow suspending rod, a cylinder containing the mechanism for regulating the movement of the positive carbon pencils, a frame between the side-bars of which the carbon pencils are placed (as also the globe and shade when they are used), and the bottom plate which contains the negative carbon-holder. The automatic duplex carbon lamp is of similar construction, except that there are two suspending tubes, and two sets of carbon-holders are operated, changing the electric current automatically from one to the other when required. The carbons are 7-16th inch diameter. The single lamp—used also as a serial lamp where two or more lights are required in the same circuit—will burn from seven to eight hours. In the duplex lamp, when one set of carbons is consumed another set is automatically ignited, without cessation or diminution of light, and the duration is from fourteen to sixteen hours.

By means of an automatic cut-out, attached to both single and duplex lamps, any injury from accident or the defective operation of one lamp in a series is prevented from extending to the other lamps in the same series.

The Focusing Lamp is so constructed as to maintain the burning point of the carbons always in the same focus, and is especially designed to be used with a reflector or projector. Both carbons are fed with a positive motion, and not by cords or chains, and an adjustment at the base prevents any troublesome result, in case either of the carbons should burn faster than in the proper proportion. This lamp operates perfectly in series with both single and duplex standard lamps. With all lamps a hand-switch is provided for cutting the lamp out of circuit while replacing carbons, or in case the light is not required.

The usual size of the lights is 2,000 candle-power (nominal), but lights of much greater illuminating power are furnished when required.

The day has gone by when any argument was needed in favor of the adoption of the electric light. It is making its own way and demonstrating its economy in cost, its immense advantage in brilliancy and purity, and its freedom from unwholesome effects upon the air or injury to the eyes. For the illumination of streets and squares, and the interiors of large buildings, it is the only agent known, unless we choose to remain in the twilight of the past. Of the especial merit of the lamps and apparatus furnished by the Fuller Electrical Company, the best proof is the extent to which they are used. Their lights have been adopted in Brooklyn, Buffalo and Troy, N. Y.; in Hartford, Springfield, Providence, Philadelphia, Chicago, Washington, and various other cities. In the city of New York they are in use in numerous localities, among which are the spacious saleserooms of the Wheeler and Wilson Sewing Machine Co., Messrs. Lord & Taylor's Grand Street store and Broadway warehouse, the office of the U. S. Express Co., and the dock of the Old Dominion Steamship Co.

The New York offices of the Fuller Electrical Company are at No. 44 East Fourteenth Street. Mr. A. B. Chandler is the President and Mr. H. Seymour Geary Vice-President, Secretary and Treasurer. Mr. James J. Wood, inventor of the Wood Patent Lamp, and numerous other valuable improvements in connection with the art, is the mechanical engineer and electrician.

INCANDESCENT LIGHT.

THE EDISON COMPANY PREPARING FOR AN EVANSVILLE PLANT.

A Special Agent of the Company in the City—What the Company Is Doing Elsewhere, and What It Proposes to Do in Evansville.

Mr. Wm. F. Brewster, special agent of the Edison electric light company, of New York, is in the city to perfect arrangements for the introduction of the incandescent system of lighting in Evansville. Mr. Brewster has visited nearly all the cities where the Edison company has introduced its system of lighting, and has completed arrangements for the introduction of the light here. He has been in Louisville, Indianapolis, Kansas City and several smaller cities. Altogether the Edison company is now negotiating with responsible local organizations in twenty-four cities, including Evansville, and new organizations are being created and introduced almost daily. The company has within the last few months taken steps to put the Edison central system of lighting in Boston, St. Louis and Kansas City, and is now digging on Louisville, where a very strong company has been organized. Nashville, N. C., on the Pennsylvania railroad has a central system and is already lighted by means of incandescent lamps of ten candle power three lamps being on each post, and the posts being three hundred feet apart. This is the only city in the country, the streets of which are lighted entirely and satisfactorily lighted by electricity. Arrangements are now being made for similarly lighting Hamilton, Ont., near Orange, N. J., a large section of New York city is now lighted by means of these lamps, the light giving perfect satisfaction. The plant for this city cost six hundred thousand dollars, and could now be duplicated for considerably less than half that sum, the original plant having been an experiment and the system having been greatly simplified since then. There are two systems of wiring a city employed by the Edison company, the overhead wire and the underground electric tubing, the latter being in use in New York city and all other large places. That is the system it is also proposed to introduce here.

In Evansville there has been a thorough canvass of twenty-five blocks, including that portion of the city bounded by the river, between Fifth and Chestnut streets, and twenty-six more blocks are now being gone over, including First, Second and Third streets, so far as as Bayless. From this it is expected that a pretty accurate estimate can be made of the size of the plant that will be required here.

Mr. Brewster, in conversation with a JOURNAL representative last night gave quite enthusiastic talk speaking of the affairs of the Edison company. He says that until recently it has been the policy of Mr. Edison rather to perfect the system and to demonstrate its merits in a few central points, than to attempt to head off the speculators in the country at large. The system has now been brought to such a state of perfection, however, that the applications for the introduction of the light, which have for years been pouring in upon the company are receiving attention in the order of their receipt, and the result is that every block there is now a city in the east, and in the west, and south, will soon have the system in full operation. Mr. Brewster declares that the light can, on an average, be furnished cheaper than gas, and, where a large number of lights are required for fixed places as hotels, theatres, factories &c., even cheaper, upon an average.

Mr. Brewster, in answering all objections to the Edison incandescent light, says that the Edison system is the only one that is absolutely safe, and absolutely free from danger from fire. "You can," said the gentleman, "run your feet impunity break one of the incandescent lamps in a keg of powder, and the moment the glass is broken the light is out." He mentioned that during a recent visit to Chicago several experiments had been made with wirings selected with coal oil, the oil being thrown upon their midst without igniting them. Another advantage is the absence of heat. Burning in a vacuum, the lights consume no oxygen, and do not vitiate the air, and another point of importance to housekeepers is, that there is no smoke to soil pictures, curtains, furniture, etc.

Mr. Brewster was not disposed to discuss the merits of any of the other systems of electric lighting, but, in answer to direct questions by the reporter acknowledged that the so-called "arc" lights and candle power are "lamps are a delusion and a snare." He says these figures are obtained by means of what is called the Foreh standard, the light being five hundred candle power each the arcs in the four different directions running to the five hundred candle power each. There are no arc lights of one hundred candle power, as the statements to the contrary notwithstanding.

The operation of the Edison company have thus far been confined chiefly to, not wholly, to indoor lighting, for which it is peculiarly adapted; but for street lighting it is already demonstrated and in case, and Mr. Brewster thinks the public will very soon come to understand that for outdoor purposes the incandescent is very much superior to the arc system of lighting. In addition to being a steadier light, and it is, under the street-post system, much better diffused, and consequently more satisfactory.

Mr. Brewster will remain here several days in order to get matters into proper working order, and says that he desires the public to understand that when the company begins work here it will be upon a strictly commercial basis.

COTTON, WOOL AND IRON

AND BOSTON JOURNAL OF COMMERCE.

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THE EDISON SYSTEM OF ISOLATED LIGHTING.

When the writer of this was running the reportorial quill on a daily paper in New York city, some three years since, he was detailed more than once to visit the "Wizard of Menlo Park," and had pleasant interviews with him. He has also lived to see the vision, which has been heaped upon Mr. Edison's head—by a set of know-nothing journalists, who, unless they are sensationalists are nothing, and as sensationalists are very reluctantly turned into admiration of his merit and acknowledgment of his complete triumph.

The rapid strides made in electric lighting has been a matter of astonishment. It is safe to say that no man more than Thomas A. Edison has achieved success, or what is more satisfying to manufacturers, has achieved so signal a success that the electric light of to-day is free from the incidentals that have always attended gas and the accidentals that are in too close fellowship with kerosene oil. The Edison light is as far superior to any other light for manufacturing purposes as first-class kerosene is to moonlight. This is our own private expression. We have looked with much interest at the adoption of the electric light; we have seen it in the old world and the new; and it is only after some months of careful investigation with respect to its adoption by the manufacturing interests—and by manufacturing we mean mechanical as well as textile—that we are rather proud to say that the Edison light of to-day is the light, in its perfection for in advance of any and all others.

The Edison light is unlike any other electric light, and after Mr. Edison had thoroughly studied all that related to electric lighting, the circumstances under which it must be used, the purposes for which and the place in which, instead of pirating the inventions of others, making up arrangements which should neither be one nor the other make a system or invention, he made a most radical departure from any one who had preceded him, and invented a system of lights and all the appliances which were necessary to make that system successful and capable of adoption. This, as a matter of course, required time. How successful he has been, only those who have been most closely connected with him during all this work, can say.

It is true that during the time and through the delays caused by lengthy experiments he has been looked by the press, and in those who laugh last laugh longest, so Mr. Edison can afford to forgive those people for their ignorance, from the fact that he now offers the only thoroughly practical isolated light, and the only light that is completely applicable to the manufacturing or mechanical establishments where a natural light, such that does not glare in the eye, and one which is not more of a nuisance than a help, is demanded; where a light has a natural and pleasant yellow rather than the pale, ghastly white; where a light of small candle power, like eight to twenty-candle power, is furnished without that peculiar and almost intolerable flicker, jumpiness which, as we whatever term may be applied. While he has accomplished all this, he has also retained and embodied most important and essential qualities—that of proportionality his power to the light required, so that one, two, three, or more, the rooms of a large establishment can be lighted perfectly; and it is only a matter of momentary attention to graduate the power of the current to the work required; and if, on the other hand, only a portion of the work is required, it can be shut at a moment both to diminish the volume of the current and the work of the engine, with a steady that nothing approaching to incandescent adjustment of the regulation of a flow watch. Edison's points will all be considered by a Yankee manufacturer.

Mr. Edison has also accomplished other and important changes which are set forth further on in this article. He has accomplished also by his unassailing contempt for previously acknowledged laws in relation to electricity, he has ignored old and adopted standards, which had been held to be the only correct ones, and he has adopted standards of his own, seeking for himself laws in relation to electricity as he found them, the basis or the formulæ which he has established. He has proved that he can produce a current with the same energy as a "motor," and that he has accomplished the task which he set himself, namely, adapting the two greatest practical forces, steam and electricity, either his genius or those who believe in sensational. In a business manner with the two forces.

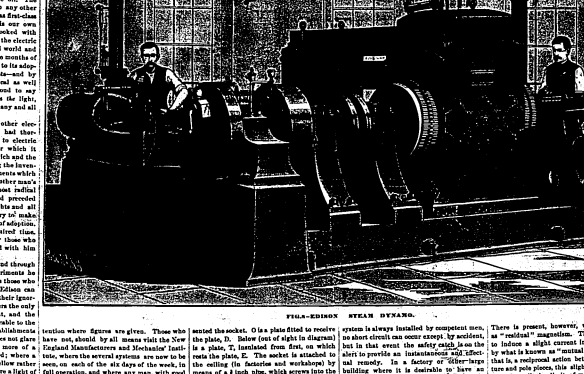
We have sought, in this article to avoid all theory, to confine ourselves to statements of fact, and these facts to such as shall interest our readers who have a wish to obtain the most authentic information in reference to this new child of invention, with a view to its adoption into their family. It is not a matter whether these families are large or small. Some of our manufacturing concerns have discarded one to two thousand gas burners, and introduced seven to nine hundred Edison isolated lights, and we shall soon show what these lights are doing by facts taken from the current expenses' sheets of these institutions. We are promised these facts and we shall very shortly give them publicity.

We have sought, in this article, to discard all biased statements of comparisons, and to confine ourselves simply and purely to fact, and we beseak from our readers careful attention where figures are given. Those who have not, should by all means visit the New England Manufacturers and Mechanics' Institute, where the several systems are now to be seen, on each of the days of the week, in full operation, and where any man, with good average ability, can make his own comparisons and deductions, with perfect satisfaction to himself, from a basis of business which is the only tangible or satisfactory one.

In the Edison system no are lights are used, the originators of that system believing that for the same power expended at the engine, or wheel, small lights, distributed over a given space, would give a far more effective illumination; for, by the former system (the are) with one large center of light, illuminating a large space, shadows must inevitably ensue. Edison uses what is known as an *incandescent* lamp, in which there are no moving parts and no mechanism; the light, therefore, is absolutely steady, provided the power is so. This lamp consists of a very fine platina thread, some nine inches in length. Within is the "carbon" about the size of and resembling a lamp-black, but in the shape of the letter U. This carbon is made of bamboo fiber (or was when the writer was there) which has been removed and is nearly pure carbon. This carbon is fastened to a small copper wire by bending the wire like a clamp about the carbon ends, and, to secure contact is rendered still more perfect by electroplating. This is known as the "carbon." In the manufacture of platinum wire, not more than a foot in length, and, to secure contact in the most perfect manner, a platinum wire is used, as also the same as that of glass, and consequently the two spread equally; therefore, the glass is not broken and the vacuum mentioned below is maintained. The base of the lamp is made of plaster of paris. At its bottom is a brass plate, which forms one of the "leading in" wires, and to which one of the "leading in" wires is soldered. The second brass plate which is pressed into the plaster, as in the base of the lamp, into the form of a screw. This forms the other "leading in" wire. The air is now exhausted from the globe until a practically perfect vacuum is obtained. The light is produced by the current passing from the battery, plates placed over the carbon to the second plate. As the carbon is of very high resistance, the mechanical energy furnished by the engine or water wheel is transformed first into electrical energy, and then into the energy of heat. Below is given (Fig. 1), a cut of the lamp. A represents the glass globe, B the carbon, C the plaster base, D one terminal, and E the other terminal. The average life of these is guaranteed to be at least 600 hours. In the same figure, and immediately below the cut of the lamp, is represented the socket. G is a plate fitted to receive the plug. Below cut of sight is diagram 2, which is a plate, T, insulated from first, on which rests the plate, E. The socket is attached to the ceiling (in the machine shop and workshops) by means of a 4 inch pipe, which screws into the base as H. The cap screw has also a hole inside of this pipe, one being attached to the plate, G, and the other by means of a small lead wire to plate, F. This lead wire serves as a safety guard; for since lead has about thirteen times the resistance of copper, if any short circuit or excess is accidentally produced, thus setting up an extra current, the lead will melt and the circuit be broken (stopping the flow at once) before the copper is heated. The key, K, serves as a break in circuit at pleasure, the "extinguishing" of the light. Each lamp is thus entirely independent of all others and can be turned on or off at will. Fig. 2 shows the lamp in position in the socket, being secured in same by means of the screw threads, I. The lamp can be used in any position, but in industrial work it is usually placed with the globe down as a screen of a metal or porcelain shade, attached to the ceiling (in the lamp, all the light is reflected on to the work in hand, and is used the same as a projection in the lamp. If it is desired, however, to use the lamp in any position can be readily changed, arranging this by means of a screw, which is also provided as shown in Fig. 2. These brackets are made in various forms, and are attached to the ceiling as mentioned above. As the circuit is metallically united on the system and lamp is made through brass in the box A, and not by the ground, as shown in Fig. 3, there is no danger of breaking this circuit by turning off a lamp. This can be required indefinitely. At the junction of the leg wires with the mains carrying the current from the generating machine, represented in Fig. 4. This consists of two parts, the base, A, and the plug, B. The main wires are led through the grooves, C, and the leg wires through the grooves, D. At the base of the plug is a plate, A, while the other, B, is the ceiling, in the plug, B, and, as in the base of the lamp, into the form of a screw. These are connected by means of a lead wire, C. When the plug is screwed into the block, A rests upon O, and D upon E. The current enters at S, passes through the lead wire to O, thence by the tap wire to lamp and back to main at X. This safety catch serves an analogous purpose to the automatic sprinkler in a factory. In the latter case, an abnormal heat melts the fusible metal, thus allowing the water to flow; in the safety catch, an increased current melts the lead wire for the reason mentioned above, thus breaking the circuit. This current might otherwise momentarily heat the copper wires. This device is a distinctive and noteworthy feature in the Edison system. As the system is always installed by competent men, the short circuit can scarcely occur, by accident, but in that event the safety catch is on the alert to provide an instantaneous and effectual remedy. In a factory or other large building where it is desirable to have an approximate whereby a number of lamps may be shut out simultaneously (as for instance, in the counting rooms or separate lays in the same room), without turning the keys in the individual lamps, a "switch" is inserted in the line at the junction with the central feeder coming from the generator. On a dark or cloudy day the aisles nearest the windows do not require the light as soon as those in the center of the room. The former are shut off by the switch until required, when the lamps are all turned on at once.

Where a large number of lights are distributed over several stories of a building, or where the light is required at some distance from the generator, "electric tubes" replace the ordinary feeders mentioned above. The tubes are the same as used by the Edison Illuminating Company of New York, in Edison's "First District." These tubes consist of lengths of gas pipe in which are placed two large cylindrical copper rods, separated from each other and from the tube by hard rubber insulating and impermeable washers; the intermediate space is then filled in with a fine sand and the tube is then the insulating properties of gutta percha. These tubes are laid in small trenches a foot and a half deep where it is desired to use the current. These trenches or tubes are connected directly with the dynamos or generators. These machines are of two sizes as shown in Fig. 5 and 6. Fig. 5 is known as a "Z" machine, and is capable of supplying the current sufficient to maintain 800 to 65 lamps at 16-candle power, or 125 to 100 lamps at 8-candle power. This will perhaps be more readily comprehended when it is stated that 16-candle represents the light furnished by an ordinary argand burner consuming 5 to 10 feet coal gas per hour. Fig. 6 represents the "L" machine with a capacity of 250 to 200 16-candle power, or 500 to 400 8-candle power lamps.

Fig. 7 is the "Z" machine, with a capacity of 800 16-candle power or 500 8-candle power lamps. In each of these cuts A represents the arms of the electro magnets, B the pole pieces between which the armature, D, revolves, and K the keepers. The brushes, C, collect the current generated in the armature, B, from the commutator, T. The current passes from one brush along the conductors shown on side of magnet arms to the top of the machine where it divides, part passing off by conductor, G to the feeder through the lamps back to D, and part passing about arms of magnet, joining the return current, in B, which is connected to the other brush. When the machine is first started there is no perceptible magnetism in the pole pieces



FIGS.—EDISON STEAM DYNAMO.

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Length.	Width.	Weight.	Pulley.	Speed.
Inches.	Inches.			
Z 0	30	3000	6x10	1200
L 00	30	2000	8x10	900
K 70	30	1750	10x10	800

Fig. 1. Engine represented in the Edison "Steam Dynamo." The crank shaft of driving engine

(Continued on page 6.)

THE EDISON SYSTEM OF ISOLATED LIGHTING.

(Continued from Page 5.)

is lengthened out and forms the armature shaft. This machine is capable of maintaining 1200, or, in an emergency, 1500 lamps of 16-candle power each. Six of these large machines are already installed and in operation in the "First District" in New York. The current produced by all the Edison machines is perfectly harmless to the person as well as to property and can be taken by a child with perfect impunity. The reason for this is that the electromotive force (analogous in some measure to pressure in a steam system) is extremely low and is very nearly constant and independent of the number of lamps burning; it is the same on the various sizes. The quantity varies very nearly in

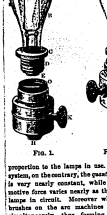


FIG. 1.

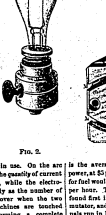


FIG. 2.

proportion to the lamps in use. On the Edison system, on the contrary, the quantity of current is very nearly constant, while the electromotive force varies nearly as the number of lamps in circuit. Moreover when the two brushes on the new machines are touched simultaneously, thus forming a complete circuit, a "counter electromotive force" is set up, which is many times the original. Thus a nervous shock is produced causing death. This "counter electromotive force" cannot be set up in the Edison system, as the circuit was already complete through the lamps; one more path was simply opened to the current. It is preferable to have the generators attached to a separate power, but it is not necessary, as the power can be applied by means of cotton belts, shaft from engine or wheel already in use. The power required to drive the various dynamos is as follows: 2, 8 horse power; 5, 20 horse power; 8, 32 horse power.

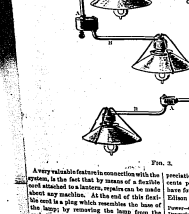


FIG. 3.

A very valuable feature in connection with the system, is the fact that by means of a flexible cord attached to a lantern, repairs can be made about any machine. At the end of this flexible cord is a plug which resembles the base of the lamp; by removing the lamp from the socket and placing the plug in which the cord is attached in its place, the current can be carried to any desired place.

The gas meters used in factories consume about one foot of cost gas per hour. One dollar's worth of 16-candle power lamps is equivalent in illuminating effect to about two such burners, and in ordinary work will replace about that number; as, however, they would give about the same illumination as at present, some manufacturers, believing "that it does not pay to run in the dark," increase the number. It has been found by experiment that standard and ample light is provided by using one 16-candle power lamp to four forty-inch boxes, or to two wide looms (say 96 to 112 inch reeds) on white goods, or the same for two gingham looms. In woolen mills, the swinging bracket mentioned above, is found especially valuable. On this class of work one of these is required for over each end of the loom, and so arranged as to swing in between the frame and the harness. This allows the weaver to keep run of the yarn on the bobbin in the shuttle box, and to "draw in" the yarn through harness, by swinging the lamp over the warp beam. On white or light colored woolens, two 8-candle power lamps per loom are sufficient. On dark colors, two 16-candle power lamps are used. The expense of lighting by the Edison system, as compared with gas, is much in favor of the former. Let us assume, for an example, a cotton mill of 10,000 spindles or about 200 40-inch looms, manufacturing sheetings and shirtings. This mill will require about 500 16-candle power lamps; the cost of installation will depend upon the length of mill, and also upon the position of the dynamo in relation to the work; but assuming an average length, the plant will cost in the neighborhood of $8000. For this purpose we shall need two "K" (250 light) dynamos, requiring in the neighborhood of 48-horse power. Assuming that, in an ordinary engine, 31 lb. of coal

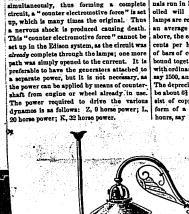


FIG. 4.

is the average hourly combustion per horse power, at $2 per short ton (2000 lb.) the expense for fuel would be the neighborhood of 3 cents per hour. The depreciation on the system is found first in the lamps, second in the commutator, and third in the brushes. The journals run in Babbitt metal, and when properly oiled will show no appreciable wear. The lamps are renewed at a cost of $1 each. With an average life of 600 hours, as mentioned above, the expense for lamps will be about 831 cents per hour. The commutator, composed of bars of copper about an inch thick, closely bound together and insulated from each other, with ordinary care will last 1500 to 2000 hours, say 1500, and can be renewed at a cost of $50. The depreciation on the two commutators will be about 63 cents per hour. The brushes consist of copper wires bound together in the form of a pillow; they will last 100 to 200 hours, say 150, and cost $8 per set. The depreciation on brushes thus amounts to 16 cents per hour. Tabulating the above, we have for the hourly expense for running 500 Edison 16-candle power lamps, as follows:

Fuel—31 lb. per hour, at $2 per ton	.03
Depreciation—Lamps	.08½
Commutator	.06
Brushes	.16

Let us now make a similar estimate on the cost of running 500 4-foot gas burners. At 22 per 1000 feet, this amounts to $1 per hour. Estimating 200 hours as the "lighting time" in factories in Massachusetts, we have a yearly cost for gas of $200, and $1,250 per hour the Edison system will cost $474, showing a saving of $726, equivalent to a little more than 2 per cent on the investment. This does not allow for depreciation, the interest on the apparatus, nor the fact that the Edison system is furnishing twice the light of the gas. Assuming $90 (cost, say, of $150) as the interest on the plant, and $400 as interest on fixtures, the former, furnishing but half the light, costs 331 per cent. more than the latter.

In ordinary manufacturing work, the above 500 lamps will replace at least 750 gas burners. On this basis the Edison system can furnish a far steadier, safer, and more healthy light, and one which does not heat or vitiate the air, at a cost of 50 per cent. original gas bills (interest on gas piping being figured at $400—at 20 per cent. on $2000). The above basis of 200 hours is the average period of illumination

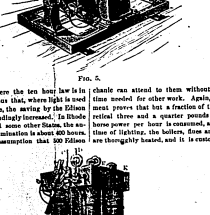


FIG. 5.

tion per year where the ten hour law is in force. It is obvious that, where light is used for a longer time, the saving by the Edison system is correspondingly increased. In Rhode Island, Maine, and some other States, the annual period of illumination is about 400 hours. Under the above assumption that the Edison

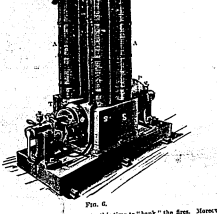


FIG. 6.

lamps of 16-candle power will replace 720 4-foot burners, in these States. We shall have a reduction equal to about 552 per cent, gas bills; or, reducing the cost to the equivalent of gas at 831 cents per 1000 feet, including 2 per cent. interest on plant. Or, to put the matter in still another form, the purchaser, from saving

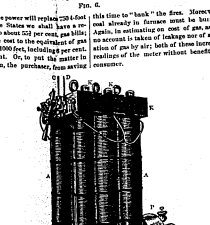


FIG. 7.

In expense of lighting his work, makes a profit greatly good investment. In these times when government bonds are 3 per cent. are considered good security.

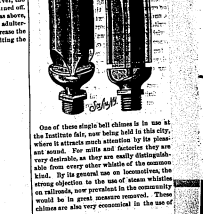
In the above calculations, it may be noticed that no allowance is made for attendance, as very little is required by the Edison system; no more, in fact, than is necessary to light the 720 burners. The general method pursued by this company is to place the dynamos in the engine room, machine shop, or other convenient place, where the engineer or master mechanic can attend to them without taking time enough for other work. Again, experiment proves that but a fraction of the theoretical three and a quarter pounds fuel per horse power per hour is consumed, as, at the time of lighting, the boilers, fires and stack are thoroughly heated, and it is customary at this time to "bank" the fires. Moreover, the coal already in furnace must be burned off. Again, in estimating on cost of gas, as above, no account is taken of leakage nor of adulteration of gas by air; both of these increase the readings of the meter without benefiting the consumer.

In mills using water as a motive power, the economy is obviously still further increased, and the cost for the above 500 lamps is reduced to the neighborhood of $1.50 per hour. Therefore, with water power the 720 4-foot burners being replaced by 500 16-candle power Edison lamps, and assuming 400 hours as the lighting time per year, the annual cost of the electric light, including interest on original outlay, will be equivalent to gas at 75 cents per 1000.

For domestic lighting the Edison system commends itself especially to the attention of householders; for, with the electrolliers and the brackets manufactured by this company, the wires are entirely concealed, and there are no noxious gases given off to vitiate the air and tarnish the metal hangings of the room, and no smoke to blacken the walls and ceilings. The lamps are now being manufactured and in use, which are connected by means of a flexible cord to the chandelier, and on which any purpose now occupied by the drop light. Meters also are used; these are virtually electrolytic cells. Each meter contains two cells, in each of which are suspended two zinc plates. One one-thousandth of the current used in the house is shunted through the first cell and one six-thousandth through the second. By the laws of electrolysis a current of a given strength will deposit a fixed amount of zinc per second. As the cells are carefully weighed before using, the accumulation of zinc on the negative pole shows the exact amount of current used in the house. The second cell is a check upon the first. As these cells might be placed in position where the sulphate of zinc solution would be frozen, an automatic arrangement is provided which will meet this difficulty. It consists of a compound spring made of brass and steel. This spring is set at 60°; the coefficient of expansion of brass being greater than that of steel (that is, the brass expands or contracts more quickly than steel), any change of temperature will tend to produce a curve in this spring and thus force the end against a contact piece, throwing into circuit an Edison lamp beneath the cells; by the slight heat produced from the lamp the mixture in cells is heated above freezing point; this heat also acts on the spring, which gradually straightens again, and when 60° is reached the contact is broken and the lamp thrown out of circuit. Thus no part necessary to the completeness of the Edison system, appears to have been overlooked by its originators, and the system now stands before the public perfect and complete in all its parts.

A NEW STEAM WHISTLE.

The "Single Bell" china whistle, a cut of which, showing the outside and the inside, is given herewith, has been before the public for about three years, during which time it has steadily grown in favor, and its sale largely increased. It is manufactured by the Crosby Steam Gage and Valve Company, at 50 and 97 Oliver street, Boston; they have exclusive control of it throughout the United States. It consists of a single bell, or cylinder, which is divided longitudinally into three compartments of unequal length, and so graduated that each gives a different tone, but so arranged that one steam valve sounds all together, and all the tones are blended into one agreeable and harmonious sound, free from the shrill, harsh noise of the common steam whistle.



One of these single bell chimes is in use at the Institute fair, now being held in this city, where it attracts much attention by its pleasing effect. For mills and factories they are very desirable, as they are easily distinguishable from every other whistle of the common kind. By its general use on locomotives, the strong objection to the use of steam whistles on railroads, now prevalent in the community at large, would be greatly removed. Those would be in great measure obviated if chimes are also very economical in the use of steam.

Remarkable Run by a Locomotive.

We note a remarkable run on the West Jersey railroad by a special passenger train, made up of a Class C anthracite locomotive, burning bituminous coal; a combination car, and two passenger cars; 114 passengers were on the train. The train ran through from Camden to Cape May, a distance as only one point, about 40 miles out, for water. The train left Camden at 2.01 P. M., and arrived at Cape May at 3.34. Records of speed were taken as follows: Westville to Cape May, 76.1 miles, in 76 minutes; Woodbury to Court House, 61.1 miles, in 60 minutes; Glassboro' to Vineland, 16.5 miles, in 14 minutes.

D. M. Smythe, the inventor of the book stitching machine made in Hartford, has gone to Europe to attend to business for the company there.

THE ELECTRIC LIGHT IN HOUSES.

FOUR years ago the famous Baron Munchausen took a trip to the moon. At the time the object of his excursion was unknown, but it is now supposed to have been taken on behalf of an electric lighting company, to discover how the soft white light, which we now obtain from a current of high tension, the light was supplied from dynamos in the comparative darkness of the moon. Whether the current could be so equalized that dynamos at any point could supply the lady at the man in the moon with an equal light, and whether the current could be distributed at all, are the Baron's chief but interesting and extensive account of life 'now does not relate. The moon named, it is to be presumed that this mission was a failure. At any rate nothing came of it, and it was reserved for Mr. Edison to evolve without a luxury excursion a method which has furnished a theme for many pens, and which has certainly proved that will soon be able to get up a little private moon, each for himself, and, by a simple system, even when the lunes are without any current, the silver rays as they come down will be a trifle dearer. Though it is to be devoutly hoped that the number of pens will not increase with the number of electric lights.

Mr. Edison's invention naturally met with much opposition, and, though the opposition has diminished considerably, there are still many who regard the electric light, in its present form, as a "delusion and a snare." The first lot of doubters, who did not believe that Mr. Edison could subdivide the current into small lights, were silenced some time ago by the actual subdivision, and soon the Edison Company proposes to illustrate to us the practicability of his system by illuminating the streets and houses in about a square mile of our city—that part bounded by Wall, Spruce, and Nassau streets, and the East River. In England the system has already been tested. Mr. Edison runs a model town there known as the Holborn Viaduct Station, and it illuminates, among other buildings, Dr. Tanner's Temple, and part of the London General Post-office. Besides the Bank Theatre in Milan, a portion of the Strasburg *Opéra*, and two steamships of the Oregon Navigation Company are lighted by Mr. Edison's system.

Yet it is certain that the inventor should meet with considerable opposition. The introduction of new forces, at first violently opposed, and now that gas is generally in use, it in turn opposed the introduction of electric light. How serious that opposition is, may be judged from the immense power at its back. It is reported that about one thousand millions of dollars are invested in gas all the world over. Of this amount about three hundred and eighty-five millions are invested in the United States, and about four hundred and five millions in England.

In selecting the down-town district for the first experiment on a large scale in this country, Mr. Edison had in view the fact that besides the large consumption of gas in this district, there is a good deal of steam motive power employed, which the Edison Electric Lighting Company proposes to supplant by electric motor power from the same current which supplies the light. A careful preliminary canvass of the district gave the following statistics: There are in the district 19,858 gas and burning between the hours of six in the evening; 1270 store-lamps, aggregating 2385-horse-power; 715 lamps and 90 chronometers, and 68 sewing-machines. Besides, the canvass elicited the interesting fact that five persons were used in the leather manufactories in the swamp. Eighty-four persons were employed in the top stories of buildings. Some of these horses are kept there from the time they are taken up until they die.

A canvass of the Madison Square district, bounded by Twenty-fourth and Eighteenth streets and the Eighth and Madison avenues, where work will soon begin, elicited facts with not less interest when contrasted with the statistics of the first district. There are in the houses 41,000 gas and kerosene buildings (hotels and theatres) burning over 600 gas jets each; 52 steam-engines, aggregating 1453-horse-power; only 8 boilers, and 14 elevators (the latter only in the hotel buildings). The buildings where the most sewing-machines are found contain the fewest gas jets.

The great saving in the current for motor power, as compared with steam, is that, as one engineer said, "while the electric motor does no run-ning, the steam-engine must run all the time." The introduction of a large number of electric motors will be required in run a large of sixteen-candle-power—the ordinary lamp. We can see a sewing-machine all day long at a cost to the consumer of five cents. There are in New York some 210,000 sewing-machines, and there is no reason why we should not supply each one with the cost of three."

The streets in the down-town district require thirteen miles of pipe. The Madison Square district embraces 180 acres, or forty-seven blocks, aggregating in length about 42,000 feet. As the pipe in this district will be laid on both sides of the streets, about 90,000 feet of pipe will be required.

The central station of the down-town district is located at Nos. 255 and 257 Pearl Street. Much work was required before the building was ready for the plant. This consists of six dynamos, and six engines to run the dynamos. Besides its incidentally four boilers, with an aggregate capacity of 1000-horse-power, boiler fittings, two large smoke-stacks, steam conveyors for coal and ashes, shafting, blowers, and the pumping and blowing apparatus. The placing of these requires vaults under the sidewalk, and a tendency iron framework resting on a strong bed of masonry and concrete. Each of the six engines has a normal capacity of 125-horse-power, and a maximum capacity of 200-horse-power, making a total maximum capacity of 1000-horse-power. A dynamo like the six used in this structure weighs thirty tons, so that the weight of the six is 180 tons. The weight of the fuel necessary to run the plant continuously for about 600,000 pounds, which is distributed on a floor to carry about 200 pounds per square foot of structure. The boilers, when under full headway, will consume 1800 pounds of coal and 4,000,000 gallons of water per annum, equivalent to a daily consumption of about the tons of coal and 11,000 gallons of water.

A full description of the dynamos belongs to electric circuits and insulation, and would fall to give an intelligent idea of the system as a whole. The dynamos, they consist in the main of powerful electro-magnets, between the poles of which a armature-coil revolves. The poles of the armature-coil are connected through the brushes with the commutator, from which the current passes by the pipe laid in the street to the various places of consumption, and similarly is given from whatever point the pipes are tapped into the circuit. The strength of the current can be regulated according to the amount of work required of it at any moment, so that there will be no waste of power or material. A regulator, namely, by varying the resistance of the circuit of the dynamo-field magnets, weakens or strengthens the current induced in the armature. An electro-motive-force indicator shows instantly any variation of the current produced by increasing or re-arranging any of the number of lights in the circuits. A supplementary instrument shows in the circuit of a number of "plus lights" in the regulating room.

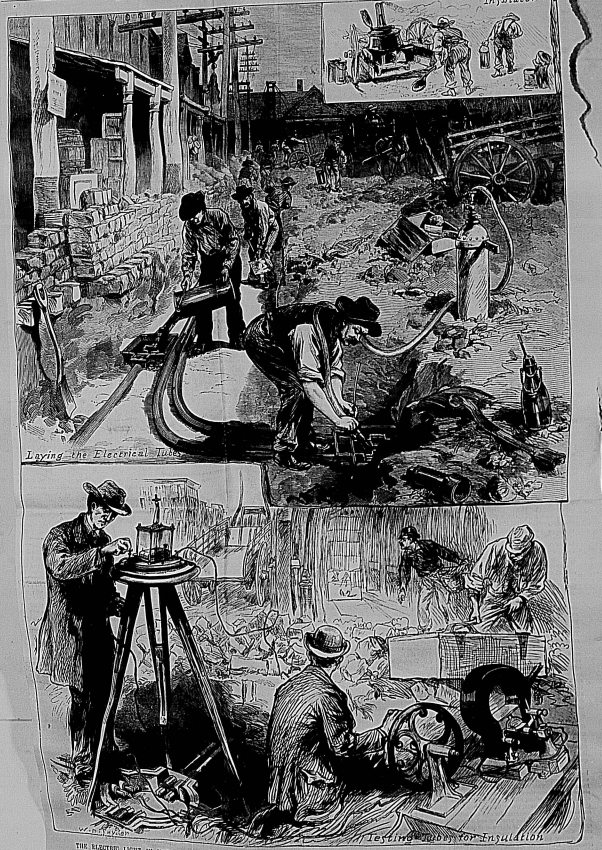
The laying of the pipes and boilers is a curious and interesting and popular feature of the work. The water remembers how much current was used exactly in October last by the queer-looking pipes and burns that were being piled up on the sidewalks of Gold, Spruce, and William streets.

Walking down Spruce Street one day he saw a number of people gathered at the corner of Spruce and William streets looking into a hole. In the hole a few feet below the surface was an iron pipe, which was covered with rough boards. But there was no one to explain the noises *Nitre* either of the hole or of the pipe. Soon workmen came along and began filling up the hole, but they had no information to give. Looking into Spruce Street, though, the writer saw that digging was going on in Gold Street. As he neared the spot he saw brace similar to that in the hole on William Street piled up on the sidewalk. The roadway on either side was dug up a few feet below the surface. A man was shipping about in the ditch with a tape measure, and several others were measuring small iron pipes, from which the thick pieces of metal projected. When an iron pipe was measured, a mark was made on it, and it was then lifted into the ditch. The writer was told by a man who was helping to lower the measuring pipes from which wires were to be led into the houses and business places of a portion of the district bounded by Nassau, Wall, and Spruce streets and the East River; and that Mr. Dynne, one of the engineers of the company, could explain the process.

According to Mr. Dynne, the pipes are ordinary iron pipes which insure thick copper wires and which are laid in the streets. The pipes lying on the sidewalk—separated from the curb by an iron railing—are intended for the houses, not differing much in size, are used. They are about ten inches in diameter, and are of cast iron. They are respectively junction boxes, connecting boxes, and distributing boxes. The junction box, of which the circular of the coupling and service boxes, is a combination of these in the coupling and service boxes. The junction box is the coupling box, to which connection between two pipes is made. The pipes rest on sections cut into the sides of the box, the pieces of metal projecting from either side being connected by clamps. The box is then filled up with a rubber insulating fluid, which cools into a solid. Then the lid of the box is closed. The combination coupling and service box is the same as the last, except that the coupling has a third, through which the wires are "served" to the houses.

The safety box is an ingenious contrivance to prevent danger from the heat caused by accidental crossing of the wires. The principle on which it works is as follows: Should wires cross by accident, the damage caused by the crossing heat would be considerable. In the safety box the fuses of copper wire are interrupted by lead. At most instantaneously with the crossing of wires the heat rises along to the lead and melts it. The result is to break the danger zone at once. These boxes are on the corner of every street, and are so arranged that the wires can be traced to any of those whether in the house or along the block are in good condition. Through the junction boxes the wires pass from the street mains in iron wire and enamelled cloth. Each wire is then led to the meter, which registers, for he looked on her as a superior being? Perhaps she was the current consumed. The meters are simply clocks, and her Nademan-like head was full of the mysteries and her father thought highly of her, and consisted at his visits, and as they were often together in a friendly way, but she has to be gone to make downright love to her, she told him plainly she could go no further in friendship than "and indeed," said she, "I would never leave my father for any young man."

Joseph Pinder knew that this declaration has just "Joseph Pinder knew that this declaration has just "Joseph Pinder knew that this declaration has just the friendly sensibilities and times two other men were in love with her, and that she was fond of them all, fight at being merely friendly, and she cool and friendly, and that she was fond of them all, fight at being merely friendly, and she cool and friendly, and that she was fond of them all, fight at being merely friendly, and she cool and friendly



THE ELECTRIC LIGHT IN HOUSES.—LAYING THE TUBES FOR WIRES IN THE STREETS OF NEW YORK.—DRAWN BY W. P. BEYCOK.—[SEE PAGE 394.]

July 25, 83. Phila Pa

THE OLD RELIABLE FALL RIVER LINE.

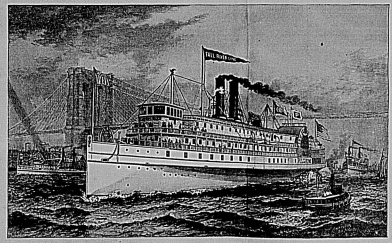
Since steam navigation began, the Thames or "North" River and Long Island Sound have each had their night lines, each progressing, in construction and fitting, through successive steps of size and magnificence. The Sound, however, is the greater water-way, open all the year, lying between the more important points, and serving for the larger fleet; the vessels there are the largest, strongest, and costliest, and the best of them have no equal in the world. Of the several lines, at times four but now three,—the Fall River has always been the leading one, and is now more than ever so. Its supremacy was first assured by its geographical position. Having three tenders for freight and two for passengers, it has always offered to the travelling public the unequalled advantage of long water-route and short rail, so that a whole night's rest is secured, and not merely half a one. An admirable rail service, offering choice of several morning trains Eastward from the boat, has supplemented this. The management has also been exceptionally progressive and pushing, and the world-wide popularity of the "Fall River Line" has been partly made by (and has partly made) the construction of the newest, largest, and incomparably superior boats afloat, vessels which without hyperbole may be called floating palaces.

From the time of the old and the wonderful *Bay State*, *Empire State* and *Metropolis*, the advance to the boats of the Line to-day is marvellous in all respects. The *Old Colony* and *Newport*, still running as the Newport boats in summer and the Fall River ones in winter, may still be called new and can hardly be excelled by the best vessels on other lines. Then came the mammoth *Priscilla* and *Providence*, originally built for the successful Bristol line, and they have been the kings of the Sound for some ten years. In features of construction which are apparent to the casual glance, these superb vessels are extremely unlike any of their predecessors; their holders are below deck, instead of "on the guards" outside; the wheels, wheelhouses and towns are less prominent, and they have more the appearance of sea-going vessels.

The careless outsider might suppose that the Fall River Line had vessels enough, and had built the *Pilgrim* (see the fine illustration accompanying this article) as a sort of present to the travelling public, or just to show what can be done by a corporation having the money, experience, and enterprise. This Line has always been the Consul of the Sound in respect to safety and humanity (even a misfortune, purchased by good management); it has combined with the White Star regularity of trips the Golon reputation for speed, and in bringing out the *Pilgrim* it discourages competition, or (if it be more American to say so) invites and challenges competition to come on.

The old New England flavor and history come to the front in the name of *Pilgrim*, and it has perhaps been forgotten by most of their thousands of passengers that the *Bristol* and *Providence* (belonging to the line by adoption, not birth) were originally intended to have a New England air, in the names of *Puritan* and *Plymouth*. The Fall River Line set out to build a steamship, and it is a simple truism to say that *they have done it*.

Externally the *Pilgrim* looks like her two sisters, except in having a simpler and subtler appearance by having the usual "big-chimney" and by having her two 4 twin-stacks near together and in line with the keel. But she is distinctive in being fire-proof and collision-proof. Of iron—double-skinned, being a ship within a ship, and as strong as if intended for an iron-clad for war purposes—for over a hundred water-tight compartments, and would not sink if her bottom were broken in. Her engines and boilers are iron-encased; the pantry has iron ceiling and walls, and (last floor) the kitchen is similarly protected, and there is no fire elsewhere on the boat; abundant hose and pumps complete the precautions in this respect. The twelve steel boilers are capable of developing 5,000 horse-power. Steam moves the huge rudder, and the steersman has only to start the engine which does his formerly hard work for him. Electricity does the lighting.



The light is worthy of a separate paragraph, and does of a separate article. The system is of course Edison's. There are 321 lamps and candles the same lamps in some other steamboats the power is not supplied parsimoniously, and the lamps give standard light. Two engines, supplied by a 150 horse boiler, run the three dynamos, and these can be also connected to the regular "donkey" engines, if need be. The Edison system is perfection itself, as regards safety from fire and personal injury; fire is impossible, the wires may be handled with impunity, the lamps will not burn the hand, and breaking their globes instantly puts out the light. There are six miles of wires for the light-system, and nearly a ton of candles, with their intolerable heat and disagreeableness, would be required for the same work; the Edison lamp gives out the least heat possible for a light, and if it *nothing but heat, having absolutely no effect upon the air except to warm it.* The grand saloon, decks, and passages are illuminated by beautiful electoliers of from two to thirty-six lights, and in each room the occupant has simply to touch a key in order to flood his room with light; there being, of course, an electric "call" or annunciator close by for summoning a servant. The light-system is divided into separate sections, so that no accident to the engines or boat can put the boat in darkness. Nervous passengers need not dread the imaginary burglar at the window, or the actual disorderly person; there is too much light for disorder, and a touch of the finger, in any emergency, real or fancied, makes everything as bright as noon. Could anything more perfect or desirable be imagined?

It is rather discouraging to try to describe the *Pilgrim's* decorations. They resemble those of her sister boats in departing widely from the old-time white paint with gilt gingerbread, which gives place to marquetrie in natural woods, real elegance in upholstery and carving, and tasteful but indescribable combinations of "picked out" and neutralized and contrasted color. There are carpets by the mile, four acres by the square acre; beyond this, one must fall into a bewilderment of panels, cornices, bronzes, etc., with hints of Vaniyke brown, salmon, rose, gold, maurelive blue, pearl, stone-gray, seagreen, and every other tone which taste can devise and money secure. From eleven saloons—including, ingleni, lavatory, dining-room, hall, stateroom, saloon, mast, passage, barber, butcher, fire-staff, dog, commander and deck-hand, the *Pilgrim* was meant to be the highest, attainable perfection, adapted in each part to its purpose, and the verdict of seeing has already been pronounced. She measures 376 feet in length, weighs some 3,500 tons, can talk 1,200 persons away to sleep, is the largest inland steam vessel in the world, and cost (if any passenger cares to know) a round million.

The Fall River Line has thus the greatest number of boats, and by comparably the finest; the largest rail portion, with the largest number of sleeping cars; the only attraction of water-travel; the only direct Brooklyn and Jersey City connecting by Annex boat. It also has unequalled freight capacity with four exclusive freight steamers running, the largest of some 2,500 tons. To its aim nor secrets are old: line offers a most varied selection of boats to all places of interest, and will make for him other combinations not expressly stated. If there were anybody who ever travels or will travel, and had not already heard of it, body who ever travels or will travel, and had not already heard of it, he might be urged to inspect the *Pilgrim* and try the Fall River Line he might be urged to inspect the *Pilgrim* and try the Fall River Line —he could not condition like Touchstone, "when I was at home I was in a better place." If any regular traveler did not know of Mr. Oscar L. Conner, the boat-in-himself Passenger Agent (O. P. A.) for about 10 New York, he might be expressly mentioned. To those who possess his acquaintance it isn't necessary, for he is himself a sort of dividend to the possession of the *Pilgrim*.

switch-stand shown by this company has an effective self-locking lever handle; the operation of locking the rail after the throw is made by simply dropping the handle, it having a forked end which drops upon a projecting lug. A rail brace for frogs and curves is another notable exhibit. This is made by simply twisting a piece of short flat iron ⅜ inches thick, so that the lower end which remains flat can be drilled to receive the bolts holding it to the crossties. The upper end, owing to the twist, has a vertical position which is out to fit under the shoulder of the rail. Such a brace is of course more serviceable and less liable to break than the ordinary cast-iron ones.

Engineering Instruments.

OAKMAN & SONS.

Messrs. W. Gaskan & Sons, of New York, show their improved levels and transits for the use of civil and mining engineers. The level made by them has a long center bearing in the telescope so that the object end can be moved for use, smoothly and accurately. This bearing is continuous and made of the best gun-metal. Some new and important features have been introduced in the manner of adjusting the instrument which makes this operation easily and expeditiously performed. Their transits are also improved upon in many respects, noticeably so in having gun-metal bearings, ground glass shades for the verniers and shifting centers for plumb and instrument without disturbing the tripod.

This firm have in addition a mining transit with a solar attachment for reconnoissance or underground surveying, possessing many features which renders it desirable for the mining engineer who has both underground and surface work to perform.

YOUNG & SONS.

Messrs. Young & Sons, of Philadelphia, the well-known makers of instruments of precision for civil and mining engineers, have a well selected display of transits and levels for use on railways and in mines; also the new Davidson level; solar transits and compasses, level rods of different kinds, also transit rods, chains of different lengths, tapes, pins, note-books, etc. They have on exhibition a transit made by themselves in 1832. It has an inside vernier, universal bubble, ball and socket-joint, otherwise it appears like the ordinary railway transit of to-day, only smaller and lighter. It has been in constant use, and was loaned to the firm by a Pennsylvania surveyor for the Exposition.

L. MANASSE.

Mr. L. Manassee, of Chicago, optician, manufacturer and importer of optical and mathematical instruments, makes a large and attractive exhibit. He has the Gurley level and transit, level and transit rods, tape lines of all kinds, Swiss and German drawing instruments, surveyors' and mining compasses, colors, brushes and drawing paper for the engineer, draughtsman and artist. He has also the "Positive" T square and section liner, it is positive in all its motions, has measurements in fractional and decimal parts of an inch, working with accuracy, and by it lines can be drawn at any angle on any part of a draughting board.

KEUFFEL & ESSER.

Messrs. Keuffel & Esser, of New York, have a large and varied exhibit of engineers' and draughtsmen's instruments, including transits and levels, with their accompanying rods for the use of civil, mining and hydraulic engineers; machinists' rules—engine-divided—U. S. standard or metric measurements; draughting tables and instruments of all kinds; also planimeters, protractors, stereoscopes, mercurial and mining barometers. Their latest novelty is the "unique" T square, with patent swivel, locks instantaneously at any angle, and has a single movable head.

STRASSBURGER & CO.

Messrs. Strassburger & Co., of Chicago, have an exhibit of instruments of their manufacture, consisting of a level, transit and the accompanying rods, tape-lines, chains, reading glasses, etc. The levels and transits made by them have the latest improvements, and are of the different sizes in general use. The exhibit reflects great credit upon this western house.

BUFF & BERGER.

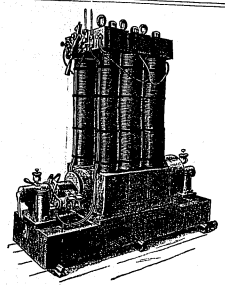
Messrs. Buff & Berger, of Boston, have an excellent display of engineering instruments of all kinds, including theodolites, astronomical instruments, mercurial and mining barometers, field glasses and telescopes.

THE EDISON DYNAMOS AND METER.

The large illustration shows the Edison Central Station Dynamo of 1200 lamp capacity. It may be observed that in this machine the field magnets are placed in a horizontal position for the purpose of securing connections and economy of space; the engine and dynamo rest upon the same bed plate. This machine was designed especially for town use or village lighting, where overhead conductors are used and streets as well as buildings are to be lighted, thus being termed the "Village Plant System."

The engine shown as connecting with the large dynamo, is a Porter-Allen high speed engine, especially designed for the purpose of driving dynamos, being termed the "Standard Pattern," and is manufactured solely by the Southwark Foundry and Machine Company, of Philadelphia. They are generally run at a speed of 250 revolutions per minute, developing 125-horse power when driving 1200 lights.

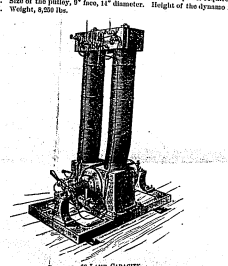
An engine of this class is driving the Edison dynamos at the Chicago Railway Exposition. It is 100-horse power and drives 350 Edison incandescent, and 60 Thompson-Houston arc lights. The cylinder is 11½" dia-



DYNAMO—550 LAMPS CAPACITY.

meter and the piston stroke 20". This engine at 230 revolutions per minute develops 100-horse power with 85 lbs. initial pressure in the cylinder.

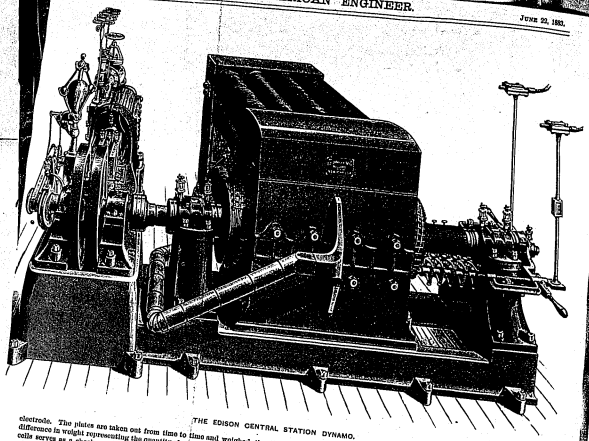
The dynamo shown as having six vertical magnets has a total lamp capacity (16 candle) of 550 lamps. The revolutions of the armature per minute to produce this light should be 900, and the horse-power required is 12. Size of the pulley, 9" face, 14" diameter. Height of the dynamo is 6' 6". Weight, 8,250 lbs.



DYNAMO—20-LAMP CAPACITY.

The dynamo shown with two vertical magnets has a total lamp capacity (16 candle) of 60 lamps. The revolutions of the armature are 1200 per minute, and the horse-power required is 3. The size of the pulley is 5" face and 10" diameter. Its height is 6' and weighs 300 lbs. The Western Edison Light Company, of Chicago, also manufacture dynamos having lamp capacity of 100, 165, 250 and 300 lamps respectively. In all these smaller machines the magnets are vertical.

The meter used in connection with the larger dynamos, when several persons are supplied with light from the same machine, operates as follows: As the electric current passes through the meter a portion is diverted through the corrugated shunts and the electro-lyte cells. These cells being partly filled with a solution of sulphate of zinc, to which are inserted the electrodes of zinc, chemical action resulting from the passage of the current causes a transfer of zinc from the positive to the negative



THE EDISON CENTRAL STATION DYNAMO.

electrode. The plates are taken out from time to time and weighed, the difference in weight representing the quantity of current used. One of the cells serves as a check upon the other and all the meters, whose used in a large system, have a check in the large meter at the central station which

EDISON METER.

automatically records all current produced by the dynamos. This ingenious device is said to operate within 1 per cent. of accuracy, and as there can be no leakage of current the consumer pays only for the actual light used.

PROCEEDINGS OF SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.—A regular meeting of this society was held June 2, 1883. Mr. Washington Jones in the chair; 18 members and one visitor present. Mr. Carl Hering read a short article on electrical units and formulæ, giving a list of the units and the relations existing between them; showing how these relations were known. blood into formulæ containing any two or more of the units, for convenience of calcula-

tions. The units are: *ampère*, the unit of current strength; the *volt*, the unit of electromotive force, the *ohm*, the unit of resistance; the *coulomb*, the unit of quantity; the *ampère hr* or *volt*, the unit of capacity; the *volt-coulomb* or *joule*, the unit of energy; and the *volt-ampère* or *watt*, the unit of power. The relations are that an ampère is a volt divided by an ohm. An ampère is a coulomb per second. A farad is a coulomb divided by a volt. A volt-coulomb is a volt multiplied by a coulomb. A volt-ampère is a volt multiplied by an ampère. As these relations contain no coefficient other than unity, they express the relations between any quantities measured in terms of those units, as well as the units themselves. Professor L. H. Haupt exhibited a drawing of the Phœnixville Bridge which was built by Mr. Morgan Robinson, C. E. (formerly Member of the Club), in 1866, for the Philadelphia and Reading Railroad, over the Schuylkill. It is a two lattice and one special skeleton 72 feet chord spans and 184 feet of iron masonry. There are four regular lattices of 175 feet each, and whole length of the bridge 1,000 feet. Yearly inspection of this bridge is said to be entirely filling. It is believed to be one of the lightest and oldest lattices of its kind in this country, having cost but $28,000.

The Secretary exhibited a sample of Japanese paper which he had obtained through Mr. J. L. L. Waddell. Many years ago papers were of excellent quality and could probably be used with great advantage in engineering practice. The method of manufacture is a large secret to some extent, as there is no patent law in Japan. Just the paper is made of new material instead of old rags, as in America. The best qualities are made of silk; the others probably of bark fibre. The specimens exhibited are about 20" X 24½", and would cost but a few cents each to import. The Secretary presented the following communication, which he had received from Mr. F. Hecht, member of the club: "I enclose a few blanks being 'Application for Admission' and 'General Regulations' regarding an International Exhibition which is to take place next winter, at Nice, France. Some of the readers may desire to avail themselves of this opportunity. Mr. Cassaboom, Secretary of the Commercial Exhibition, will be President of the Committee. By applying directly to him or through me the latter may receive all information desired. I am a member of the Committee. Please return blanks with application." Mr. Hecht requested for any further particulars, any one can obtain any information he desires.

LITERARY NOTICES.

THE MATERIALS OF ENGINEERING, PART II., IRON AND STEEL. By Bourne H. Woodbridge, A. M., C. E. Size, 7½×5. Pp. 104. New York: John Wiley & Sons, 15 Astor Place. $0.50 paper cover, $1.00 cloth.

In this little volume the author has given clear concise descriptions of the processes of the Manufacture of Iron, Steel, and Malleable Cast Iron. 2. Manufacture of Cast Iron. 3. Manufacture of Wrought Iron. 4. The Ores of Iron. 5. Reduction of Ores. 6. Manufacture of Steel. 7. Manufacture of Steel. 8. Chemical and Physical Properties of Iron and Steel. 9. Strength of Iron and Steel. 10. Effect of Temperature and Time on Resistance. 11. Flow of Metals. 12. Fatigue; Weshler's Law; Launhardt's Formula. The condensation of material contained in this volume is too great to enables a detailed review

The name of material contained in this volume is too great to enables a detailed review

ELECTRIC LIGHTING.

The Practical Working in This Important Branch of the Electrical World.

Illustrations of the United States Electric Lighting Company's Plant.

For the purpose of presenting a popular view of the subject of electric lighting we give several illustrations of the United States Electric Lighting Company's plant, which has been in operation for over a year at work in the Railway Exchange Building, at Chicago, run by a Westinghouse engine and lighting a considerable part of the building. The light is also in use by a large number of prominent establishments all over the country.

WESTON ARC LIGHT.

Among others the Pennsylvania Railroad Co., at Horse Shoe, Renova, Pa.; Susquehanna Shops, Sunbury, Pa., and at Erie Shops, Erie, Pa.

Armstrong Mfg. Co., Manchester, N. H.; Merrimack Mfg. Co., Lowell, Mass.; Rhode Island Locomotive Works, Providence, R. I.; Congress and Empire Spring Co., Saratoga, N. Y.; New York, Lake Erie and Western Railroad Co., Susquehanna Shops, N. Y.; Iron Steamboat Company, New York City; New York Central and Hudson River Railroad, Elevator, New York City; New York Tribune, New York City; John Roach & Son, New York City and Chester, Pa.; Spuyten Duyvil Rolling Mill, Spuyten Duyvil, N. Y.; Consolidated Iron Works, Greenpoint, L. I.; Globe Woolen Mills, Utica, N. Y.; Dunkirk Locomotive Wks., Dunkirk, N. Y.; Schenectady Locomotive Works, Schenectady, N. Y.; New York State Capitol, Albany, N. Y.; J. B. & J. M. Cornell, New York City; Cornell, Witherbee, Sherman & Co., Port Henry, N. Y.; Philadelphia Postoffice, Philadelphia, Pa.; Bethlehem Iron Works, Bethlehem, Pa.; Wharton Switch Co., Jenkintown, Pa.; Kensington Mfg. Co., Reading, Pa.; W. Va.; Atlanta and West Point Railroad, Atlanta, Ga.; Hall's Safe and Lock Co., Cleveland, O.; Cuyahoga Rolling Mill Co., Cleveland, O.; Cleveland, Mt. V., and Del. Railroad Co., Mt. Vernon, Ohio; North Chicago Rolling Mill Co., Chicago, Ill.; Palmer House, Chicago, Ill.; Wheeler, Hill & Co., Chicago, Ill.; Weaver & Chadwick, Chicago, Ill.; Rand, Moore Paper Co., Lockport, Ill.; Brookhaven Bridge & Co., Kansas City, Mo.; Hannon Shoe and Clothing Co., St. Louis, Mo.; Alex. Hyndman & Co., St. Louis, Mo.; Michigan Car Co., Detroit, Mich.; and Plankington House, Milwaukee, Wis.

The purpose of this article is to present a brief description of the Weston dynamo electric machines, supplied by the United States Illuminating Company. The last light is a mile and a half from the battery. There are two Watts-Campbell Corliss engines, of fifty horsepower each, stationed in Prospect park to supply the light. The effect of the night was magnificent. The softness and brilliancy was altogether different from what one has been accustomed to in the perfect electric lights furnished for local purposes. It threw out the shadows sharply and strong, presenting almost as remarkable pictures of all below and around—pallid, but clear and strong. As persons passed beneath the rays their sharp shadows rotated around them as they moved. The outline of the bridge was thrown in sharp relief beneath, its reflection in the waters almost completing with it a perfect circle. From the towers the view was unspeakably grand. The two great cities lay beneath in irregular outline, with patches of deep shadows here and there and spots of bright glare between. Each circuit is worked by two twenty-light Weston dynamos, coupled in tension, and driven by an independent Corliss engine, of the Watts-Campbell type. Considerable margin has been provided both in dynamos and steam plant, in view of a probable increase in the number of lights.

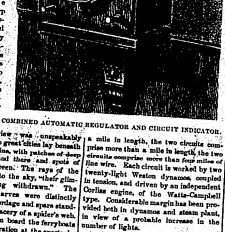
COMBINED AUTOMATIC REGULATOR AND CIRCUIT INDICATOR.

As the structure of the bridge is mainly of iron, unusual difficulties have been encountered in regard to insulation; but the approach to the City of Chirches. From the Brooklyn side each light looked like a glorious beacon inviting the citizens of New York to a haven of repose.

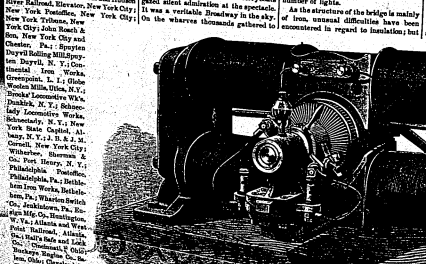
There are in all seventy arc lamps in two circuits of thirty-five lamps each. Of these fourteen, are placed in the main span, fifty on the approaches, and the remainder at the stations at each end, and in the engine house. The two circuits are entirely independent of each other, and are so arranged as to take in alternate lamps entirely around the bridge. As the bridge, with its approaches, is more than two miles in length, the two circuits comprise more than a mile in length, the two circuit conductors more than four miles of wire.

There are in all seventy arc lamps of the Weston double carbon type, arranged

WESTON ARC LIGHT.



COMBINED AUTOMATIC REGULATOR AND CIRCUIT INDICATOR.



THE WESTON DYNAMO ELECTRIC MACHINE.

witness the grand spectacle. On the two towers, on both sides of the river, men, women and children came out to gaze upon the dazzling scene. The lights that usually glimmer and blaze in the two cities paled their ineffectual fires before the wonder. From the New York entrance to the bridge the scene was particularly striking. Every light looked like a watch-fire seatinel guarding the approach to the City of Churches.

There are in all seventy arc lamps of the Weston double carbon type, arranged in two circuits of thirty-five lamps each. Of these fourteen, are placed in the main span, fifty on the approaches, and the remainder at the stations at each end, and in the engine house. The two circuits are entirely independent of each other, and are so arranged as to take in alternate lamps entirely around the bridge. As the bridge, with its approaches, is more than two miles in length, the two circuits comprise more than a mile in length, the two circuit conductors more than four miles of wire. Each circuit is worked by two twenty-light Weston dynamos, coupled in tension, and driven by an independent Corliss engine, of the Watts-Campbell type. Considerable margin has been provided both in dynamos and steam plant, in view of a probable increase in the number of lights.

As the structure of the bridge is mainly of iron, unusual difficulties have been encountered in regard to insulation; but these have been surmounted in a very satisfactory manner, and the arrangement and position of the circuits is equitably to be commended. The wire used for the mains is insulated by a thick coating of kerite, wound with a kerite tape, and the whole enclosed in a heavy braid of braided cotton.

As the alternate lamps are entirely independent of each other, in regard both to circuits, and to dynamos and engines, the chance of any accidental stoppage of all the lights at once is very much less. In order to provide every possible safeguard, arrangements have been made for connecting the bridge circuits with the lighting stations of the United States Illuminating Co. in New York whenever desired. This company also light a very large portion of New York City.

The illustrations in actual operation it will be seen that electric lighting has passed the experiment stage, and is already a thing numbered with the great steps of progress of this age. The system adopted by the United States Electric Lighting Company consists of the Weston arc system and the incandescent system comprising the Weston dynamo and the maxim incandescent lamp.

The Weston has been found by tests to give a higher result in electrical energy than that of other machines, and added to tests recently made at the Paris Exposition the company state that "very important improvements have been made in the Weston machine, by which a considerably higher efficiency has been obtained. Recent tests of our machine of the present type have shown a conversion of from ninety-eight to ninety-nine per cent of the power applied in driving the machine into electrical energy, and an actual or working efficiency of more than ninety per cent. That is, more than ninety per cent of the power used in driving the machine is available as electrical energy in the working circuit for producing light or power.

This extremely high efficiency is due to scientific correctness of mechanical and electrical design, great care in the study of details, and thorough workmanship and excellence of materials employed in construction."

The large cut herewith gives a general view of the machine and from which it will be seen that the great strength of the frame and rigidity of the bearings, supplemented by extremely accurate mechanical work, admit of running the armature with very slight clearance between its periphery and the pole pieces of the field, a condition essentially for high electrical efficiency.

The sectional armature is one of the most striking distinctive features of the Weston dynamo machine. By its use the formation of induced currents in the core is entirely obviated, and the armature is made to act as a centrifugal blower to maintain a rapid circulation of air and prevent injurious heating.

The field coils are placed in a branch or derived circuit of high resistance, instead of in the main circuit, as is usual in other machines.

Great advantages are secured by this arrangement; less power is required for sustaining the field; the current generated is more steady and the machine more uniform in its operation; it is impossible to injure the armature by short circuiting, and the regulation of the machine is more simple, perfect, and economical than is possible with any other construction.

The machine used in the arc and incandescent systems are of the same general type, the principal difference between them consisting in the winding of the armature and field coils, which is varied to produce the different qualities of current required.

The current generated by these machines is absolutely continuous, and free from the rapid vibrations or pulsations which render the current used in many other systems so dangerous to life.

In both systems the regulation of the machine is entirely automatic. Lights may be turned on or off at will, and a corresponding change is at once made in the current generated, and in the amount of power required for driving the dynamo.

In the incandescent system no special regulating mechanism is used. The dynamo itself is so constructed that the strength of the current generated is always directly proportioned to the number of lights in circuit. The result is not produced by any readjustment of parts, but necessarily follows from the law of operation of the machine itself. Turning lights on or off of itself instantly increases or diminishes the current correspondingly, and this operates with such quickness and precision that with a hundred lights, for example, in circuit, ninety-nine may be turned out instantly without sensibly affecting the brilliancy of the remaining light, and without any change in the adjustment of the machine.

INCANDESCENT LAMP HOLDER AND SWITCH.

The importance of this remarkable capacity of the Weston machine can hardly be over-estimated. In the incandescent system the number of lights in use is often subject to sudden fluctuations which would, without perfect automatic regulation, not only produce unpleasant variations in illuminating power, but endanger or destroy the lamps.

In the arc system, owing to the different arrangement of the lamps in the circuit, a separate regulator, shown in illustration, is used with the machine. This consists of a rheostat placed in the circuit of the field coils, and simple mechanism for automatically adjusting its resistance so as to vary the strength of the field magnets, in accordance with the number of lamps in circuit.

This regulator is extremely simple in construction and efficient in operation, and entirely obviates the waste of power and disturbance of the proper operation of the machine, which are incident to all other methods of regulation hitherto applied to arc systems.

In both systems any number of lamps, up to the full complement, may be run by the machine, and the expenditure of power is very nearly proportional to the number of lamps used. In the character

June 6, 1882.

ELECTRIC

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Chemicals, L
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THE BABCO

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WATER TUBE

In Use by

M. Gemmill & Co., Wilmington, Del., Aug. 1880, 4 boilers.

Folts Company, Norwich, Conn., July 1881, 24 order June, 1881, 4 boilers.

Lonsdale Mfg. Co., Providence, R. I., Dec., 1881, 24 order May, 1881, 4 tubs.

Campbell Sons & Co., Dutton Duck, Woodbury, Del., Aug. 1871, 24 order May, 1875, 4 boilers.

Magnolia Cotton Mill, New Orleans, La., Feb., 1882, 24 order June, 1882, 4 boilers.

Burton Woolen Mills, Boston, N. J., Sept. 1874, 24 order March 1881, 4 boilers.

Somerset Mfg. Co., Norton, N. J., Dec., 1879, 24 order March, 1881, 4 boilers.

Bound Brook Woolen Mill, Bound Brook, N. J., Oct., 1874. 4th order Jan., 1881, 2 boilers.

Fairmount Worsted Mills, Philadelphia, Pa., Aug. 1879, 2 boilers.

Conshohocken Worsted Mills, Conshohocken, Pa., June, 1881, 24 order April, 1882, 2 boilers.

W. O. Daly & Sons, Oakum, Jersey City, N. J., Feb., 1880. 24 order Feb., 1881, 2 boilers.

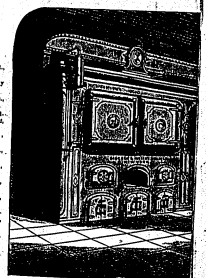
Lawrence Sugar Works, Brooklyn, N. Y., July, 1879. 1 125.

Rosamond Woolen Mills, Almont, Mich., April, 1874. 4 125.

Standard Oil Co., Bayonne, N. J., Dec., 1880. 5th order Feb., 1882. 14 125.

Brooklyn Oil Refinery, May, 1879. 24 order Feb., 1881. 2 125.

Charles Pratt & Co., Brooklyn, N. Y., July, 1881. 1 125.



THE BABCOCK & WILCOX BOILERS, AT P. C. HA

SAFETY. ECO

tal quality of the light produced, the incandescent system is the most perfect means of artificial illumination yet discovered. Although it is, for lighting large spaces, greatly inferior to the arc light in economy, it is admirably adapted for general interior illumination in places where arcs are light would not be suitable, and for a great variety of uses is unquestionably cheaper than gas or any other system of lighting.

The Weston machines for running incandescent lights are especially well fitted for use as motors; and, in addition to these, they are building a number of special sizes of motors for furnishing small amounts of power, which may be run on the same circuits with incandescent lamps when desirable.

The Weston system of regulating motors, which the company will shortly be prepared to introduce, they claim to be the only one yet devised by which different motors in the same circuit can be governed independently without waste of power.

The United States Electric Lighting Company furnishes a large portion of the illumination for the Chicago National Railway Exposition. It has put in over twenty thousand feet of insulated wire, and two hundred electric lamps, each light requiring seven tenths of one horse-power. At the northeast corner of the Main Exposition Building, within a space measuring, possibly, 45x35 feet, surrounded by an iron railing, stands a neat booth or office, handsomely painted and finished. Adjacent to the office, and to the left as the visitor approaches, is a magnificent one hundred horse power Buckeye stationary engine. This, in conjunction with the Washingtonian engine at the southern end of the building and a large Corliss in the west side, supplies the requisite power for running the dynamos. Of these wonderful electric machines, capable of reversion at a moment's notice into powerful motors, there are seven in close proximity to the office and numerous others scattered about the building. To the left of the large engine is a four horse power Weston electric motor, deriving its motive power through an ordinary-looking cotton-covered copper wire connected with a large dynamo at the other side of the exhibit. From this motor runs a belt which operates a pump, capable of raising two hundred gallons of water every minute. The water pumped is elevated one foot through a 4½-inch pipe to a tank, whence it is discharged a miniature waterfall surrounded by profuse shrubbery and imitation walls of rock. Behind the steadily falling sheet of water are arranged a number of electric lights in brightly-colored globes. The effect is startling every time of the rainbow appearing, disappearing, and blending in rapid succession.

Hanging in irregular profusion around the cluster of electric machinery are brilliantly-glowing lamps of both the Maxim incandescent and Weston arc pattern. At regular intervals along the entire eastern side of the building and down the center, reaching to the extreme southern end of the annex, are strung the United States Lighting Company's lamps. The press-room, ball leading to it, large restaurant, commissioners' offices, etc., are also supplied with lamps from the same source, either in single lights or in shape of pendant chandeliers.

The seven Weston dynamo-electric machines on exhibition comprise dynamos ranging from one forty-light arc to a five-hundred-light arc. The largest incandescent dynamo furnishes two hundred lights and the smallest fifteen lights. These are entirely separate from the 125 arc and 100 incandescent lights operated from engines in other parts of the building.

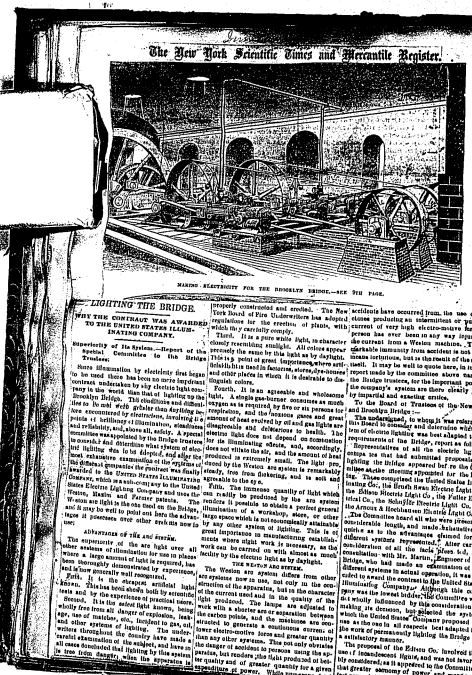
The electric railway running entirely around the gallery of the building, operated on principles entirely original as regards the application of electricity as a railway motive power, is also run by an electric current furnished directly through two Weston electric motors.

The entire exhibit of the United States Lighting Company at the Exposition is under the management of Mr. Alex. P. Wright, an electrician of long experience in both the United States and Canada. While the company has been located at New York for some years, and had its main offices at Nos. 80 and 81 Liberty street, New York, it has recently opened an office in Chicago, in charge of Mr. C. C. Warren, at 185 Dearborn street. Mr. Warren is a practical man, thoroughly conversant with the construction and operation of the electric lighting business, and has succeeded in placing a very large number of these circuits of arc lights in the West.

ELECTRIC LIGHTING COMPANIES.

A great number of companies have lately been formed for the purpose of practically applying recent discoveries in electrical science. The eagerness with which the shares of those undertakings are being absorbed by the public, is very remarkable, considering that absence of speculation in other departments. Something must, no doubt, be allowed for the novelty of the schemes in question, something, too, for the beauty and magnificence of the results obtained from the use of electricity as a lighting agent. It is certain that the astonishing effects produced by this mysterious natural force were incapable of dazzling the intelligence as well as the eyes of those before whom notice it has been placed. From one point of view, the readiness of the public to subscribe for shares in electric companies is not to be regretted. The new companies will have a fair chance of showing what they can do to redeem their promises, and in the long run the best system or systems—for it is quite conceivable that there may be several practically equal excellence—will become established in public favour. But before that happy consummation arrives there will, in fact, be a period of some trouble and anxiety to be gone through even by the shareholders in the companies which are destined to come safely out of the struggle for existence which is evidently before them. Without questioning the wisdom of those who hold that electric energy will eventually be largely used for illuminating purposes, it may be suggested to those who are thinking of investing in the shares of new electric companies, several of which were until within the last day or two apparently nearly ready to start, that they should clearly recognise that they are putting their money into a speculation, and not into an established investment. The difference between the two is not always appreciated by the class of persons who rush at the issue of any new undertaking. In the present state of development of electric lighting, the companies which have been formed to supply electricity for this end, and other purposes are very much in the position of mining speculations. That they may be successful may be fully conceded, but that they will all be successful is far from probable, and the difficulty of determining which are most likely to be so suggests the necessity of a cautious selection of their company by those who are tempted by promises of high profits.

It seems clear that no fewer field than electric companies for the display of the astuteness of the promoter has been discovered for some time. The rapid increase of the system of electric lighting is a matter on which only experts and those who are qualified experts, in this branch of electrical science are by no means conscious. The progress of invention has been so rapid that the supply of adequately-instructed electricians is not at present equal to the demand for them. Another reason why people with money to invest, which they would feel the less of, should think twice before applying for shares in an electric company, is the doubtful value of many of the patents on which reliance is placed by writers of prospectuses, not that the inventions they are supposed to protect are of no value, but that they have already been patented by some one or other. Even as regards the most recent inventions disputes arise as to priority, which will probably soon furnish a fine crop of litigation. The differences between the four best known incandescent lights are almost nil, to the uninstructed eye, variations in the form of the carbon filament being to all appearance the principal point in which they differ the one from the other. And each of the companies which work them has already obtained one or more of its rivals with injunctions to restrain infringement of patents. Finally, what is more likely than that some new system may be invented which is as good as, or possibly superior to, those on which the companies now starting into life depend? Electric Lighting and Power stocks may very properly be held by those who have money which they can afford to lose without inconvenience. If they choose their company or companies well they may not lose, but, on the contrary, may gain profits, which ought to be proportionate to the risk run. But those who cannot afford to go without a return for their money, and whose circumstances may compel them to realise at an unfavourable moment, might do very wisely indeed, not only of the financial bona fides of the company, but also of the practical efficiency of the electric system it is to work, before they buy its shares. "Above all" let them beware of thinking that, because there was lately an enormous rise in "Electric Lights," the shares they think of applying for will rise too. In the first place, every fresh issue necessarily reduces in some degree the market value of all securities of the same class as itself. When new issues are numerous and frequent, the effect on the value of the mass of existing capital is sure to be perceptible after a time. In the next place, there are strong reasons for thinking that the rise in question was not wholly due to the merits of the undertakings concerned, but partly to market manipulation; that it was, in fact, due to a "corner." The heavy fall that has occurred this week may perhaps convince the sceptical that the market was a dangerous one for a speculator who was not "in the swim" to meddle with. Any market, however large, may be "cornered," as was seen in Liverpool last year, if a sufficient number of speculators have sold "for the fall." The electric light market is a small market—a ridiculously small market considering the noise it has made—and is consequently easily manipulated by a few powerful operators, especially with the public to help them by taking up the shares freely.



The New York Scientific Times and Mercantile Register.

MAKING ELECTRICITY FOR THE BROOKLYN BRIDGE.—SEE 7TH PAGE.

LIGHTING THE BRIDGE.

WHY THE CONTRACT WAS AWARDED TO THE UNITED STATES ILLUMINATING COMPANY.

Dissatisfactory of its System.—Report of the Special Committee to the Bridge Trustees.

Since illumination by electricity first began to be used there has been no more important undertaken by any electric light company in the world than that of lighting up the Brooklyn Bridge. The excellence and skillfulness so far displayed by the Bridge trustees have been exemplified by electricians, involving in a number of intelligent illumination, simultaneous and reliability, and, above all, safety. A special committee was appointed by the Bridge trustees to consult and determine what system of electric light lighting was to be adopted, and after the most exhaustive examination of systems of electric illumination, the contract was finally awarded to the United States Illuminating Company, which, as will occur easy to the United States Electric Lighting Company and then the Weston, Maxim and Farmer patents. The Weston arc light is the one used on the Bridge, and a word by way of point out here the advantages it possesses over other systems now in use:

ADVANTAGES OF THE ARC SYSTEM.

The superiority of the arc light over all other systems of illumination for use in places where a large amount of light is required, has been known and generally recognized by experienced electricians. It is the cheapest artificial light known. The best results both by scientific tests and by the experience of practical users. Second, it is the safest light known, being wholly free from all danger of explosion, heat, escape, use of matches, etc., incident to gas, oil and other systems of lighting. The uniformity throughout the country have made a careful examination of the subject, and have in all cases manifested that lighting by this system is free from danger, when the apparatus is properly constructed and worked. The New York Board of Fire Underwriters has adopted regulations for the erection of plants, with which they carefully comply.

Third. It is a pure white light, in character closely resembling sunlight. All colors appear correctly the same by this light as by daylight. This is a point of great importance, where artificial light is used in factories, stores, dye-houses and other places in which it is desirable to distinguish colors.

Fourth. It is an agreeable and wholesome light. A single gas-burner consumes as much oxygen as is required by five or six persons for respiration, and the noxious gases and great amount of heat created by oil and gas lights are disagreeable and deleterious to health. The electric light does not depend on combustion for its illuminating effects, and, accordingly, does not vitiate the air, and the amount of heat produced is extremely small. The light produced by the Weston arc system is remarkably steady, free from flickering, and is soft and agreeable to the eyes.

Fifth. The immense quantity of light which can readily be produced by the arc system renders it possible to obtain a perfect general illumination of a workshop, store, or other large space within a less economically attainable by any other system of lighting. This is of great importance in manufacturing establishments where night work is necessary, as the work can be carried on with almost as much facility by the electric light as by daylight.

THE WESTON AND OTHER ARC SYSTEMS.

The Weston arc system differs from other arc systems now in use, not only in the construction of the apparatus, but in the character of the current used and in the quality of the light produced. The lamps are adjusted to work with a shorter arc or separation between the carbon pencils, and the mechanism used to operate is so constructed as to generate a continuous current of lower electro-motive force and greater quantity than any other systems. The not only obviates the danger of accidents to persons using the apparatus, but renders the light produced of better quality and of greater intensity for a given expenditure of power. While numerous fatal accidents have occurred from the use of machines producing an intermittent or pulsating current of very high electro-motive force, no person has ever been in any way injured by the current from a Weston machine. This remarkable immunity from accident is not by any means fortuitous, but is the result of the system itself. It may be well to quote here, in full, the report made by the committee above named to the Bridge trustees, for the important points of the company's system are there clearly stated by impartial and scientific men.

To the Board or Trustees of the New York and Brooklyn Bridge:

The undersigned, to whom it was referred by this Board to consider and determine what system of electric lighting was best adapted to the requirements of the Bridge, report as follows:

Representatives of the several lighting companies that had submitted proposals for lighting the Bridge appeared before the Committee at their meeting appointed for the hearing. The companies were the United States Illuminating Co., the Brush Swan Electric Light Co., the Edison Electric Light Co., the Fuller Electrical Co., the Schuyler Electric Light Co., and the Arnoux & Hochhausen Electric Light Co.

The Committee heard all that were present at considerable length, and made exhaustive inquiries as to the advantages claimed for the different systems represented. After careful consultation with Mr. Martin, Engineer of the Bridge, who had made an examination of the different systems in actual operation, it was decided to award the contract to the United States Illuminating Company. Although this company was the lowest bidder, the Committee was wholly influenced by this consideration in making its decision, but selected the system which the United States Company proposed to use as the one in all respects best adapted for the work of permanently lighting the Bridge in a satisfactory manner.

The proposal of the Edison Co. involved the use of incandescent lights, and was not favorably considered, as it appeared to the Committee that greater economy of power and more perfect general illumination would be obtained in the Bridge, by the use of powerful arc lights.

Of the different arc systems represented, the Weston system is used by the United States Co., and the Brush system used by the Brush-Swan Co., seem to present greater advantages than the others. Both of these systems are well known and have for a long time been in successful and very extensive use throughout the country, and the companies which are introducing them are doing a large business and have had great experience in carrying out installations similar to that desired for the Bridge.

While there seems to be little room for choice between the two systems in regard to reliability of the apparatus for continuous use, the Weston system appears, from the facts presented to the Committee, superior to the Brush in other respects, and especially in economy of power and in safety.

The engineers of the Bridge have carefully examined the Weston apparatus and are of the opinion that it is admirably designed and well constructed, and the large number of lights of this system which they have observed in operation on New York City appeared to be working in a very satisfactory manner.

It appears that local and momentary lights which have been made of different dynamo machines with reference to economy of power, and especially those conducted by the Committee appointed for that purpose at the Paris Electrical Exposition, show a considerably higher efficiency for this Weston dynamo than for the Brush or for any of the others which have been brought into competition with it; and it is stated by the representatives of the United States Co. that important improvements have been made in the Weston machine since those tests were made, which make its superiority in this respect still greater.

As the expenses of supplying power to operate the lights is to be borne by the Bridge corporation and will be continuous, any considerable reduction in the amount of power required appears to be a very material consideration.

In view of the numerous reports of fatal accidents occasioned by persons coming accidentally into contact with the wires of electric lighting circuits in which a current of very high tension is employed, the Committee inquired very carefully into the relative safety of the different systems submitted and from the facts elicited, is satisfied that the advantages of the Weston system in this respect are very marked. The Weston lamp is constructed to work with a very short arc or the separation between the carbon points (the length of the Weston arc being about 1-32 of an inch, while the arc employed in other systems is from 1-16 to 1-8 of an inch in length) and the tension of the current required for working a given number of lamps in the same circuit on the Weston is correspondingly low. The Weston current is also continuous and uniform, while in other systems, notably the Brush, the current is pulsating in its character; and all writers on the subject appear to agree that a pulsating current is more dangerous than a continuous one of the same tension.

As the Bridge is to constitute a great public thoroughfare and any defect of insulation or accidental disfacement of the wires might bring the iron work of the structures into the circuit, it seemed to the Committee to be highest degree objectionable to permit the use of such a current as would be capable of doing deadly harm. A current of very high tension, especially when it is pulsating in its character, appears to be peculiarly dangerous in this respect.

Of the systems examined, those of the Weston Co. and the Brush Co. are the only ones which have been in successful and extensive use for a long time, and which are known to be reliable. Both of these systems are well known to be reliable. Both of these systems are well and very extensive use throughout the country, and the companies which are introducing them are doing a large business and have had great experience in carrying out installations similar to that desired for the Bridge.

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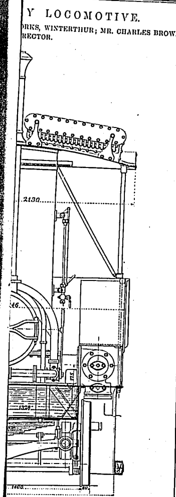
ELECTRICITY AND TELEGRAPHY.

THE COST OF ELECTRIC LIGHTING.

AT the lecture delivered by Mr. J. W. Swan at the Royal Institution, on electric light, on March 10, the author chiefly dealt with its cost. He directed his remarks principally to the mode of lighting known as the "incandescent." He said that the difficulties encountered in the construction of incandescent electric lamps had been conquered, and that their use was economically practicable. They knew by actual experiment that continuous heating to a fairly high degree of incandescence during 1200 hours did not destroy a well-made lamp. What the utmost limit of a lamp's life might be they did not know. Probably it would be an ever-increasing span; as, with increasing experience, processes of manufacture were sure to become more and more perfect. Taking it, therefore, as fully established that a cheap and durable lamp could now be made, the further question was as to the cost of the means of its illumination. The cost of producing light by means of electric incandescence might be compared with the cost of producing gas light in this way: 2 cwt. of coal produced 1000 cubic feet of gas, and this quantity of gas, of the quality called fifteen-candle gas, which produce 3000 candle light for one hour. But besides the product of gas, the coal yielded certain bye products of almost equal value. He would, therefore, take it that they had in effect 1000 feet of gas from one cwt. of coal instead of from two, as was actually the case. The one cwt. of coal would give fifty horse-power for one hour. Repeated and reliable experiments showed that they could obtain through the medium of incandescent lamps at least 200 candle-light per horse power per hour. But as there was waste in the conversion of motive power into electricity, and also in the conducting wires, he made a liberal deduction of 25 per cent. and took only 150 candle-light as the nett available product of one horse-power. For fifty horse-power, the produce of one cwt. of coal, they had then 7500 candle-light, as against 3000 candle-light from 1000 feet of gas. That was to say, two-and-a-half times the amount of light which the gas from the same quantity of coal was capable of producing. There remained, however, an allowance to be made to cover the cost of renewal of lamps. There was a parallel expense in connection with gas lighting in the cost of the renewal of burners, globes, chimneys, &c. He could not say that those charges against gas lighting would equal the corresponding charges against electric lighting, unless they imported into the account—as he thought it right to do—the consideration that, unless minute attention be given, far beyond what was actually given, to all the conditions under which the gas was burned—nothing like the full light product which he had allowed to be obtainable from the burning of 1000 cubic feet of gas, would be obtained. Taking that into account, he thought but little, if any, greater allowance need be made for the charge in connection with the renewal of lamps in electric lighting than ought to be made for the corresponding charges for the renewal of gas burners, globes, chimneys, &c. But it would be seen that even if the cost for renewal of lamps should prove greater than the corresponding expense in the case of gas, there was a wide margin to meet it before they had reached the limit of the cost of gas lighting. He thought, too, it might be fairly placed to the credit of electric lighting, that by this mode there was entire avoidance of the damage to furnishings and decorations of houses, to books, pictures, and to goods in shops, which was caused through lighting by gas, and which entailed a large expenditure for repair, and a large amount of loss which was irreparable. In comparing the cost of producing light by gas and by electricity, he had only dealt with the radical item of coal in both cases. Gas lighting was entirely dependent upon coal—electric lighting was not; but in all probability coal would be the chief source of energy in the case of electric lighting also. When, however, water power was available, electric lighting was in a position of still greater advantage, and in point of cost altogether beyond comparison with other means of producing light. With regard to the cost of plant, there would be a more even balance in the two cases. In a gasworks they had retorts and furnaces, purifying chambers and gasometers, engines, boilers, and appliances for distributing and regulating pressure. Plant for generating electricity on a large scale would consist principally of boilers, steam engines, dynamo-electric machines, and batteries for storage. No such electrical station, on the scale he was supposing, had yet been put into actual operation; but several small stations for the manufacture of electricity already existed in England, and three large stations designed by Mr. Edison were almost completed in America. They were therefore on the point of ascertaining by actual experience what the cost of the works for generating electricity would be. Meanwhile they knew precisely the cost of boilers and engines, and what ought to be the cost of dynamo-electric machines of suitably large size. There were consequently sufficient grounds for concluding that to to produce a given quantity of light electrically the cost of plant would not exceed greatly, if at all, the cost of equivalent gas plant. There remained the cost of distribution. Could electricity be distributed as widely and cheaply as gas? On one condition, which he fully hoped could be complied with, that question might be answered in the affirmative. The condition was that it be found practicable and safe to distribute electricity of comparatively high tension. The importance of this condition would be understood when it was remembered that to effectively utilise electricity in the production of light it was necessary that the resistance in the carbon of the lamps should be relatively great to the resistance in the wires which conveyed the current to them. In order to supply the current to the lamps economically there should be comparatively little resistance in the line. Distribution in this manner had the merit of simplicity, and it involved no danger to life from accidental shock; moreover it did not demand great care in the insulation of the conductor. But it had the great defect of limiting within comparatively small bounds the area over which the power for lighting could be distributed from one centre. In order to light a large town electrically on this system, it would be necessary to have a number of supply stations, perhaps half a mile apart. It was evidently desirable to effect a wider distribution than this, and he hoped that either by arranging the lamps in series, so that the same current passed through several lamps in succession, or by means of secondary voltaic cells, placed as electric reservoirs in each house, it might be possible to economically to obtain a much wider distribution. Whether by the method of multiple arc, which necessitated the multiplication of electrical stations, or by means of the simple series or of secondary batteries connected with each other from house to house in single series, the lamps being fed from these in multiple arc, he was quite satisfied that comparatively with the distribution of gas, the distribution of electricity was sufficiently economical to permit of its practical application on a large scale. As to the cost of laying wires in a house, he had it on the authority of Sir William Thomson, who had just had his house completely fitted with incandescent lamps, that the cost of internal wires was less than the cost of plumbing in connection with gas pipes. Referring to the use of carbon as the wick of an electric lamp, Mr. Swan pointed out that excellent carbon filaments could be produced from the bamboo, and also from cotton thread treated with sulphuric acid. The sulphuric acid treatment effected a change in the cotton thread similar to that which was effected in paper in the process of making parchment. He exhibited an example of a carbon filament produced from parchmentised cotton thread. The filament, he said, was not more than the ·01 of an inch in diameter, yet a length of three inches, having therefore a surface of nearly one-tenth of an inch, would give a light of twenty candles when made incandescent to a moderate degree. The interesting experiments with which Mr. Swan illustrated his remarks were watched with much interest by a crowded audience, including Dr. Tyndall, Professor Abel, Professor Franklin, and other well known scientific men.

Y LOCOMOTIVE.

RKS, WINTERTHUR; MR. CHARLES BROWN, RECTOR.



These engines having generally to run on grooved ram rails, and these rails generally being (in addition to he grooves) bodily lower than the general level of the oad, it is evident that mud and dirt must there accumu-ate, so that in addition to the great wear which inevitably akes place in engines which have to work on lines with requent curves, and these with very small radii, we have o add the destruction caused by the mud and dirt car-ied by the wheels into the mechanism, and further by he defective state of lubrication in consequence of the ubricants being washed out by water and thin mud or ried up by dust. Taking these things into considera-ion it can easily be imagined that the amount of wear and ear must be enormous, in some cases it being almost npossible to work the line, one-half the engines being lways laid up for repairs. Boxing up the mechanism alliates the evil in some degree, but introduces others at he same time, and not the least of which is the rendering he mechanism inaccessible; further, the doors, &c., work oose and soon cause a most intolerable clatter.

The organs which suffer the most in tramway locomo-ives are the axles, axle boxes, and hornblock guides, the onnecting and coupling rod bearings, crosshead guides, ccentrics, &c. To get over these difficulties it will be bserved that in the new design of Mr. Brown now illus-rated the axle boxes embrace the axles entirely for their hole length and are so closed at the sides and on the ... that dust and mud cannot enter (see Fig. 3). Further, ... axle boxes, instead of working in the ordinary horn-block guides, are furnished with globe ends lodged in suitable bearings formed in two frames which are independent of the general engine framing; these independent frames are anchored to the general framing by four radius bars, two of which form the longitudinal and two the transverse connexion, so that the general engine framing is free to follow the vertical play of the carrying springs, but in all other directions is constrained to follow the independent frames and wheels. The radius bars just referred to will be seen in Figs. 2, 3, and 5. By this arrangement all sliding motions between guides are replaced by angular motions round pivots, and this motion is of course not only much less in amount than the direct sliding motion would be, but as care is taken to make all the pivots dust and dirt proof, the friction and wear and tear are enormously reduced. A further advantage of this plan of independent frames is that it affords an opportunity of increasing the spring base indefinitely so that with a very restricted wheel base, which would require very stiff springs, by lengthening the frames beyond what is necessary for carrying the axle boxes, as shown in plan on the engravings, the spring base is increased to 2.350 metres (= 7 ft. 8½ in.), the wheel base being only 1.450 metres (= 4 ft. 9 in.), and laterally the springs are 1.450 metres (= 4 ft. 9 in.) from centre to centre, instead of about 1.200 metres (= 3 ft. 11¼ in.), which it would be if the spring pillars were made to rest direct on the axle boxes as in the usual manner. This arrangement in the case of engines with such a small wheel base (as is necessarily the case with tramway locomotives) and relatively high centre of gravity, makes them ride much more easily, and of course reduces the wear and tear of engine and line. The manner in which the springs are arranged so as to bring the bearings on to these points will be clear on inspection of our illustrations.

The brakes are made to embrace extra brake wheels fastened on to the inner side of the driving wheels (similar to the plan of Mr. Larson, as exhibited at Paris in 1878). The brake blocks being hung from the independent frames the action of the springs is not suspended whilst the brakes are in action; it is evident that by the above arrangement the strain on the brake gear, axles, and axle boxes, is much reduced, and this is a matter of considerable importance in the case of tramway locomotives where the brakes are so frequently applied.

It will be observed that the connecting rod which connects each vibrating beam with the wheels, does not work direct on to the crank-pin as usual, but is connected to a prolongation of the coupling rod; in this way the whole movement is in a vertical plane passing through the cylinder axis; further, the wear of the crank-pins is symmetrical, so that the centres always remain correct, which is not the case as generally arranged when the connecting and coupling rods are disposed side by side. The crank-pin bearings and all the connecting rod bearings are of exactly the same size, and are composed of simple bushes rolled into the eyes by means of a Dudgeon tube expander, and working on steel pins as hard as can be procured. The same remark applies to all the articulations of the valve gear, which are all interchangeable and are also rolled in with a Dudgeon's expander.

Further to get rid of all sliding motions it will be seen on inspection of the engravings that the piston rod crosshead guides are omitted; this may seem at first very hazardous, but when the great length of the connecting rod is taken into consideration, together with the fact that its outer end only moves through an arc with a small versed sine, it will be seen that the thrust produced by the very slight angular motion is so small that it may be entirely neglected; in all cases the thrust which has to be taken up by the stuffing-box is much less than in the case of the oscillating engine; to make sure the piston rod is prolonged through both covers.

All the lubricators are furnished with filters, as experience has shown that simply furnishing them with covers is by no means entirely sufficient to prevent the entry of gritty matter, as the machine gets so incrusted in dirt that every time an oil-cup is opened a certain quantity of this dirt finds its way in.

In this new type of tramway locomotive now illustrated all loose doors, covers, &c., are avoided, as they all work loose and cause a clatter; everywhere, as far as possible, the connexions are made by rivetting. We hope in a future number to be able to publish engravings of some of the chief details of Mr. Brown's engine, these details being very ingeniously worked out.

PORTABLE ELECTRIC LIGHT PLANT.

WE illustrate on page 112 a very complete arrangement of portable electric light plant, designed especially for railway purposes by the Anglo-American Brush Electric Light Company. As will be seen from the drawings, the arrangement consists of an iron built van 18 ft. long, 8 ft. wide, and 6 ft. 8 in. high, adapted for travelling on railways. This vehicle is divided into two parts, in one of which is the water tank (below the floor level), the boiler, and coal bunker, and in the other is the engine, dynamo-machine, and electric lamps, when the latter are not in use. Upon the top of the van are packed a series of tubes that can be fitted up as tripods to support the lamps

Engineering, Feb 24, 1882.

THE LAING ELECTRIC LIGHT.

A COMPANY has lately been registered under the above name, and is now making preparations for lighting Waterloo-place, Piccadilly-circus, and Regent-street, with twelve lights. The difficulty of finding a suitable position for the engine and machinery, usually a matter of great trouble in such a locality, has been solved with a simplicity that is astonishing by building a wooden shed for their reception in the centre of the roadway between the Crimea Monument and the Duke of York's Column. It is evident that even London vestry, at any rate, does not place needless obstructions in the way of scientific experiments. The company is one of which little is at present known, except that it has a nominal share capital of one million sterling, and that its system has been already tried on a small scale in France. There are, however, in the Patent Office three specifications of inventions in electricity commencing with the names of Bontellieux and Laing, Nos. 847 of 1880, and Nos. 3102 and 3214 of 1881, and unless we are much mistaken, these form part of the stock-in-trade of the new company, though how much they represent of their astounding capital we do not know. The first was filed-entered in our Patent Record of October 8, 1880. In it is shown a lamp having an upper carbon carried in the form of a tube enclosing a core of non-conducting material, such as was claimed by M. Jablochkoff in a supplement to his first patent (see ENGINEERING, vol. xxxii, page 256). The point of the lower carbon abuts against this core, and the arc forms between it and the cylinder around it, and is always of one constant length. The lamp requires no regulating mechanism, and the feeding of the lower carbon is effected by a weight or a spring. The third mechanism appears to be in part a development of the first, and aims at conducting to one lamp both an arc, as the term is usually understood, and a non-conducting shuttcock. One example somewhat resembles a Wilde candle. Two pencils, inclined at a slight angle to each other, abut at their upper extremities on the core of a tubular carbon towards which they are fed, as fast as they waste, by weights or springs. The arc is formed between them and the carbon cylinder, an electro-magnet, acting on their guides or slides, separating them and bringing them momentarily in contact with the cylinder when the arc fails. In another lamp an ordinary carbon pencil is employed as the lower electrode, and its upward feed is regulated by a spring brake opposed to a magnet in a shunt circuit. Provision is made that if all the current passes through the shunt, as it would do if the light were extinguished, that it shall lift the lower electrode out of the annular carbon and the circuit is re-established. The non-conducting core appears to be held in reserve and only to come into use in operation when worthy of remark that the new specification does not follow the usual method and refer to the previous one, but reproduces it in full with slight alterations, and also appears to claim the previous invention as well as the present one, a method of "making assurance doubly sure" that is not without its drawbacks in patent matters. The remaining invention relates to the use in conjunction with magnets or dynamo-electric machines of a commutator working in water or other fluids of little or no conductivity. The specification contains no drawings, as it is the principle rather than any particular method of putting it into operation that is claimed. The object is to prevent, or to mitigate, the disruptive action of the spark that occurs as the successive plates of the commutator pass under the brushes, by isolating them from the oxygen of the atmosphere. It is very much to be doubted whether the expectation of the inventors will be fulfilled; there will certainly be no greater resistance to the secondary currents in the water than in the air, and as they spring from plate to plate, or from plate to brush, they will probably carry particles of metal with them, whether they be oxidised or not. The copper dust that falls so plentifully from the commutator of an over-driven machine shows but little evidence of oxidation. It might at first sight be imagined that the cooling effect of a liquid envelope would prevent the formation of the sparks, but, seeing that with a little trouble an ordinary arc lamp may be made to burn satisfactorily under water, even when the latter is in a state of great agitation, it does not appear probable that this cause would be of much avail against the minute arcs in question. The invention, whatever may be its merits, is not entirely a stranger to the Patent Office. In 1854, C. F. Varley patented an electro-meter, with regard to which he said: "In order to prevent the burning of the parts where contact is made and broken I surround them with oil or any suitable hydro-carbon, or other matter for gas, which excludes the presence of oxygen; or I extract the air from the chamber surrounding them. I am aware that it has been before proposed to employ oil or naphtha about the contact surfaces of, but, therefore, claim this principle, but I find it to be usefle in all cases to employ it." Again, in 1877, MM. Gramet and Varvin, of Paris, described an electro-magnetic engine in which reciprocating rods slipping into mercury cups distributed the current, and water or other non-conducting liquid was placed in the cups above the mercury for the purpose of extinguishing the spark that resulted from the rupture of the circuit. It may be, however, that Messrs. Bontellieux and Laing have been more successful in their experiments than would appear from their specification, and we shall await their exhibition of their apparatus with interest, as there is no doubt that commutators are the most troublesome parts of electric light machinery.

Engineering, March 2, 1883.

ELECTRIC LIGHTING NOTES.

In our last week's issue, on page 178, and again in this on page 188, we have devoted considerable space to an explanation of the construction of the Brush secondary battery, and of the current manipulation by which it is governed. Just before Christmas the Brush Company of New York announced that they were ready to supply these batteries to persons residing along the line of the mains used by them to street illuminants. It was stated that the generator which had hitherto been driven during the daylight, should be employed during that time in charging those batteries with a store of energy, that would be available for feeding local installations of incandescence lamps in the evening. In order to do this it was necessary that the arc lamps should be disconnected from the mains, and the mains coupled to the battery circuits before the charging could cause one, and for this purpose the expedient was adopted of reversing the current when it was transferred for one use to another. By this means and the use of "shorting" constructed after the manner of pole-changers, the current is directed to either of the two sets of apparatus in which it is to be utilised.

The sizes and capacities of the batteries are given below:

Size of Cells.	Capacity in Swan Lamps.	Size of Plates in Inches.	Number of Cells for Swan Lamps.
No. 2	10 to 8	8 × 8	20
„ 2	20 „ 15	8 × 10	20
„ 3	26 „ 30	8 × 10 } [Double]	20
„ 4	40 „ 60	10 × 10 } [Double]	20

At an exhibition in New York, 27 Swan lights and a one horse-power motor were shown in action fed by a box of batteries measuring 3 ft. by 1ft. by 10 in. The means whereby the main current is delivered to the batteries, until such is fully charged and is then switched off, will be found illustrated and explained in detail at page 190.

Assuming further, since all the quantities are small, that when the jackets were set in use there would be the same amount of radiation as when they were, we have the following results:

Condensation per Stroke.	Pounds.	Thermal Units.
In steam pipe	.0026	0.7
Non - condensing cylinder valve chest	.0008	0.8
Non-condensing cylinder ends ...	.0016	0.2
,, ,, barrel ...	.0009	0.9
Condensing pipes and receiver ends ...	.0009	0.6
Receiver sides	.0019	1.7
Condensing cylinder valve chest ...	.0003	0.3
,, ,, ends ...	.0007	0.4
,, ,, sides	.0022	2.2
Total in steam pipe and high pressure valve chest ...	.0031	7.5
Total in cylinder and receiver ...	.0071	6.0

On the other hand, a certain amount of heat will be discharged by the friction of the valves and pistons. Assuming the power of the engine to be 100 indicated or 15-horse power, the quantity of heat would be 4.2 thermal units per stroke. Hence we may assume that the loss by radiation from the cylinders was balanced by the heat equivalent of this friction.

Now let w be the weight in pounds the percentage of water in the steam supplied to the engine, let:

f be the number of pounds of vapour delivered to the engine per stroke;

T its temperature in degrees Fahrenheit.

q the number of thermal units in 1 lb. of water at temperature T.

If the number of pounds of water discharged from the jackets be f_1,

t the number of pounds of steam, and y the number of pounds of water contained in $V = 1$,

$x + y = 772$ the equivalent in thermal units of the number of foot-pounds of work done per stroke.

l the number of pounds of injection per stroke.

t_1 t_2 t_3 the temperature in degrees Fahrenheit of the injection, ejection, and feed to economiser.

Then the heat received by the engine is:

$$x(1114 + .305T) + y\,q,$$

and the heat accounted for by the engine is:

Heat converted into work,

$$2\,p + 0.772.$$

Heat discharged from the condenser after deducting that received in the injection water,

$$l\,(t_2 - t_3) + .5\,t_2,$$

heat supplied to feed water in passing through coil in exhaust pipes

$$(1{\cdot}4\,D) - (t_2 - t_3),$$

heat discharged from jackets

$$D\,t_1.$$

Whence assuming the heat lost by radiation from the cylinders and receiver to be equal to that produced by the friction of the valves and pistons, and rearranging that $x + y = 772$:

$$x = 2\,p + 0.772 + l\,(t_2 - t_3) - .2\,(t_2 - t_3) + (1{\cdot}4\,D)\,(t_2 - t_3)$$

Consider the data for Tuesday, 31st October:

$M = 0.3313$	$M + D = 0.6021$.
$m = 0.2748$	$\Delta = 221$.
$l = 18.52$	$t_2 - t_3 = 11.17$.
$d = 2.25.77$	$p = 14.1$.

$x + y = 772 = 141.85 + 18.52 \times 11.17 - 0.2 \times 11.17 + 0.6021 \times 14.1$

$= 772$.

$y = 0.0021$ lb.

But the total weight of water supplied to the boiler per stroke was $0.6021 - 0.0221 = 0.5800$ lb., and the weight of this vapour produced was $0.3313 - 0.0221 = 0.3092$ lb., of which, as we have seen in the previous note, 0.0071 lb. was due to condensation in the steam pipe, leaving 0.3021 lb. as the weight of water carried over from the boiler, or less than 0.5 per cent.

Proceeding in this way, the following Table may be formed:—

	Oct. 25.	Oct. 26.	Oct. 27.	Oct. 28.	Oct. 31.	Nov. 1.	Nov. 2.
Weight of steam and water used per stroke	0.6241	0.5757	0.5292	0.5013	0.4787	0.4921	0.5021
,, dry steam in ditto	0.3313	0.3112	0.3107	0.3021	0.2748	0.2992	0.2992
,, water in ditto	0.2139	0.2072	0.2185	0.2132	0.2039	0.2052	0.2029
Condensed in steam pipe	0.0071	0.0074	0.0078	0.0071	0.0072	0.0074	0.0076
Brought over from boiler	0.3021	0.2702	—	0.2113	0.2076	—	0.2013

It will be seen that on every days the assumed weight of steam condensed in the steam pipe is greater than the calculated quantity of water in the steam delivered to the cylinder. Indeed, on the 27th of October the calculated weight of dry steam exceeds the weight of water supplied to the boiler, which is impossible. This anomaly, of course, arises from inaccuracy in the data from which the calculations are made, or, in other words, from errors of observation. The excess however, is only

$$0.2723 - 0.2677 = 0.0037,$$

or 0.57 per cent.

0.5307

The wettest steam seems to have been produced on the 26th of October, when the quantity of moisture was to 0.0123 lb., or nearly 1.53 per cent. This, however, is but little more than might be attributed to errors of observation, and, therefore, for the whole of the trials, as far as they go, it will be observed that the boiler produced very dry steam which, owing to loss of heat by radiation, became vapour containing per cent. of moisture by the time it reached the cylinder.

Note 1.—To explain the formation of Table I., consider the experiment of the 2nd of November. Tables XI. to XIV. show that the feed water used was 7.251 times as heavy as 44,770 lb., the weight of coal burnt as 350 lb., of which 481 lb. were ash; the indicated horse-power 282.5, and the total 2825.25. The water used per indicated horse power per hour was therefore

$$\frac{44{,}770}{7.251 \times 2825.25} = 17.10\ \text{lb.}$$

And as the steam held 1 per cent. of moisture when it reached the cylinder, the weight of dry saturated steam used per indicated horse power per hour was 17.10×0.99 = 16.929 lb. The other figures may be found in the same way.

In calculating the number of thermal units rejected per indicated horse power per minute, the heat put into the feed water as given in line 3 of Table II. must be added to the heat put into the injection water.

Note 2.—The following explanation shows how Table II. is formed. Take the data of 29th October. The feed per hour = 7.251 × 2825.25 = 20,490 lb. This, however, is at a temperature of 212.2 deg. (as shown by line 12 in thermal units is a pound, while 0.06031 thermal units as water, containing only 237.0 units per pound.

The total heat supplied to the engines was therefore—

In dry steam ...	= 0.9370 × 1210.8 =	1122.39 units.
In water... ...	= 0.0093 × 237.0 =	2.09 ,,
Total ...		1124.48 ,,

Again, the injection water used per stroke was 16.25 lb., and its rise in temperature 79.31 deg.—27.41 deg. = 51.9 deg.; therefore the heat received by it was 16.25×51.9 = 843.71 units. The feed per stroke was 0.6339 lb., and its rise in temperature in passing through the coil in the exhaust pipe of the condensing cylinder 119.39 deg.—27.41 deg. = 91.98 deg.; therefore the heat received by it was 0.6339 × 91.98 = 58.31 units. The water discharged from the jackets was 0.0442 lb. per stroke. In the condenser it became water at 90.31 deg., and therefore contained 0.0442 × 90.31 = 3.99 units. And lastly, the water received from the steam jackets was 0.0662 lb., while the temperature at which it was condensed and left the jackets was 328.5 deg.; therefore the heat carried off by it was 0.0662 × 328.5 = 21.75 units. The total received from the boiler was therefore 843.71+ 17.85+60.31+21.85=978.58 units. Thus the difference between this and the heat received by the engines, or the heat available for conversion into work, was 1124.02— 978.58=145.44 units. The actual work shown by the indicator diagrams was 109,085 foot-pounds per stroke, which is equivalent to 141.30 units, which differs from the latter found above by 4.31 units, or less than 3 per cent. of the total heat supplied.

Note 3.—With the aid of the explanations given in Note 2, and on page 20 of the report, the formation of Tables IV. to VII. will be easily understood. The data required will be found in lines 5 to 17 of Table XI., and in lines 2 to 12 of Table XII.

Note 4.—The relation between the change of the internal heat, the work of the expansion, and the heat supplied, is stated as in this way. For the sake of simplicity, suppose the steam to expand in a single vessel without receiving heat from or giving heat to the surfaces in contact with it, and let us divide the total expansion into three periods, and consider each separately. In the first period, let the internal heat fall from U_1 to U_2, and let the work done be called W_1; then

$$W_1 = U_1 - U_2.$$

Now let a certain quantity of heat, Q_2, be added, and let the steam continue to expand till the internal heat becomes U_3, then W_2, the work done during this period is given by

$$W_2 = U_2 + Q_2 - U_3.$$

At this point let a quantity of heat, Q_3, be taken from the steam, and let the expansion continue till the final internal heat U_4 is reached, then the work due to this change will be

$$W_3 = U_3 - Q_3 - U_4,$$

and the total work done during the whole expansion will be

$$W = W_1 + W_2 + W_3 = U_1 - U_2 - (U_3 - Q_2 - U_3 - U_4). \quad (1)$$

But the total work done is quite independent of the number of vessels in which the expansion takes place, and therefore if the steam be expanded in the most perfect manner, however complicated they may be, provided the initial and final internal heats are given out by the condensing surface. We may, therefore, apply the relation found above to the compound engine, with it will readily be seen that U_1 and U_2 are the initial and final internal heats in the cylinder, Q_2 the heat put into the steam by the jacket round the cylinder, U_3 the final internal heat in the receiver, Q_3 the internal heat of the steam conveyed away, and U_4 the heat equivalent of the work of the compression, the work done will be exactly the same as in the single cylinder.

Further it is evident that if we remove the restriction concerning the interchange of heat between the metal and the steam, the form of the right-hand member of equation (1) will be unaltered. The left-hand member, however, will contain a new term $E - H$, which is the difference between the heat lost by the metal at the beginning and end of the expansion, when the changes of the internal heat now corresponds, not only to the work done, but also to the gain or loss of heat by contact with the metal. Therefore, for the actual conditions under which the engines work, in other words, the work done, the heat received, and the change of the internal heat are connected by the relation

$$W + E - H = U_1 - U_2 - (U_3 - Q_2 - U_3 - U_4).$$

INCANDESCENCE LIGHTING.*

By J. W. Swan.

(Concluded from page 212.)

THE high electrical resistance of platinum, and its high melting point, mark it out as one of the most likely of the metals to be useful in the construction of incandescent lamps. When platinum is united with ten or twenty per cent. of silver (platinum silver is formed), which has a much lower melting point than platinum; and many attempts have been made to employ it in the form of electric lamps. But these attempts have not been successful, although as platinum has as the melting point of brick-platinum, it is not hot enough to allow of its being heated to a degree that would yield a sufficiently large return in light for energy expended. Besides, as temperature is raised, platinum becomes brittle and loses its resistance and breaks. This is a fatal fault, because the moment a wire breaks in a circuit there is the greatest possible advantage in having as low as least the incandescing body in an extremely high temperature. Then the tenacious action when it is resuscitated by a strong current is required to raise a wire to a cream red heat, and when this has been attained, it melts instantly (p. 214). The power absorbed in passing the leak up to that point is thrown away in any system of lighting in which it occurs. If the current which made the wire red-hot, be doubled in quantity, the wire will become white-hot, and then it will melt an appreciable amount of light. I will illustrate this by experiment.

It will be observed that a considerable amount of current is required to heat the wire up to the temperature at which it begins to emit light, and that when that point is reached the current must be increased to increase the production of light. One unit of current passed through the filament will only make it red-hot. It is at once regarded light. If the current be doubled, the light is at once raised to that of some four candles. But one unit cannot current at once raises the light to no less than forty candles.

The next important consideration is the fact (I have shown that it is essential to economy that the incandescing material should be able to bear an enormous temperature without fusion. We know of no metal that fulfils this requirement; but there is a non-metallic substance which does so in an eminent degree, and which also possesses another necessary quality, that of low conductivity. The substance is carbon. In attempting to utilise carbon for the purpose of incandescence, I have several serious practical difficulties to encounter. The first is that carbon is very combustible and difficult of fusion in its infusible. Carbon, as we commonly know it, is a brittle and non-elastic substance, possessing neither ductility nor tenacity to fit it for being shaped suitably for use in an electric lamp. Yet, in order to make it serviceable, it is necessary that it should be form it into a slender filament, which must possess sufficient mechanical strength to enable it to be being firmly attached to conducting wires, and to prevent its breaking. If tested while hot in the air, however, it will be found that the mechanical strength of an electric lamp. It is only while the hot three or four hours that these difficulties can be said to have been surmounted. It is now found that carbon can be produced in the form of straight or bent filaments of extreme slenderness, and possessing a great degree of elasticity and strength. The process by which this is effected is very simple—by the carbonisation of paper, and subsequently of woods and grasses. Excellent carbon filaments can be produced from cotton, from bamboo, and from cotton thread treated with sulphuric acid. The sulphuric acid treatment is necessary, as it gives to the cotton thread or paper which it acts on paper in the process of making parchment paper, and which is found to be necessary in making carbon filaments. In carbonising these materials it is of course necessary to preserve them from contact with the air. This is done by surrounding them with charcoal.

Here is an example of a carbon filament produced from cotton thread. It is about 0.02 inch in diameter, and less than 20 of an inch long. Another, and yet a length of three inches, having therefore a surface of nearly the one-tenth of an inch, gives a light of seventy candles when made incandescent in a moderate degree.

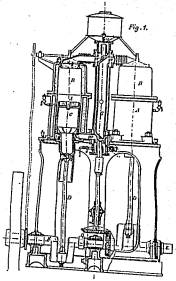
I have said, that in order to preserve these slender carbon filaments from combustion, they must be placed in a vacuum. Experiment has shown that if the vacuum be at all durable, the vacuum must be a very high one. One of the chief causes of failure of the carbon filaments is due to the presence of carbonic acid, and the imperfection of the vacuum in which the carbonising operation is performed. The presence of this gas in the filament when it is placed in a vacuum due to the production of a better vacuum in the lamps.

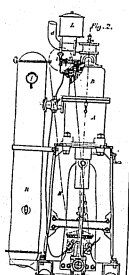
In the pistolite lamps, the glass globe or globe which enclosed the carbon filament was large, and usually had three joints, with leading-in wires passing through them. These joints were troublesome things to have with accuracy, and it was found necessary to make the glass globe as small as possible, and as as to have a vacuum like that at the upper end of a barometer, or the air was

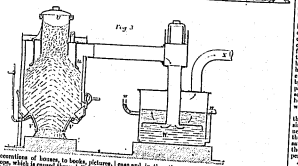
* Paper read before the Royal Institution.

SIEMENS' GAS PRODUCER AND MOTOR.

(*For Description, see Page 271.*)







furnishings and conditions of houses, to books, pictures, and to goods in shops, which is essentially destructive. Such a system would require a large expenditure for repair, and a large annual loss which is irreparable.

I have heard discussions of cost of electric light, power is 100 candles. But a knowledge of the latter is not to be considered, and it is impossible of the former had been obtained. The question of an abstract question how much light can be obtained from the motive power developed from ascertained fuel, how much, without much increased cost of light as obtainable by the operation of various means. I might have suggested that even more than double the light for this expenditure. Certainly double and beside the fact that this expenditure would be obtained. The fact which I have supposed can be obtained with long life in the lamps, and there would be a great difference of power, if we take more hours of light for this expenditure of power, or if we take more light for a shorter expenditure of power, or if we have a higher degree of incandescence with a proportionately greater expenditure of power. It is on this point which I have to make my comparison with the electric light.

In comparing the cost of producing light by coal and by electricity, it is essentially that with the rudest form of coal in electric lighting is only dependent on the skill and care of the chief source of expense in all the processes of gas also. When, however, as in the case of electric lighting power is in a position of still greater advantage, and in point of cost, altogether beyond comparison with other means of producing light.

To complete the comparison between the cost of electric light and gas light, we must consider not only the amount of coal required to yield a certain product of light in the one case and in the other, but also the cost of converting the coal into electric current and into gas; that is to say, the cost of manufacture of electricity and the cost of manufacture of gas. I cannot speak with the same exactness of detail on this point, as on the same exactness of detail on the cost of the raw material. But if you can state the exact cost of the gas manufacture, and that is the failure of the process through the loss of coal by natural labour processes, in so far as the quality of the clothing of a steam boiler, and if electricity generated by means of steam, then that if electricity is chiefly involved in both processes is not only the coal labour that in gas manufacture it would be necessary to clean into the furnaces and retorts free or at times as much coal have to yield the same light as it would be under the latter, in which case engine and dynamo-element lamps. But labour is necessary to attend to the engine and dynamo, labour is required in the products other than gas, and to half—i.e., that is, it will be only half the cost of labour in the case of gas. But when in our calculation we have charged gas with only one half the cost of labour which electricity can, in fact, have to bear. But when in respect of labour in favour of electricity there is chiefly in favour of the cost of gas, but it is well known that labour products of gas, and that can be obtained for gas.

With regard to the cost of coal, I am aware that gas works are even better situated than electric lighting stations in respect to railways and furnaces, justifying standing charges, and establishments, and appliances for distribution. Plant for generating electricity on a large scale would consist chiefly of boilers, steam engines, dynamo-electric machines, and batteries for storage.

No such electrical station, on the scale and in the completeness of arrangement which I have supposed, has yet been put into actual operation; but several small stations for the manufacture of electricity already exist in England, and three large stations, one by Mr. Edison here, if I am rightly informed, almost completed in America. We are therefore on the point of ascertaining by practical experience, what the cost of the works for giving the electricity will be. Meanwhile, we know precisely the cost of coal to steam engines, and we know approximately what ought to be the cost of dynamo-electric machines of suitably large size, and we have, therefore, sufficient grounds for concluding that to produce a given quantity of light electrically the cost of coal will not exceed greatly, if at all, the cost of equivalent gas light.

There remains to be considered, in connexion with this part of the subject, the cost of distribution. Can electricity be distributed as widely as gas? On one condition, which I fully have not yet accomplished, this may be answered in the affirmative. That condition is that it be found practicable and safe to distribute electricity of comparatively high tension.

The importance of this condition will be understood when it is remembered that to effectively utilise electricity in the production of light in the manner I have been explaining, it is necessary that the resistance in the carbon of the lamps should be relatively great to the resistance in the wires which convey the current to the lamps. When lamps are united with the conducting wire the current divides, which it conveys is divided amongst them, you have a considerable strength in which aggregate resistance of the lamps will be small, and the conducting wire, to have a relatively small resistance, must either be very short, or, if it be long, it must be very thick, otherwise there will be a waste of much energy; in fact it would not be a practical condition of things.

In order to supply the current to the lamps economically, there should be comparatively little resistance in the line. A waste of energy through the resistance in the wires of over perhaps 20 per cent. might be allowable, but not much beyond. Coupled in the lamps in the manner I have described—that of multiple arc, each lamp being as it were a conducting bridge across main wires, there—even if the individual lamps offered a somewhat higher degree of resistance than the lamps at present in use—the thickness of the conductor would become enormous if the line was far extended. In a line of half a mile, for instance, the weight of copper in the conductor would become so great, in proportion to the number of lamps supplied through it, as to be a serious charge on the light. On the other hand, if a smaller conducting wire were used, the waste of energy and consequent loss would greatly exceed that I have mentioned as the permissible limit.

Distribution in this manner has the merit of simplicity, it involves no danger to life from accidental shock; moreover it does not demand great care in the insulation of the conductor. But it has the great defect of limiting within commercially small bounds the area over which the current for lighting purposes can be distributed from one centre. In order to light a large town electrically on this system, it would be necessary to have a number of separate stations.

There is a mode of supply of power, however, which effects a wider distribution practicable to be able to do so. Arranging the lamps in series, so that the same current traverses through several lamps in succession, by means of several short coils, placed as electric resistance in each lamp, it would be possible to economically obtain a much wider distribution.

Whether by the method of multiple arc which necessitates the multiplication of electrical lines, or by means of the series system, or by means of secondary batteries conveyed with each other from house to house, or by other means, satisfactorily being fed from these in multiple arc or quite practicable and economically with the distribution of power of its power of electricity is sufficiently economical for general application on a large scale.

As to the cost of the electric light, I have it on the authority of Sir William Siemens, who has just had his house completely fitted with incandescent lamps, that the cost of internal wires for the electric lamps is so small—that the cost of lighting will

THE LIGHTING OF THE SAVOY THEATRE.

The general adoption of the electric light for the illumination of theatres and other places where large numbers of persons congregate, cannot be very much longer delayed, because it fulfils every requirement for perfect lighting, and when properly carried out is free from nearly all the dangers and defects which appear to be inseparable from all other systems of illumination.

The lighting of a theatre, however, involves the fulfilment of conditions peculiar to itself, and which differ in very essential qualities from all other installations, and it is not too much to say that any system of illumination which is applicable to the lighting of a high-class theatre can be successfully applied almost anywhere, for there is no installation which can furnish so severe a test for any given system. Let us see then what are the peculiar requirements to be fulfilled in the lighting of a theatre. In the first place the auditoriums of theatres are, for obvious reasons, not provided with windows, and thus they are at once deprived of the principal means of ventilation and circulation of air, both of which other buildings can have the advantage. It is, therefore, highly important that an illuminating agent should be employed which does not in its action overheat the air, and above all which is incapable of vitiating the atmosphere by continually pouring into it the poisonous products of combustion that are inseparable from every system of illumination except that of electricity.

Another requirement of theatre illumination is the production of a well-distributed, brilliant, and pure light, one which is completely under control, and can be regulated at will from the stage. This requirement is fulfilled with very considerable success by gas, but, on the other hand, gas illumination cannot be conjured from the wondrous artificial light with any of the incandescence systems of electric lighting.

Many who have never been behind the scenes at a theatre are under the impression that the principal source of illumination for the stage is the row of footlights, and perhaps a few gas jets immediately behind the proscenium, but in order to obtain adequate illumination for the various scenes, the stage of every theatre is provided with long rows of gas jets above the backs of the scenes and behind almost every layer of scenery, as well as a corresponding number of vertical columns of lights behind the "wings," and no one can stand behind the scenes when matters are being struck with any amusement that it is possible to run a piece for many nights together without the theatre being burnt to the ground, for the whole surroundings, above, below, and on every side, appear to be one vast naked gas jet, and scenery composed of the most flimsy and inflammable materials, the two supporting almost to come into contact at every draught of air. As a matter of fact, however, the flames are rarely allowed to be covered with wire netting, by which the scenery is kept out of the flames, but the comparative rarity of fires at theatres is a proof that managers and their responsible agents are very careful in the handling of so dangerous a combination. It is therefore impossible to over-estimate the importance to the lighting of a theatre, and especially the stage, of employing a system of illumination which is practically a perfect

* See ENGINEERING, vol. xxxiii., page 417.

safeguard against fire. We have referred to the comparative rarity of fires in theatres, but this rarity is unhappily only comparative, and must be considered rare only in connection with the dangerous combination of gas jets and inflammable material, which until lately was necessarily inseparable from the stage of a theatre. When, however, a fire does occur during a theatrical performance, it is too often awful in its character, and the fatality which accompanies it, and the recent disasters at Nice and Vienna have not only moved the public and the authorities in all countries to consider the safety against fire of theatres, and other similar places of amusement, but theatrical managers have all, for more reasons than one, been awakened to the importance of attending to this all-important question.

In the autumn of last year some highly interesting experiments in connection with the Exhibition of Electricity were made at Paris on the electrical illumination of the Grand Opera, and were described in these columns at the time.* These experiments excited very considerable public interest, and constituted the first practical indication that the light of the future for theatre illumination must be in a degree electricity.

Almost simultaneously with the establishment of the experimental installations at the Paris Opera, Mr. D'Oyley Carte, the enterprising proprietor of the new Savoy Theatre, in London, determined to light this charming little theatre by the Swan incandescence electric light, and the work of installation was entrusted to Messrs. Siemens Brothers and Co., who appointed one of their electrical staff, Mr. C. Kingdon, to carry out the work on their behalf. The theatre is to be lighted by not less than 1158 Swan lights of the improved form recently introduced by Mr. C. H. Gilbert, one of the Swan Electric Light Co.'s engineers, who has adopted it as their most improved pattern, and these 1158 electric lights the auditorium is lighted by 114 lamps attached in groups of three, supported on very elegant threefold brackets projecting from the different tiers and balconies, each lamp being enclosed within a ground, or opaline shade, by which arrangement a most soft and pleasant light is produced.

Fig. 1 (see next page) is a view of one of these bracket lamp holders, which have been designed and constructed by Messrs. Faraday and Son, of Berners street, London. Two hundred and twenty lamps are employed for the illumination of the numerous dressing-rooms, corridors, and passages belonging to the theatre, while no less than 824 lamps are employed for the lighting of the stage.

The stage lights are distributed as follows:

6 rows of 100 lamps each above the stage			600
1	„ 16	„	16
1	„ 18	„ fixed uprights	18
5	„ 10	„	50
2	„ 10	„ ground lights	20
2	„ 11	„	22
			824

And in addition to the above-mentioned lights within the theatre, there are eight pilot lights within the engine-room, which serve the purpose of illuminating the switchboard; and as they are in the same circuit with some of the lights in the theatre, they indicate to the engineer in charge of the machines, by the changing of their illuminating power, when the lights on the stage are turned up or down. The new form of Swan lamp employed in this installation is shown in Figs. 2 and 3, and is both simpler and neater than the lamp of the same company of earlier construction, and, moreover, can be turned out more rapidly and at a cheaper rate. By this new arrangement the very objectionable and unsightly flattage of the old lamp is entirely dispensed with, and the exterior of the lamp is entirely of glass, having two very small platinum loops protruding from the lower part of the neck and which form the terminals of the carbon filament within the lamp. The fitting by which these lamps are attached to the brackets is illustrated in Fig. 3, and is of the simplest possible construction, consisting merely of a small cylindrical button of ebonite which by a screw above below the figure can be attached to the brackets or may be screwed into any ordinary gas fitting in the place of the burner. In the upper surface of this button are inserted two little platinum hooks communicating with the two small metal screws, and these hooks are fixed at a distance apart equal to that of the little eyes or loops of the lamp, and which, when the lamp is in its place, are hooked over them, the two long metal springs which form the electrical contact by the spiral brass spring shown in the figure, and which is set up by the shoulder of the glass envelope of the lamp.

The lamps are so placed in the various branch circuit in six groups, five of which comprises two hundred lamps each, and the fifth one hundred and sixty-six lamps. The current of each group is produced by one of Messrs. Siemens Brothers' W, alternate current machines, illustrated in Fig. 5, with field magnets of which are excited by a separate dynamo-electric machine of the Siemens type, known as D, and which is in general form similar to that shown in Fig. 4. The machines and engines are fixed in a shed erected on a piece of waste land adjacent to the Victoria Embankment, the current being conveyed to the theatre by means of insulated cables laid beneath the soil.

The six alternators or W, machines are driven at a speed of 70 revolutions per minute, and the six D machines at 1150 revolutions, by three steam engines, that is to say, a portable 20 horse engine by Garrett, a 12 horse power portable by Marshall, and a 20-horse semi-portable engine by Robey, but the horse power actually utilised is measured by a Hefner von Alteneck dynamometer, is but seven 120 and 130 horse power, as it was not, however, easy to state, that in addition to the six pairs of machines for working the 1166 incandescence lamps there is also a D, Siemens dynamo machine for producing the powerful arc electric light suspended outside the theatre, and over the principal entrance, and that the power to drive this machine is included in the above mentioned horse power employed.

The most interesting feature, however, from a scientific point of view, of this most interesting installation is the method by which the lights in all parts of the establishment are under control, for they are all under the control of an attendant turned up to their full power or gradually lowered to any desired level, as easily as if they were gas lamps, by the simple turning of a small handle. There are six large regulating handles—corresponding to the number of the machines and circuits—arranged in a row against the wall of a little room or rather closet on the left of the stage, and each of these is fixed on the end of a screwed shaft which, by throwing into its corresponding support circuit, greater or less resistance (increasing or decreasing it in six stages), the strength of the current passing through the lamps in the circuit is increased by so many grades. The special interest of this part of the installation, however, is the fact that the turning down of the lights is accomplished by a corresponding weakening of the power in the engine, for the variable resistance which is controlled by the regulating handle is thrown into the external or lamp circuit of the alternate current machine, which is the current generator, and thus the field magnets are excited. When a series of lights is lowered, increased resistance is thrown into the circuit of the dynamo machine, which is exciting the magnets of the alternate current generator corresponding to that particular series of lights, and the intensity of the magnetic field of the latter machine is thereby reduced, and consequently the current induced in the coils of that field and transmitted to the lamp circuit are diminished in strength; but by the weakening of the magnetic field the mechanical resistance to rotation is correspondingly reduced, and therefore less power is required to drive the machine. This very beautiful arrangement is at present applied to four of the six circuits, but from its very successful working it will probably ere long be applied to the other two with a corresponding increase of working economy. The resistance thrown into the circuits are at present of two sorts; the four switches, to which we have just referred, transmit the exciting current into long spirals of iron wire supported on a frame and having a free circulation of air around them by which the heat generated by the current is rapidly dissipated, and the switches of the other two circuits operate in a similar way upon resistance composed of zig-zag bands of loop iron similarly arranged. It has occasionally been put forward by persons who have interest in it to oppose the introduction of electric illumination, that lighting by electricity is accompanied by two sources of danger, the one that of causing fires through improper contacts or over-heating conductors, and the other that of the giving of dangerous shocks to persons who touch or handle the wires. These objections to electric lighting have just that substratum of truth in them which makes it necessary to refer to them, and also to explain what they mean. It cannot be denied that fires have been caused by badly laid or badly constructed electric light conductors, and this occurred more than once at the Exhibition of Electricity at Paris, and it is also well known that occasional accidents have occurred from shocks received from some of the higher electromotive force machines. We venture, however, to affirm without the slightest fear of intelligent contradiction, that there cannot exist the very smallest fear of fire occurring in an installation of incandescence electric lighting if the conductors are properly constructed, and just up by a person who understands the business, and the same remark applies with equal force to the question of the danger of electric shocks (but this element of danger is absent in the machines which are employed in connection with the Swan system), and we would also venture to say that no accident arising from either of these causes is to be apprehended in an incandescence installation of a slightly more extensive character than that of the theatre for an illustration so far as unsafe conductors, that there is for a gas-fitter to lay a leaky or otherwise defective gas-pipe, which would be attended with still greater certainty of disaster. In all industries electric competition is certain to lead to inferior articles being manufactured in order to reduce estimates, and the business of the electrical engineer is no exception to this liability, but we would venture to point out that the employment of inferior conducting cables for electric light transmission is the very falsest of economy, for, in the first instance, it might lead to serious results for reasons given above, and in the second, the installation could not be worked through such conductors with a proportional loss of current, and therefore of motive power. We do not think it is too much to say that, with but very few exceptions, if any, all the accidents which have occurred, either of fire or of serious shocks in electric light installations, may be traced to faulty construction or improperly-laid conducting wires. With the splendidly constructed cables of Messrs. Siemens, accidents of this description are practically impossible, and we would also point out that it is part of the Swan system as it is of that of Mr. Edison, to make use of little fusible safety strips at various points in the circuit, so that if from any cause there occurs any liability for the conductors to become overheated the current is instantly interrupted; this is, however, unfortunately no remedy to guard against a danger which is next to impossible to occur in practical working, but incandescence lighting from dynamo-electric machines is a powerful a current being transmitted through them. In every article and among points after nothing could be more completely successful than the incandescence lighting of the Savoy Theatre; the illumination is brilliant without being dazzling, and while being slightly whiter than gas, the sensation of "ghastliness," so often urged against the light of the electric arc, is in no way to be applied. In addition to this the light is absolutely steady, and thanks to the exertions of Mr. D'Oyley Carte, it is now possible for the public to go to the Savoy of an evening for the theatre to sit for a whole evening and enjoy a dramatic performance in a cool and pure atmosphere.

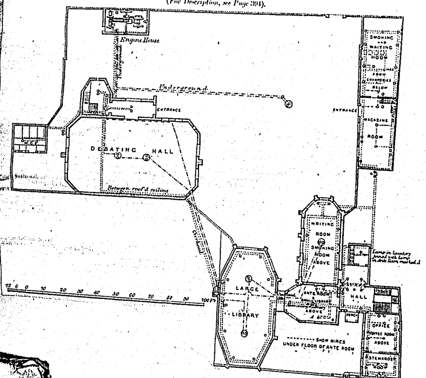
NOTES.

THE JABLOCHKOFF LIGHT AT THE CRYSTAL PALACE.

THE Compagnie Générale d'Electricité is making a very fine display at Sydenham, and pending by the completion of the Paris Exhibition has judiciously divided the collection of lights into groups with separate sources of power. These groups includes the lighting of the low-level station at the Crystal Palace, of the Joseph Brotherhood, and of the Canal Railway Company. This is very efficiently arranged for lighting the latter scene entirely, fed by two Gramme generators driven by a 15 horse power portable engine by Messrs. Ransomes, Sims, and Co., of Gainsborough. This installation is arranged for lighting the latter scene entirely, and is attended to by one man. The western gallery of the Palace is lighted on Jablochkoff system under various adaptations, which include two classes of lamps for street lighting, some hanging lamps, and some on brackets, especially adapted for lighting shops. In this group there are twenty lights fed by one machine, driven by a 15-horse power portable engine, made by Messrs. Crossley Brothers; this installation is also under the charge of one man. Near the theatre is a series of lights

ELECTRIC LIGHTING AT THE UNION SOCIETY, OXFORD.

(For Description, see Page 394).



ELECTRIC LIGHTING AT OXFORD.

THE whole of the large buildings belonging to the Union Society at Oxford, consisting of libraries, debating hall, writing-rooms, offices, &c., accommodating over one thousand members, are lighted with electric lights, fitted by the Pilsen, Joel, and General Electric Light Company, Limited, of London, and apparently with great success.

During the last year's Electric Light Exhibition at the Crystal Palace, a committee from the Union Society specially visited the Exhibition with a view to adopting the electric light in the Union Society's buildings, and they were commissioned to report upon the best system for the purpose. The result of their visit was the selection of the Pilsen arc lamp for the large halls, as being the steadiest and most free from noise, and the Swan incandescence lamps for the small rooms, &c. The following description will give some idea of the extent of this successful installation: The debating hall, which is 70 ft. by 40 ft., was previously lit with two sunlights, each consisting of forty-nine gas jets of 8-candle power each, giving a total light of 784 candles, at an elevation of 30 ft. These have been replaced by two Pilsen lamps at the same elevation, each of 2000-candle power. Fifty per cent. of this light is lost owing to the opal globes used to soften its intensity, so that the useful light given out is a total of 2000 candles, or almost three times that given by the discarded gas. The lamps are lowered for trimming and cleaning by a special arrangement of cords passing over drums fitted above the ceiling, and which are so arranged that the cable is pulled up simultaneously with the lamps, thus avoiding the disfiguring festoons usually employed. In the library, which is a handsome hall 50 ft. high by 30 ft. broad by 70 ft. long, are hung two Pilsen lamps to replace a large gaselier of fifty-four jets and ten single lights under the gallery. The lamps are suspended about 25 ft. from the floor, and their weight is counterbalanced by cast-iron counterweights, which are suspended by cords passing over drums fixed above the ceiling, and over which the cable is made to pass automatically. Under the gallery are distributed nine incandescence lamps (each of 20-candle power) to relieve the shadows cast by the gallery (these, however, are really not required). The Pilsen lamps are identical with those in the debating hall, so that the total light given out is 2180-candle power, as compared with sixty-four gas jets of 10-candle power, or 640 candles.

Since the electric light has been started in this room there is already a marked difference in the condition of the books, especially those near the roof, owing to the total absence in the electric light of those injurious elements which render gas so objectionable.

The library walls have been decorated by old students of the University with paintings illustrating the Arthurian Legends, and these are now seen to much greater advantage than previously.

The next room in rotation is the writing-room, which used to be lighted by four gaseliers having a total number of fifty gas jets, but by placing the electric lamps in more advantageous positions, they light up the writing-tables more efficiently with fourteen incandescence lamps of 20-candle power each. The smoking-room, which is immediately above the writing room, is furnished with one Pilsen lamp and seven incandescence lamps to replace one gaselier of fifty-four jets of 8-candle power, and ten single lights, so that the light is about doubled. In the other rooms, entrance halls, staircases, &c., incandescence lamps are entirely used, and in most instances simply replace the gas jets.

The incandescence lamps are joined up in multiple series of two, so that in case of one lamp short-circuiting, the other in the same series serves as a safety plug, and in practice this is found to be more to be depended upon than the ordinary lead fuses which are usually employed. Fusible plugs are, however, fitted on all the main branches.

The incandescence lamps are worked by a thick wire quantity machine, and the Pilsen lamps by a No. 6 Pilsen dynamo machine. The generating power consists of a 12 horse nominal Crossley gas engine specially balanced. The power is transmitted through a 3 in. countershaft, on which is keyed a 5 ft. flywheel weighing 6 cwt. Both dynamos have also balance wheels fixed to them, so that by these precautions an absolutely steady current is obtained, notwithstanding the unequal motion incidental to gas engines.

The engine-room is a neat brick building 24 ft. long, 12 ft. wide, and 10 ft. to eaves, and is in the grounds very near the main building and close to the adjoining street, so that it became of importance that the noise of the engine should not disturb the inhabitants. To accomplish this three exhaust boxes and one large quieting chamber, supplied by Crossley Brothers, are used, and the result has been quite satisfactory.

The illustration on page 400 shows the general arrangements of the engine-house and leads. It also shows a Pilsen lamp in the garden suspended from an iron pole, which has a fine effect on the trees and grass; formerly there was no light at all in the garden.

A summary of the installation shows for the electric light, six Pilsen arc lamps of 1000-candle power, actually equal to 6000 candles; 109 incandescence lamps of 20-candle power, equal to 2180 candles, or a total of 8180 candle power; against, 353 gas jets formerly used, giving, say, ten candles each, or a total of 3530-candle power.

Careful readings have been taken every night of the gas consumed by the engine, and estimating as nearly as possible the number of hours the light will be used during the year and taking gas at 2s. 10d. per 1000 ft., which is the price in Oxford, it was found that the annual cost for gas will be about 70*l*.

To this must be added about 120*l*. for carbons and attendants' wages and other expenses; thus we get a total of 190*l*. per annum. The gas bill paid by the Society has been 250*l*. per annum, so that this leaves a margin for depreciation of the electric plant. Assuming that the cost of the electric light with depreciation and interest is the same as the cost of gas, the difference in favour of the electric light is very remarkable, giving nearly three times the light with all the advantages of pure air and decreased expense in redecorating, whilst the many valuable books in the Society's libraries are preserved, and for fine art studies the colours can be seen as well by night as by day. This installation is in every way noteworthy, as indicating what can be practically done with electric light, and will do much to completely solve the question as to its relative costs. The work has been carried out by the Pilsen Company, under the supervision of Mr. D. C. Smith, one of the company's assistant engineers.

Engineering, May 25, 88.

THE ELECTRIC LIGHT AT THE FISHERIES EXHIBITION.

THE arrangements for the lighting of the Fisheries Exhibition are upon a most extensive scale, and should the promises of the catalogue be fulfilled, will form one of the most interesting shows of the kind. Most of the well-established systems are amply represented, while on the other hand there is a total absence of unknown names from the list of exhibitors. The feature which distinguishes this show from previous ones is, that instead of the various systems being massed in a large hall, where the effect of the whole was blended into one great glare of light, each will have its own special building, and can be there disposed in the best way to show off its special advantage. The Exhibition is so extensive that this is readily possible, without stinting the space afforded to each, while the great diversity in the forms and dimensions of the buildings renders it easily possible to find suitable opportunities for the display of all sizes and varieties of lights.

The main vestibule is to be illuminated by 500 incandescence lamps supplied by Messrs. Woodhouse and Rawson, and fed by Messrs. Elphinstone and Vincent from two of their dynamos. At the end of the vestibule, where a short flight of steps leads into the British Sea Fisheries Section, will be seen the magnificent exhibit of Messrs. Siemens Brothers to which we have already alluded in a previous article. 1000 Swan lamps will be disposed upon the underside of the pinnacles of a reduced model of the Eddystone lighthouse, 60 feet in height, probably forming the most striking example of electric lighting that has yet been arranged for exhibition purposes. These lamps will be fed from two alternate current generators of large size, separately excited in the usual way. Messrs. Siemens Brothers also provide four arc lamps in the conservatory, each of 2000 candle-power; these will be arranged in parallel circuit instead of in series as has hitherto been usual, the lamps employed being of the hanging pendulum type, and being used without any modification whatever. The range of refreshment rooms to the left of the first gallery will be lighted by twenty-eight Lever arc lamps, fed by two Hopkinson and two Gramme dynamos. The passage leading to the right, past the dressing room of the Prince of Wales' Pavilion, is to be occupied by Mr. Matthiesen, whose lamps have lately been exhibited at the Aquarium, where they were severely handicapped by the insufficient supply of steam. Branching from this passage to the left, the machinery in section will be illuminated by 25 Gilbert lamps, arranged in parallel, and to the right the life-saving appliances, which are to be partly lighted by the Electrical Power and Light Contact Agency by six Werdermann lamps. At the end of the gallery one enters a small building devoted to the Newfoundland fisheries, divided between Newfoundland, the Netherlands, Denmark, and Belgium, and this is to be furnished with sixty Jablochkoff candles, while the latter country will be provided with three Lea and Gerrard lamps respectively. This brings us to the promenade gallery, in which will be found the only striking novelty of the show, viz., fifty Hochhausen lamps supplied by Mr. Edmunds, who further provides 500 incandescence lights in the eastern gallery, parallel Exhibition-road, and on the upper terrace a light tower on the same plan as that in Madison-square, New York, carrying six large lamps of 12,000 candle-power each, driven by a Hochhausen dynamo. We have heard much of the success of these towers in the States, and shall be anxious to see how far they are adapted to our climatic conditions. The aquarium, which bounds the garden at the side nearest Queen's Gate, is to be lighted by 1000 incandescents lamps driven by a single Ferranti-Thompson dynamo, while the adjoining building will be furnished with eight lamps in the same firm. The Gilchrist Company, in addition to the installations we have already mentioned will have twelve lamps in the Spanish section, and 400 Crookes' lamps in the Italian section, which are included in the contracts for the Eastern Pacific. This almost concludes the list, and we have only to note twelve Gerard lamps in the Russian Section, seven arc lamps in the Fish Market, and two Hawkes lamps at the entrance to complete the catalogue, as far as it is at present determined. Messrs. Goddard and Gibbs are to have twelve stations for the demonstration of their method of distribution by secondary generators, but at present their situation and extent are not decided. There has been a great deal of bidding among the exhibitors to see what their competitors would do, with the result that the whole installation is very beleaguered, and cannot be expected to be in operation before the commencement of June. At present Messrs. Siemens Brothers are the only firm that are ready to commence lighting

Engineering April 1883.

ELECTRIC LIGHTING NOTES.

DURING the recent six days' thunderbolt on board the steamboat Rainbow, now lying off the Eisteddfod, Swansea, and moored to the Victoria Dock, Cardiff, the Rainbow is attached to the Royal Reserve, and the performances were given in aid of a charitable fund. There were 28 Swan lamps, of nominal 16-candle power, but each lamp gave in practice more light. They were supplied with current by a primary battery of large cells of the Kinnersley pattern, which work with 53 volts of electromotive force at 1.8 volts per cell. Each cell has approximately a short circuit. The cells were joined up in series; the total electromotive force being 53 volts, and the current 21 amperes. By means of the switch the current could be divided amongst the different lamps so as to produce light or darkness in each of the tents of the stage. The light was maintained for ten hours.

THE Egerton woollen mills at Ucclfarr, in the Pendleton, have been lighted by 16 Brush lights, fed by the irrigation canals, and the installation may be regarded as the first step towards the utilisation of water power in these three canals, which would create some 1000 horse-power. The looms, carders, and other machinery are well lighted, and the native weavers can read the colours of their cloths with ease, distinguishing without difficulty light is 10 pence, or 7½ per month, and a saving is effected on insurances. The installation was made by the Eastern Electric Light and Power Company. While upon this subject we may also mention that the Brush light is found very useful in the Kimberley diamond mines, South Africa, after dark, since it enables the colours of the stones, when a diamond is found, and there is a request to light the entire mines by it, but owing to the cost of coal this would be an expensive undertaking.

THE management of the Savoy Theatre having determined to abolish gas-lighting altogether in the entrances, corridors, and offices, Messrs. Spagnoletti and Son are supplying some tasteful fittings for the Swan lamps, which Messrs. Siemens Brothers are erecting in placing them. The corridors are to be three parts lighted from walls with 8 in. carved reflectors, the lamps depending therefrom only a few inches below the ceiling. The electrician for the royal rooms is a gentleman connection between the banks, from which the lamps hang. While referring to Messrs. Siemens, Faraday and Swan, we may mention their display of new designs in electroliers, &c., in conjunction with the accumulators of the Electrical Power Storage Company at the Manchester Exhibition. Reflecting pendants made for the workings of the Swan and Co. lustrous candle for the workings for theatres, saloon fittings for ships, and an ingenious double swivel bracket for bedrooms, also form part of their exhibit.

Part of the town of Nantua (Ain), in France, has been lighted with an semi-incandescence and discharge lamps by M. Emile Reynier. The generator is a Siemens continuous current shunt wound dynamo of the type S D A, weighing 130 lbs., and absorbing one horse-power. It is driven by a hydraulic motor. The current is led to charge thirty-six Reynier accumulators joined in tension. These accumulators are of two distinct sorts, eighteen are of copper and eighteen are of zinc. The first consists of a plate of lead peroxidised as positive pole, and a plate of lead coppered as negative pole. They have an electromotive force of 1.93 volts, and weigh about 25 kilogrammes (55 lb.) per cell. The zinc accumulators consist of a peroxidised lead plate as before and a negative plate of lead coated with zinc. The weight of a cell is 23 kilogrammes (50 lb.), and the electromotive force 2.3 volts. These thirty-six accumulators are in tension, and represent a total electromotive force of 71 volts and an internal resistance of 0.18 ohm. They supply 12 Edison lamps of 16 candles, which work with 53 volts of electromotive force. The lamps are joined in parallel or derived circuits. The accumulators also feed four Regnier semi-incandescence lamps, which resemble those of Verdermann and Jaed, and work in multiple arc lamps. There are three of 16 candles each, and one of 32 candles. The lamps require 53 volts, a resistance is inserted in the general circuit and regulated by a key which increases or lessens it in proportion to the discharge required for maintaining the light. The four semi-incandescence lamps have also one derived circuit, and to prevent the extinction of the lamps during the rest 36 Regnier cells are used, a secondary battery to each, these being joined in tension in such a way that their electromotive force is opposed to that of the first current. When the latter fails no current passes through the batteries, but when a lamp through accident ceases to act, the secondary battery in the batteries of the other series of lamps keep them lighted and are fed by the current. A similar plan has been patented in this country. M. Reynier's installation at Nantua is peculiarly interesting from the fact that three sources of lamp are employed in it and are fed by the same source. The accumulators of copper and zinc are also novelties which have stood the test of trial, and the utilisation of waste water power is another feature in the work which adds to its merit.

ELECTRIC LIGHTING AT THE BRÜNN THEATRE.

SOME time since (see ENGINEERING, vol. xxxiii, pages 18 and 204) we described the lighting of the Savoy Theatre and considered at some length the advantages gained by the use of the electric light in theatres. Little has happened since that date to modify the opinions then expressed, and later installations have tended to show how numerous the advantages are, both as regards the quantity and quality of the light, and the improvements in ventilation. Below is given a very successful installation of this class recently fitted up at one of the new theatres in Brünn. The particulars and drawings of this installation are taken from our esteemed contemporary *Die Elektrizität* (*Zeitschrift für Elektrotechnik*, Vienna), which recently published a lecture read by Mr. Ludwig Fischer, of Brünn, upon the electric installation at the Sarony and the Brünn theatres. Since we have already published a plan of the former and a diagram of its installation we do so now in Figs. 1 to 4, on page 350, and say, that the plan of the Sarony is Fig. 1, and that of the Brünn Theatre, Fig. 4, are drawn to the same scale, which at once shows the great difference in the dimensions of the two buildings, Brünn, the capital of Moravia, is one of the most important manufacturing towns in Austria; its 90,000 inhabitants are for the most part engaged in cloth and woollen manufacture. The theatre, which accommodates 1200 persons, was originally intended for 1000, but after the experience of the fire at the *Ring* Theatre in Vienna, the passages were considerably widened, and four instead of two side exits as originally proposed, were provided. The enlargement of the means of the internal ways necessarily curtailed the seats in the auditorium. The theatre is externally imposing and internally provided with all modern improvements, and is very tastefully decorated in white and gold, with a profusion of gold. Massive walls, varying from 2·7m. to 4·6. 6in., in thickness, with iron girders and tie accessories from the rest of the building, while iron curtains divide the principal stage both from the auditorium and from the large room at the back of it. No gas is used for any purpose in the Brünn Theatre, electric illumination having been adopted long previous to the completion of the building. The contract was carried out conjointly by Messrs. Schuckert, Nürn, and Co., of Vienna, and the Brünn Engineering Works.

The engine and boiler houses, illustrated in Figs. 5 and 6, contain three semi-portable *locomobile Dolzwitz*, a pair of horizontal compound engines coupled to one fly-wheel, driving by means of ropes, the countershaft below. The boilers consist of three cylindrical flue boilers, 5m. long by 2·1. 8·5in. in diameter, fitted on to a vertical tubular boiler 6·6. 0·5in., and 2·7. 0·5in. in diameter, provided with 69 tubes 2·1in. in diameter. The total heating surface of each boiler is 500 square feet, and two only are required to supply the necessary steam, leaving one always in reserve. The grate area is 19·6 square feet, which appears to be the proportion of grate area to heating surface both as 1:25. The feed is heated by waste steam to about 100·5deg. Fahr. by the exhaust steam in a feed-water heater of 170 square feet of heating surface. The chimney has a sectional area of 19·6., and is 40m. high. A steam jet is provided, which is put in operation each time after firing.

The motor is a double-cylinder coupled high-pressure Corliss engine, fitted with 150 h.p. cylinders, 311 in. stroke, working at 75 revolutions per minute, cranks being set at right angles. The flywheel, grooved to receive the seven large ropes, is 17·5 in diameter, 1·5 in. wide, and weighs 12 tons. Exposed to steam about six times, that is cutting off as soon as it gets a commencement, about 28.3 lb., each cylinder indicates 65 horse-power; should any repairs be necessary to one cylinder, the full power can easily be resumed, and all the work is done with one cylinder only. The main rope driving pulley on the engine shaft is 4·6 in. diameter, and as the speed is 300 revolutions per minute, the rope's speed is said to be 700 feet per minute. The seven dynamo machines are driven by seven ropes of cotton belting. The Edison machines are provided for supply the inverted incandescent lamps, while the Siemens machines provides the current for five flaming arc lamps of 1000-candle power each, placed outside the theatre; another small dynamo is reserved for special effects by means of arc lamps on the stage; these two machines require respectively five and two horse power. The Edison dynamos are of the K pattern capable of supplying each 200 incandescence lamps of 16-candle power, but since the four collectively have seven times 200 lamps to maintain at full power they are usually not worked to their total capacity; a spare dynamo is not provided, and in case of a breakdown the three machines must suffice to do the work. The resistance of the armatures in these dynamos are 0·0625 ohms, that of the magnets 12.18 ohms, strength of current 133 amperes and the tension between 102 volts; each machine consumes 20 horse-power when at full work. Fig. 7 represents the arrangement of joining the terminals of the four machines, and the current of each machine passes through a switch, after which the four circuits are joined into one main circuit. The arrangement is adopted for the exciting circuit shown in dotted lines. The united current passes through one of two Schuckert ampère meters Fig. 8, one of one of Schuckert's thinometer, to the theatre, a distance of about 120 yards. This cable is placed in a trench 3 ft. 3 in. deep and at distances of about 20 ft.; separate cables, as illustrated in ENGINEERING, vol. xxxiii., page 606, Fig. 7, are provided.

The installation inside the theatre consists of 1400 Edison incandescence lamps of 16-candle power each, of these the cable enters the building as at once divided into two lines, to one of which all these lamps are joined which illuminate the entrance hall, passages, and which requisite are also illuminated during the whole evening; the number of these lamps is 300. The second and no cable changes alternately, the lamps in the auditorium and on the stage. There are 800 lamps in the former and one the latter, while a few are also supplied from the engine-room, making a total of 1292 incandescents in daily use for Edison dynamos. For driving a small Siemens dynamo, supplying the current for small Edison lamps of 8-candle power each, and in this engine-room, arranged in the basement of the theatre, leaves the engine-room, and then grows the gas engine also serves to drive the ventilating fans. Fig. 8 shows the switch for the two exciting circuits, Fig. 9 shows the switch for the two cables, the short bars in, being of iron, the current overheating placed literally in the Brünn installations, are being divided for 4 light groups each. The switch-table rises vertically from the basement, having branches on every floor, each one of which is provided with a safety switch, B, and an ordinary plug switch, A, Fig. 10. The stage lamps are divided into three groups, one set while, one set red, and one green, for different stage effects, the colours being obtained more than one of these lamps groups are in operation at the same time, the total number of lights being somewhat over 900 lamps. The regulating switches shown in Figs. 10 and 11, are also well complicated, as in the case of the various experiments in theatre like that of Brünn, which have requirements of the kind, it is necessary to have all the lights under control, and yet to be able to regulate, in any moment, any one or more groups, or any individual switches, with great rapidity, which can be flowers, bells, and a number of distances; the switches are so, that any part of the circuit may be cut out, and the lamps in the various circuits, so that different groups can be regulated in the lamps currents. The switches B and C, Fig. 10, are ordinary switches, and A and D, Fig. 11, are switches for the regulator is placed on the stage, Fig. 4.

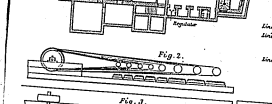
All the lamps in the auditorium are provided with ground opal glass globes, which soften the light considerably, and the terrace of the contract upon by the architect; this arrangement was not successful, the effects with the shaded to cover the whole stage. All the lamps on the full light would be too hot for full light, and it is said to be 700 hours, and for temporary illumination 50 oil lanterns are provided.

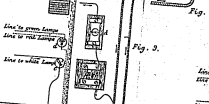
Particulars as to cost of lighting this theatre are not given, but the installation has so far proved very satisfactory, and the terms of the contract with the Brünn Engineering Works, and the municipal authorities of Brünn, and the contractors bearing on the point of cost, are as follows: The municipality provide the complete installation free of charge, also for a monthly rent of 140fl. maintain the same for twenty years, after which time it becomes the property of the town. According to particulars in the contract, 700fl. are supposed to go towards payment of interest and amortisation, while the other 700fl. pay for maintenance. In case of failure the conditions named rather lenient for the contractors; for the extinction of ten lamps or more, ten shillings, and in addition the contractors provide light by means of the oil lamps during such derangement of the electric lighting.

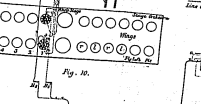
All copper leads in the Brünn Theatre are protected by silk, as layers of lace, soaked in insulating solution and they have so far given good results. Since the Savoy Theatre and the new Opera in Rome have successfully adopted electric illumination, quite a number of other theatres have followed this good example. The Théâtre Variétés in Paris, with 1200 lamps; the Eden Theatre, Monte Carlo, and Sonzogno Lamps, the new theatre at Munich, the Italian Opera in Paris, and a little theatre in Havanna, are all provided with Edison's system.

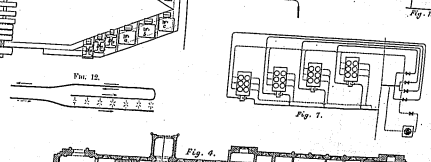
ELECTRIC LIGHT AT THE NEW THEATRE, BRÜNN, AUSTRIA.

(For Description, see Page 345.)









ELECTRIC LIGHT AT THE NEW THEATRE, BRÜNN, AUSTRIA.

(For Description, see Page 345).

Fig. 5.

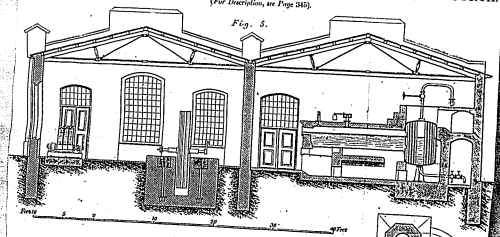
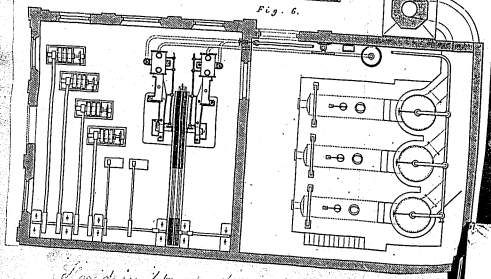


Fig. 6.



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THE EDISON SYSTEM OF ELECTRIC ILLUMINATION.

(*For Description, see opposite Page.*)

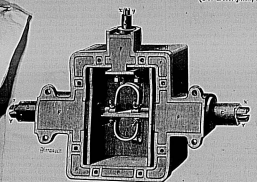

FIG. 2.

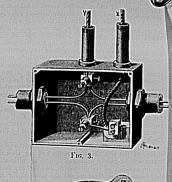

FIG. 3.

FIG. 1.

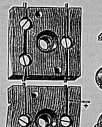

FIG. 5.

FIG. 6.

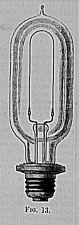

FIG. 13.

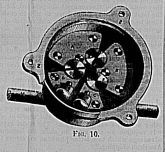

FIG. 10.

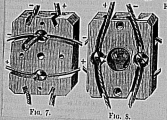

FIG. 7.

FIG. 8.

FIG. 9.

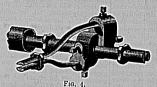

FIG. 14.

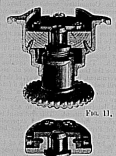

FIG. 11.

FIG. 12.

of their goods, including fish tanks and slabs suitable for fish-curing yards, fishermen's houses, coopers' or bait shops, piers, &c. On another occasion we may take somewhat more prominent notice of the generally commendable case, and the extent to which the material is now being used.

Coming next to Class VIII., which is very comprehensive, though not fully illustrated, we notice a model of Aberdeen Harbour, and a plan of the same, furnished by Mr. William Smith, harbour engineer; Arbroath and other models of harbours are also exhibited, one of which is a model of a proposed new harbour for Tynemouth, from designs by Messrs. Thomas Meik and Sons, civil engineers, Edinburgh. Every item of the design is well fitted to assist in making a most secure fishery harbour of very great extent, and at comparatively small cost. Dysard—by the scheme will doubtless be carried out. Another exhibit of a similar kind is a model of Buckie Harbour, and photographs of the same, sent by Lady Gordon Cathcart. Several plans and models of fishermen's dwellings are likewise exhibited; and Mr. Meehan, city architect, Edinburgh, shows a model of a proposed wholesale fish market, in which there are embodied some excellent structural features. Messrs. Low and Duff, of Dundee, show a sample of their gun for firing lines from shipwrecked or stranded vessels to shore, a very ingenious piece of apparatus which has already been described in our columns. As in most other public exhibitions, there are here several examples of the proverbial "fly in amber," one of which is nothing less than a "patent gas governor for equalising the pressure and increasing the illuminating power of coal and other gas." Why such a piece of apparatus should get in amongst collections of fishing garments, models of fishing boats, &c., is a difficult to understand.

As was naturally to be expected, the question of pollution of rivers is prominently illustrated in the Fisheries Exhibition. In Class X. there are three systems of treating town sewage and manufacturing waste very fully illustrated by models, specimens, &c. These are the A. B. C. system, as pursued at Aylesbury, the one pursued at the Hawick Sewage Purifications Works, and that adopted by the paper-making firms on the North Esk, Midlothian. The first has been so often described that we need not enlarge upon it; but the others are still possessed of much a great degree of novelty and industrial interest that we shall probably take an early opportunity of dealing with them at some length.

We had almost omitted to take notice of the exhibits in Class IV., which comprises piers, (new-

THE EDISON SYSTEM OF ELECTRIC ILLUMINATION.

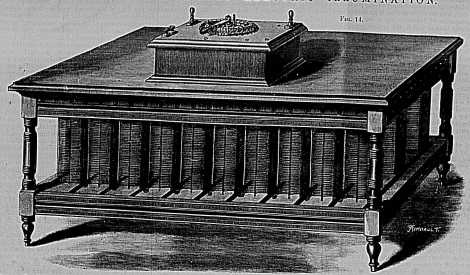

FIG. 14.

ings, models, &c., of fish passes, stairs, and ladders for enabling salmon and other migratory fish to surmount the natural and artificial barriers that obstruct their descent to the spawning grounds in the rivers of this and other countries. There are in this class some nine or ten exhibitors—Scotch, English, Canadian, and Norwegian. Two of the exhibits are models executed in Stuart's patent granolithic composition of salmon passes—one at Morphie, on the North Esk; Forfarshire, and the other at Dunnaton Mills, on the Tarth, Perthshire. The actual passes are in length, respectively, about 70 ft. and 250 ft.

Next week we propose to mention some of the exhibits on account of which medals, money prizes, and diplomas have been or may yet be awarded, and at the same time we may possibly refer further to the Exhibition.

THE EDISON SYSTEM OF ELECTRIC ILLUMINATION.

In our last article on the Edison system* we described the form and process of manufacture of Mr. Edison's incandescence lamps, as well as some of the fittings supplied with them, several of which possess points of special interest, and display much ingenuity. On the present occasion we shall go on to describe the conductors adopted under the Edison system for what the French call the *canalisation* of the current, and by which electricity is distributed over a district to be lighted from a central station; we shall then refer to some of the switches and other details connected with the distribution, and lastly to the apparatus devised by Mr. Edison for regulating the strength of the current as the work it is required to do, and the instruments by which the extent to which the current is utilised by subscribers or lost through defective insulation is measured and recorded.

The conductors may be grouped into three classes, viz. (1) the principal and submains which carry the great bulk of the working current beneath the streets, and to the subways; (2) the conducting cables which are employed for the comparatively short house-service leads, supplying the currents to such numbers of lamps as rather would require the conductors of the first group; and (3) the single insulated wires of small sectional diameters by which the groups of lamps are placed in circuit with the service conductors and their branches. Those of the first class, or electric mains, alone require special notice, the two other classes, differing in no material respect from the electric light cables and wires used under other systems.

The mains are, however, of peculiar and interesting construction. The conducting portion consists of two solid copper rods of segmental cross section, clearly shown in Fig. 1 on the opposite page, which represents a cross section of these different-sized three conductors, suitable respectively for large mains or for branch circuits, or for the mains of smaller installations; the two segmental bars are protected from injury and from moisture by being passed through the middle of a wrought-iron pipe, and are held in position in the final place by diaphragms punched out of stout millboard, which is threaded on to the bars at intervals along the length of the tube; and the whole of the conducting systems are filled with a bituminous insulating compound which performs the threefold duty of keeping the conductors within the limits of the tube throughout their length, of serving as an insulating material protecting the conductors from damp, and of so completely filling the tube that the latter, with its conductors in place, can be bent to any desired angle without any distortion of the sectional cross figure, or displacement of its contents. At both the Paris Exhibition of Electricity and the Electrical Exhibition at the Crystal Palace, specimens of these conductors in various sizes, some seven years old, and others a couple of years old, were exhibited, and any one rode of such a length and necessarily of such a constructions, would naturally follow that unless some provisions were made to allow for contraction or length without distorting the mains, they would to a short distance themselves, or at least would soon be injurious to both conductivity and insulation. The arrangement for meeting this difficulty is shown in Fig. 1, which is an illustration of one of the main junction boxes with its cover removed. This consists of a box of cast iron (A) with double walls, through the side of which (B) pass the ends of two pieces of conductors X Y, one of which is to be joined on to one section of the mains, and the other to the next section. Or Labeled strips of metal, by way of example, being of equal sectional area to that of the conductors X Y, on account of its form, to that of the conductors X Y, on account of its form, are employed for closing or opening under the elongation or shortening of the straight conductors. The illustration also shows the method of connecting a lamp circuit in parallel or with the main circuit; the conductor C being connected to the loop A by the copper strip D, while E is a notable connection with B by the lead strip C. Every branch circuit throughout the system is provided with a protected against any sudden increase in the strength of the current by being provided with a safety guard consisting of a short length of lead wire, through

* See ENGINEERING, page 365 *ante*.

which the whole of the current passing into a branch circuit is transmitted; and as long as this current is of its normal strength, it acts simply as one portion of the conductor, but its cross section is so determined that it is incapable of transmitting a current of a strength above that at which the branch circuit can be worked in safety; the moment this strength is exceeded the lead wire fuses, and the branch to which it is fitted is cut out of the circuit. This safety guard is applied not only at every junction of submains with the main, but at every branch leading from the submains, and at every branch leading group of lamps, branching again within a house; the arrangement is still more clearly shown in Fig. 3, which represents a junction box for connecting the cables for a house service with a submain. In this case the conductors of the two submains are coupled together by the curved copper rods A, B, C, and D, and the house cables X and Y enter the box by the tubes shown on the top of the figure being connected respectively with the blocks G and H, the former of which is coupled to C and D through the block F by the short length of lead wire E, which, by fusing, if by any chance the strength of the current rises beyond a certain point, cuts out the branch without affecting the main current passing through the box from right to left. Fig. 4 is an illustration of another form of branch between two medium size mains, the construction and principle of which is sufficiently clear from the sketch.

Fig. 5 shows the arrangement of the branch block and safety guards employed under the Edison system for the smaller branches, such as those within a house leading to one room or to a separate group of lights. This consists of a square block of wood having on its one face two grooves ploughed into it capable of allowing the cables to be laid in them, and on the other face are ploughed two smaller grooves whose direction is at right angles to those on the other face. In the centre of block is imbedded one of the lamp sockets or fittings which have already been described*, and the conical seat and screw connexion are so connected to the cables and the branch wires, that if a lamp were screwed into the socket its filament would act as a coupling piece, placing the branch in circuit with the cable conductors. Instead, however, of a lamp a little screw safety plug, shown in Fig. 6, is inserted; this plug is in its external fittings identical with the screw and cone fitting of a lamp, but the cone is connected with the screw by a short piece of lead wire within the cavity of the plug, which, when the plug is screwed into its socket, places the branch in circuit with the cables, but fuses the moment that the current approaches a strength dangerous to the safety of the lamps. Mr. Edison has recently introduced a slightly improved form of branch block, shown in Figs. 7 and 8. In this apparatus the new lamp-fitting is introduced, the cone at the larger end of the plug being replaced by a flat bearing plate at the smaller end, which when the plug is screwed into its place bears against a flat plate at the bottom of the socket. A plug of this description is shown in Fig. 9, and its flat bearing plate is connected to its screw by a piece of lead wire. The grooves in the block are moreover curved so as to make room for the safety socket in the centre of the block without, however, necessitating the pair of conductors on each side being laid at such a distance apart as was necessary with the earlier form of branch block.

Under nearly all electric light systems, especially in those like Mr. Edison's, in which currents of great quantity and of low electromotive force are employed, considerable difficulty is experienced by the burning and consequent destruction of the contact surfaces of the switches, for it must follow that however rapidly a contact may be broken an electric arc must be momentarily produced, and this means consumption of the metal of which the contact surfaces are constructed, and the amount of the consumption will depend upon the strength of the current, on the area of surface affected by the arc, and on the time during which the current is passing from one contact to the other in the form of a visible arc or spark. In the switches adopted under the Edison system, especially in those used for interrupting strong currents, this difficulty is reduced to a minimum, first, by dividing the spark due to interruption over two, three, or more interruptors at the same moment, and thus reducing the arc at any one interruption to a half, a third, &c., according to the number of interruptions produced; second, by increasing thereby the area of surfaces in contact; and, third, by insuring extremely rapid making and breaking of the circuit. Fig. 10 is a view of the back of one of Mr. Edison's three-fold switches, showing the internal arrangements. This switch is so designed that by turning the cross handle M M through a portion of a revolution, the three conical spring plugs E, F, and G (which are nearly identical in construction with that shown in Fig. 8 on page 302 of our issue for March 31*) are simultaneously thrown into or out of their seats, which are cut in the edges of the four plates A, B, C, and D. The current entering by the attachment screw H when the switch is "on" passes in succession through D, G, A, E, B, F and C to the other terminal screw K, and as this is accomplished by a cam suddenly setting into action a strong spring the interruption is extremely rapid and the sparking is distributed over no less than six surfaces, so that not only is the spark reduced to a minimum at any one spot, but the area of surface contact is proportionately increased. In the improved switches recently introduced, the conical connecting plugs are pushed in from their base instead of being drawn into their seats by their smaller ends; by this means a central rod passing between the fixed plates is avoided, and the cone comes clear away from its seat with no danger of an arc being formed through the rod becoming bent or otherwise eccentric. Figs. 11 and 12 represent a section of a single switch recently sent over from America by Mr. Edison, in which the arrangement of conical plug to which we have just referred is employed. By the rotation of the hand-wheel at the bottom of Fig. 11, a double cam attached to its spindle pushes into its seat or suddenly withdraws the split spring cone shown in both figures, and thus connects or electrically separates the two plates shown in the upper part of Fig. 12, which represents a section through the switch taken in a plane perpendicular to that of the section Fig. 11.

In accordance with the promise contained in our last notice we now illustrate the newest form of Edison incandescence lamp, which it will be seen on reference to Fig. 13, consists of the usual internal arrangements, but the glass envelope is of cylindrical form with hemispherical ends and the attachment fitting is of the form described in connexion with Fig. 2 in our last notice, having the flat bearing plate at the bottom of the fitting instead of the upper brass cone.

In our notice of the Edison installation at the Electrical Exhibition at the Crystal Palace,† we described the system by which the strength of the current is regulated to the work it is required to do, and as this is effected by varying the resistance of the exciting circuit of the field magnets so as to proportion the intensity of the magnetic field to the current required for feeding the lamp circuits, the mechanical resistance to the rotation of the armature is varied accordingly and with it the motive power for driving the machines. Mr. Edison's current regulator is illustrated in Fig. 14 on the preceding page. This apparatus consists of a rectangular table supporting beneath it a number of coils of German silver wire wound upon skeleton bobbins, between which and between the convolutions of each helix there is a free circulation of air so as to keep the whole system cool. All these coils are coupled together in series, the first being connected to one attachment screw of the apparatus, the other attachment screw being connected to the regulating lever, which by being moved over a number of contact pieces, arranged in a circle on the upper table, and connected severally with the resistance coils underneath, can be made to throw into the circuit of the field magnets of the generator or generators any number of the resistance coils from one to the full number in the regulating apparatus. The general arrangement of circuits will be understood by referring to the diagram, Fig. 4, page 253, and the description we have already given with reference to the Crystal Palace installation. In permanent installations the regulating room is provided with photometers by which the photometric value of one lamp in any one circuit can continually be observed, and there is also an electromotive force indicator consisting of a reflecting galvanometer, the resistances of the circuits being so balanced, that when the current is at its normal electromotive force the indicating spot of light rests at the centre of its scale, but moves to the left or the right, according as the electromotive force diminishes or is increased.

Having now described the principles and construction of the apparatus employed under the Edison system of electric illumination for the ge[neration], canalisation, regulation, and utilisation of [cur]rents, it only remains to us, in conclusion [to refer] to the highly interesting and ingenious a[pparatus] devised by Mr. Edison for measuring the a[mount of] current made use of by each "consumer," a[nd] the total amount passing out of the centra[l station] of a district. This branch of the subject is, [however,] of too interesting a character to be treated a[s part] of a more general notice, and we shall in [a future] issue illustrate and describe Mr. Edison's meters, as well as some other interesting a[pparatus] more or less connected with the s[ystem].

* See ENGINEERING, page 305 ante.

* See ENGINEERING page 302 ante.
† Ibid., page 230 ante.

PATENT LAW REFORM AND SIR [JOHN] LUBBOCK'S BILL.

(Continued from page 380.)

ONE of the most important recommenda[tions of] the memorial is the fifth, which, like the res[t of the] document, is brief, but to the point. It is ex[pressed] in simply three words, "Reduction in fees." [Now] the stamp duties proposed in the schedul[e of the] Bill do not represent an excessive total for t[he term] of seventeen years, viz., 77l. 10s., that amoun[ting to] less than half the fees now payable on a [patent] lasting only fourteen years. But althou[gh the] fees as a total are quite low enough, the div[ision of] the several payments is bad. The amount pr[oposed] for provisional protection—2l. 10s.—is too [much]. The next payment, 5l., payable on grant of [patent,] comes somewhat too soon, regard being had t[o] expenses to be referred to presently. The thi[rd pay]ment, i.e., 20l., on certificate of renewal in [the fourth] year of patent is, on the contrary, far too [...]

We some time ago referred to a paper read [by Mr.] Lloyd Wise to the Civil and Mechanical Eng[ineers'] Society last January. In that paper he dealt s[eriatim] with the several heads of Mr. Calvert's me[morial]. Referring to the matter of fees, he urged—a[nd we] agree with him—that in the early stage th[e fees] payable should be placed within the rea[ch of] inventors of very limited means, so that the[y may] have a tangible security with which they may [go to] the capitalist or the manufacturer and strike [a] bargain. It is absurd to say that workmen d[o not] invent, or that their inventions are of n[o value]. Wherever they have been encouraged, as at M[essrs.] Denny's works at Dumbarton, the results have [been] highly satisfactory. To take (as some have [done]) the lists of applicants for patents under the l[aw as] it stands, and pretend to draw inferences from [them,] is ridiculous. To begin with, it is by no mea[ns an] unknown thing for a master or a capitalist to b[e the] patentee, while the workman or person of li[mited] means is the actual inventor, and this notwiths[tand]ing that under such conditions the applicant [for a] patent—though he perhaps fails to realise it—[makes] a false declaration. In the next place, wh[en a] workman applies for a patent, he does not invar[iably] state his occupation, so that an accurate judg[ment] cannot be formed from the bare official rec[ords]. Even if it were ascertainable that comparati[vely] few workmen become patentees; that, in vie[w of] notorious facts, is simply a strong evidence of [the] inabilities under which workmen, like other[s of] limited means, suffer in the present state of the [law,] and is to be regarded as a strong argument in fa[vour] of reduction in fees.

Now the question of fees demands considerat[ion] in connexion with the term of provisional protecti[on,] to which allusion has been already made. Th[ose] who have actual experience well know t[hat] six months, as proposed, is a very short time [in] which to get even the best of inventions taken [up]. People with money and influence in some cases s[uc]ceed, but men who live from hand to mouth, a[nd] whose time is fully occupied during the day, have [a] far more troublesome ordeal to undergo. It is f[or] such, as well as for others, that the law ought [to] make reasonable provision. And we affirm that f[or] such men it is not reasonable to provide that on[ly] six months shall be available within which to provi[de] the needful funds to test an invention, mature [it,] prepare and file a complete specification, and tak[e] steps to complete the patent, and for these reason[s] we repeat that 2l. 10s. is too much for provisiona[l] protection, and that the further payment of 5[l.] follows too closely.

The memorialists recommend payment of the fe[es] by annual instalments. Now reference to t[he] statistics of foreign countries in which patents [are] subject to annuities, will show at a glance that [if,] as proposed in the Bill, the next payment a[fter] grant of the patent be deferred until the end of [the] fourth year, there will remain in force up to

THE ELECTRIC LIGHTING OF NOTTINGHAM.

The Telegraph Construction and Maintenance Company is the latest candidate for admission to the roster of the electric lighting fraternity. With this object it is promoting a Bill in Parliament to enable it to keep the scope of its operations, and in the meantime it has given in a tender to the Corporation of Nottingham to supply them with plant, consisting of distributing mains, generators, engines, boilers, and buildings for an installation of 60,000 incandescence lamps. The well-known scientific skill and business ability of the directorate of the company, as evidenced by their great success in a manufacture beset with difficulties, will command for their proposals an amount of respect that has not been accorded to many companies who have no previous history to point to. It may be assumed that this offer represents a genuine business project, designed to give satisfaction to the purchasers, and a fair profit to the manufacturers, and does not, in any sense, partake of the nature of an advertisement to be afterwards used in the manipulation of the share market. In these terms one of the most substantial pieces of evidence that has yet appeared, of what is the cost of introducing the electric light on a tolerably large scale, and though it does not greatly differ from many estimates already published, yet it carries far greater assurance from the fact that its authors are ready to enter into a binding contract to carry it out.

As is well known, the Telegraph Construction and Maintenance Company have adopted the Gordon generator for the lighting of their extensive premises, and it is this type of machine that they propose to employ in town lighting. On page 507 of our last volume will be found an illustration and a full description of the generator at the Greenwich works. The leading feature is that the field magnets are mounted upon the periphery of a large wheel, which revolves between two sets of stationary armatures coils. Thus the current is received from the armature without any rubbing contacts, and the machines can be grouped in any desired order, and arranged to feed any reasonable number of circuits. The machines already at work has been proved to have a high efficiency, while the slow speed at which it is driven avoids much difficulty in the matter of lubrication, and affects a saving in wear and tear. Unfortunately, however, it produces alternate currents, and this we hold to be a great objection to its use for town purposes. The amount of electricity that will be expended in the production of power, when it is laid on to our houses, will rival that annually used for, and up to the present no motor success. The introduction of domestic labour-saving machines has been almost prevented by the necessity of driving them by hand, but if a means of working them by power were provided, without any danger or trouble from steam, gas, or batteries, their number would increase by bounds, and the sewing or the washing machine, as universal as the domestic motor would become as universal as the

The installations at Nottingham is intended to furnish a continuous supply of a current of electricity, sufficient for the maintenance of 60,000 8-candle lamps of 20 candle-power each, for sixteen hours out of the twenty-four, and of one-third of that number during the remaining eight hours, to all the houses, warehouses, shops, factories, street lamps, &c., in a specified area. Five Gordon dynamos are to be provided, four to work and one to spare, and one each to be driven by a pair of compound condensing tandem engines of the vertical inverted cylinder type, capable of developing 1700 indicated horse-power at 150 revolutions per minute. There will be six direct current machines to excite the magnets of the large generators, and these will be driven by independent engines, whose speed will be regulated so as to maintain a field of such an intensity that there will be a constant difference of potential between the mains, whatever may be the number of lamps in action. Steam will be provided at a pressure of 120 lb. to the square inch by 38 boilers, fitted with Galloway tubes, and each capable of developing about 220 indicated horse-power, so that 30 of them may be at work and eight idle. Mechanical stokers are to be fitted to the boilers, and the coal is to be delivered into them from an elevated store capable of holding 1000 tons. The valves are to be of copper rods of such section that the current shall not exceed 1750 ampères per square inch; and are to be arranged in eight double circuits. These double circuits are a novel feature; each mains will have its lamps divided into groups supplied from two independent sources by parallel mains; and thus the chance of its being left in darkness will be greatly diminished. At the same time additional compilation will be introduced, for there will be four leads in each building instead of two, and these cannot be coupled together in parallel are as would be the case if the circuits were direct.

When the installation is complete the contractors are to run it for thirty days at its full capacity, or as near that as the demands of the consumers will allow, and if it prove successful it is to be then handed over to the corporation, and the last instalment of the purchase money is to be paid. The contract price is to be 250,000*l.* or 3*l.* 12*s.* 8*d.* a lamp, a lower amount than we remember to have seen named before, but it must be remembered that the plant is on a much larger scale than that of any previous project, and that the price does not include the price of the site, or wires or lamps on the consumers' premises.

Following the specification there comes an appendix, giving the estimated working cost of 60,000 lamps. The information is given for the guidance and convenience of the corporation, and it is believed by the authors that the figures are correct, but they are not in any way guaranteed.

Upon the assumption that the lamps will burn 2500 hours per annum, the annual charges are estimated thus:

	£
Depreciation and repairs of plant ...	10,000
Coal (21⅓ per indicated horse-power at 5*s.* per ton)	9,625
Oil, waste, &c.	500
Labour and superintendence	5,375
Rates	500
Other rates and taxes	500
Office expenses	600
Renewal of Swan lamps at 2*s.* per stand lamp hours	15,000
Interest at 5 per cent. on 220,000*l.* ...	11,000
Total	53,700

The cost of 60,000 gas jets, each burning five cubic feet per hour, with gas at 2*s.* 6*d.* per thousand feet, would be 93,750*l.*

Thus the cost of an electric light is shown to be 18·6*s.* per annum, as against 31·25*s.* for a gas jet.

Moreover, the figures, excepting the lamp renewals, seem to be fairly estimated; it is not easy to calculate the repairs and depreciations of such a plant, but if the possibility of its being superseded by some other means of generation be overlooked, 4½ per cent does not seem to be an excessively small estimate, especially when it is remembered how much of the capital is sunk in buildings, foundations, and mains. The coal and labour are also liberally allowed for, but the item of 2*s.* as the cost of Swan lamps per thousand hours is a surprise. It either involves a much greater endurance than the 1200 or 1500 hours usually counted upon, or else a reduction of 60 per cent. upon the present price. As matters now stand it must be raised to 3*s.* 3*d.*, and this will add 9270*l.* to the annual charges, and bring the cost per lamp to 21·75*s.*

But however correct its circumstances may be, the premises upon which they are founded are open to fallacious, consequently the results are totally misleading, and if the Corporation of Nottingham accept them they will be greatly disappointed. If a lamp is to work 2500 hours per annum it must be in operation on an average for nearly seven hours per day all the year round, or if Sunday be omitted for eight hours per day. Now let us see what would actually be the case. At half-past four on a winter afternoon the installation would be working at its full capacity, and 60,000 lamps would be drawing their supply of current. About five o'clock there would be a decrease in the current supplied to banks and offices, while at half-past seven woman and child in the textile factories must cease work, and accordingly the current required by the mills would be greatly diminished. At six, again, the warehouses would close, at eight the shops, at eleven the public-houses and places of amusements, and by midnight the demand would be restricted to the street lamps and an occasional light kept burning as security against burglars. Thus within about an hour of the evening lighting being fairly commenced the restriction of the demand sets in, and in four hours a great part of the original 60,000 lights will be extinguished. This opposite says, however, that "if instead of each lamp (gas or electric) burning 2500 hours per annum, one or more lamps alternately make up the 2500 hours, the result will not be altered, the electricity and gas being alike supplied by meter." Let us therefore see under what circumstances one set of lamps may be expected to replace another set that has been put out. This will occur in two cases at least; firstly, of course, a demand will spring up at the places of amusement between seven and eight, but this does not amount to much in provincial towns; and, secondly, the domestic lighting will be greater as people return home for the evening. But neither of these instances will supply sufficient ground for the reduction of light in business premises; in the houses of the wealthy the return of the proprietor produces no extra illumination, while it is not to be expected that the mill hands, who seldom use gas, will go to the expense of introducing the electric light into houses hold on a weekly tenancy.

We will now summarise the lighting for a December day (not being a Sunday) at

	Hours
Banks	4
Offices	11
Mills and workshops, morning and evening	4
Warehouses	4
Shops	5
Theatres	4
Hotels	4
Streets	16

At Midsummer this list would dwindle to

	Hours
Banks	4
Offices	4
Warehouses	4
Streets	16

It is very difficult, of course, to strike the average times per lamp, but seeing that offices, mills, warehouses, and shops will take the greater part of the supply, and that these are all closed on a Sunday, it would seem that 1225 instead of 2500 hours per lamp would be an exceedingly liberal estimate.

Considering the value of the annual charges upon this basis, we arrive at a very different result. The depreciation and repairs remain the same, that is 10,000*l.*; the coal account would be halved, the petty stores reduced to 250*l.* 000*l.*, the labour and supervision would be practically the same for the machinery must always be running, but we will reduce it to 4500*l.*; rent, rates, and taxes would be halved, while the rent for the use of lamps, at 3*s.* 3*d.* per 1000 hours, would be 12,187*l.* The interest would likewise remain constant at 11,000*l.*, hence the total would be 46,826*l.*, or 15·6*s.* per lamp as against 18·62*s.* per gas jet for the same time; that is gas and electricity would cost practically the same if an average use of 1250 hours per lamp could be secured.

That the period will not be exceeded it, we think, beyond contradiction, and it depends greatly upon local circumstances whether it will be exceeded. Street lamps burn 4000 hours a year, and no doubt in the specified district to the new undertaking, but unfortunately they only occur about once in fifty yards. Manufactories working all night, as do some of the total cost for a winter 2000 hours' consumption, while dwellings are probably illuminated for 1000 hours. This is the across side of the estimate, and upon the other may be placed theatres, &c., 1200 hours, shops 900 hours, warehouses and offices, and places under the Factories Act, 300 hours, and banks 100 hours. It will be for the Corporation of Nottingham to decide what the resultant average will be; the presence in the town of a manufacture which, to a certain extent, is continued through the night, will be an item in the favour of the electric light, and if they can induce a sufficient number of millowners to embrace their scheme they may carry it out without loss, after it has had time to establish itself in the town, but this must take some years at least, during which an increased charge must be made over the present price of gas.

"ELECTRIC LIGHTING NOTES."

THE Canadian Telegram belonging to the Dublin Company of New Zealand, is to be fitted throughout with the incandescent light on the Swan system. This makes the fifth vessel belonging to the company now partially lighted; of the four previously fitted two are on the Swan system, two on the Siemens system.

We understand that the new pensions recently fitted up for the officers of the *Irish Times* in Westmoreland-street, Dublin, are to be lighted throughout on the incandescence system of electric lighting. The installation is to be executed by Messrs. Siemens, and will consist of 150 Swan lamps of 20 candle-power each worked by an alternate current machine and an exciter. The lamps will be arranged in four circuits, so that one or more circuits may be cut off at pleasure, and each lamp will be provided with a switch for putting on or off the current as occasion may require. Fusible plugs are also to be inserted where necessary. The motive power will be supplied by a 12 horse-power (nominal) Crossley gas engine, suitable connections for which are to be made with the water and gas services for the purpose of overcoming the unsatisfactory inclination to gas engines. The installation has been ordered through, and will be carried out under the superintendence of Mr. J. Angelo Falke, Memb. Soc. C. E. and of Edison, of Dublin.

The numerous confident assertions that the Jablochkoff candle, though invaluable as a pioneer, can have no chance of survival in the struggle of the systems, appears to be fully contradicted by its intended extensive adoption for subterranean street lighting. Since days of since it was announced that a large part of the parish of Marylebone is to be lighted by the Jablochkoff Electric Light and Power Company. The district selected is, as is doubtless the parallelogram bounded by the following streets; Church-street, Edgware-road, Harrow-road, Bath, Orchard-street, and Baker-street, and Park-road, Regent's Park. It is estimated that 200 lights will be required for this area. Many recently-laid water and gas mains forming the Strand Union, namely, St. Anne's Soho, St. Giles-in-the-Fields, St. Paul's Covent Garden, the Precincts of the Savoy, and Liberty of the Rolls, and St. Mary-le-Strand districts, have been undertaken to supply the parishes with light at a moderate rate price, and many old conditions accept a seven years' contract; becoming, in fact, the servants instead of the controllers of the district. The company, however, reserve the right of supplying light either are or incandescence (the latter or other systems) to private consumers, and with the object sufficiently large main conductors will be laid in the streets. It will be seen that it is a hardship by other associations that a company with such little less hitherto been heard, should have control from districts they considered their own, and from which they have spent comparatively large sums in preliminary work. But we think that the public will be congratulated on the prospect of having an important district thus lighted by a new and well-tried system, and not by the old control of the authorities. Another point in the expenditure contemplated by the Jablochkoff Company stands half a million sterling, including the necessary lighting over a large area of the City, the Strand, and Fleet-street not yet settled.

At the several general ordinary meeting of the Electric Lighting, Contract, and Maintenance Company held on Wednesday last, Mr. Crompton stood up to the undertaking and returns the capital—less some small amount for expenses incurred—to the shareholders. The company looks forward to reconstitution at some future day, but the shareholders were convinced the time for them had not yet arrived. We trust that the shareholders of such other companies as may be compelled sooner or later to execute the happy despatch, may find themselves in the position of those forming this company.

The Hammond Electric Light and Power Supply Company, the object of the Brush electric, appears to be in the most flourishing condition of any of the family.

At the general meeting, held last Tuesday, the accounts presented by the directors showed the sum of 12,252*l.* 19*s.* 8*d.* as profit for the year 1880, and this sum it was proposed to apportion as follows: 1000*l.* in payment of a 5 per cent. dividend; 5000*l.* to be written off the goodwill and concession account; 5000*l.* to be placed to the reserve fund; and 1025*l.* 5*s.* to be carried forward. The liabilities of the company consist of paid-up share capital 80,000*l.*, creditors 8230*l.*, and a sum of 14,857*l.* to the credit of the Brush Company. The assets are goodwill, concessions, and patents, 41,097*l.*; debtors, 7699*l.*; plant, machinery, stock, and furniture, 29,055*l.*; rejected new stock on hand to be returned to the Brush Company, 8231*l.*; electrical college and lamp factory, 1656*l.*; cash, 22,966*l.*; shares in Ferranti and Co., 375*l.*; shares in sub-companies, 32,102*l.*; and preliminary expenses, 1000*l.* The profit and loss account does not give much clue to the extent of the company's operations, because it deals only with the profits on contracts and on material sold, and does not specify the gross value of the plant disposed of. Thus, during the year 1880, the account sale up to 12,000*l.*, leaving a balance from sales to concessionaires of 2165*l.* The profit on contracts is 5086*l.* from profit on completed installations and tracts and on materials sold, and the remainder 3191*l.* from discount, interest, and transfer fees. On the other side trade expenses amount to 6265*l.*, directors' fees to 1000*l.*, salaries and laboratory expenses to 1201*l.*, depreciation to 2166*l.*, and other expenses to 450*l.*, the balance of net profit being 12,252*l.* It will be noticed that this is less than the balance of sales from concessions account, and that consequently no profits has been gained by the sale of machinery or light. It is, however, hardly to be expected that an intermediate company should make a profit the first year of its existence, especially when it is remembered how many unfavorable circumstances have been arrayed against it. The shareholders will not quarrel with the dividend on account of the source from which it is derived, though it is certain, since that some of them are anxious to know upon what basis the value of the shares in the subscription is computed, seeing that those figure as their largest asset. From the accounts and the report we hear how greatly the relations between the Hammond and the Brush Companies have improved. The directors, acting under the advice of counsel, have determined to return to the purchasers of the Brush lamps in Manchester, Sheffield, Warwickshire, and Worcestershire, a considerable portion of the consideration money on account of the Edison difficulty, and are asking the Brush Company to make good the amount. We believe that this falling on the latter company they will bring a further action against the parent company for breach of contract in the supply of machines, and for absolute failure to supply a Brush dynamo machine suitable for incandescent lighting. If others of the subsidiary companies should follow this example the Brush directors will come to regard their offspring with the pride and satisfaction which they evinced some twelve months ago. The Hammond Company has acquired the sole agency for the Ferranti alternate-current machine, and has further bought, on reasonable terms, the Wright and Mackie manufacturing patents, by which the production of incandescence lamps is much cheapened.

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NOTICES OF MEETING.

THE INSTITUTION OF MECHANICAL ENGINEERS.—Ordinary meeting, Tuesday, April 5th, at 8 P.M. Paper to be read and discussed: "The Application of Steam Power to Road Traction," by Thomas Aveling.

HOCKEY OF ENGINEERS.—Monday, the 4th of April, a paper: "On the Application of Steam Power to Road Traction," by Mr. Thomas Aveling. The chair will be taken at half-past seven o'clock precisely.

INSTITUTION OF CIVIL ENGINEERS.—The meetings will be held in the Hall of the Society of Arts, John-street, Adelphi (by permission of the Council of the Society of Arts), on the following Tuesdays, at 8 P.M.:—Tuesday, April 5th, meeting at 7.30, when tea will be served at 7 o'clock; and on Friday, April 8th, meeting at 7.45, and meeting at 8 o'clock. Subject for discussion, "The Application of Steam Power to Road Traction," by Mr. Thomas Aveling, Assoc. Inst. C.E. 1. Annual Report of the Council. 2. Election of Officers and of the Council. 3. Election of Members. 4. Election of Associates. 5. Election of Students. April 12th, meeting at 7.30, when tea will be served at 7 o'clock: and on Friday, April 15th, meeting at 7.45, and meeting at 8 o'clock. Subject for discussion, "The Application of Steam Power to Road Traction," by Mr. Thomas Aveling, Assoc. Inst. C.E. (Continued.) "On Peculiarities of Detachment of Steel and Wrought-Iron Plates," by Mr. Edward Woods, Assoc. Inst. C.E. "On the Engineering Features of Steel for Shipbuilding and Marine Engineering," by Mr. Edward Woods, Assoc. Inst. C.E. Ballot for the election of Members. April 19th, meeting at 7.30, when tea will be served at 7 o'clock precisely. "On Steel Rails," by W. H. White, Assistant Constructor of the Admiralty. "Experiments on Steel Ambrosium, Bessemer, and Siemens Steel," by Mr. Ernest Anstruther, Inspector of Machinery, Admiralty. "On the Influence of the Quality and Length of Specimens on the Tensile Strength of Steel," by Mr. Ernest Anstruther, Inspector of Machinery, Admiralty. April 22nd, meeting at 7.45, and meeting at 8 o'clock. "On the Manufacture and Testing of Rolling Stock," by W. G. Wilde, Assistant Commissioner on the Railway Department of the Board of Trade. "On the Construction of Locomotive Engines," by Mr. Joseph Tomlinson. "Permanent and Displacement in Relation to Strains in Ships among Waves," by W. John, Secretary to the Underwriters' Registry of Iron Shipping, Associate Institution of Civil Engineers. "On Steel Ingots," by Mr. Jacob Dowling (Dowlais). "On Steel Castings," by Mr. Jacob Dowling. "On Steel as introduced for Girders in the Bay of Biscay," by Mr. F. J. Bell, Assoc. Inst. C.E. Ballot for the election of Members. April 26th, meeting at 7.30, when tea will be served at 7 o'clock precisely. "Shipbuilding Investigations," by Charles Cail. A.M.I.E. "Shipbuilding a Science," by Mr. Charles Barker, Glasgow.

PHYSICAL SOCIETY.—Saturday, April 9th, at 3 P.M. "Experiments on Electrical Resistance," by Mr. Shelford Bidwell. "Notes on Thermal Electricity," by Mr. J. H. Gladstone and Mr. Tribe.

ENGINEERING.

FRIDAY, APRIL 1, 1881.

NAVAL ENGINEERS.

THE engineers in our Navy have, we think, good cause for the general dissatisfaction which has for a long time past prevailed amongst them respecting their position in the service, and it is much to be regretted that those at the head of our Admiralty should either wilfully, or through ignorance, fail to recognise the just claims of an important body of men on whom the efficiency of our war-ships so very greatly depends. We have on many occasions pointed out in this journal how, during the past few years, the duties of naval engineers have materially increased, both in extent and importance. In the early days of the application of steam power to our fighting ships, the responsibilities of a naval engineer were vastly different to what they are now-a-days. At that time an engineer's duties ended almost entirely to his engines, while the latter, in the majority of cases, furnished but auxiliary motive power, so that their failure was not of such paramount importance as it would be in most of our modern ironclads. Now-a-days, in addition to main engines and boilers of vastly greater power than formerly, the naval engineer is responsible for the numerous auxiliary engines employed in all parts of the ship, for turret engines and turning gear, for iron gun-carriages, and for hydraulic gear for working them, for steering, ventilating, distilling, and screw-lifting apparatus, for water-tight doors and appliances for working them, for fire extinguishing pumps and other apparatus, and (besides other details which we need not mention) for Whitehead torpedoes with the air-compressing pumps and other machinery employed in connexion with them. Taking the special features of modern naval warfare into account, it is impossible to overrate the importance of the various duties we have just enumerated, and we maintain that it is only just that an officer to whom such important duties are entrusted should have a standing in the service commensurate with the responsibilities thrown upon him.

Judging from some remarks made by the Junior Lord and by the Secretary of the Admiralty during the recent debates on the naval estimates, an erroneous opinion appears to prevail in high quarters that a good deal has been done of late years to improve the position of our naval engineer officers. That something has been done we admit, but that this position is generally considered on the occasion of the case we most strongly deny. We use the word "occasion" here advisedly. No one of the least practical knowledge who has examined a little carefully will attempt to dispute that the efficiency of such a complex machine in time of war depends almost entirely upon the skill and energy of the engineer officers in charge. In saying this we have no desire to disparage in the least the importance of other officers and crew. To the skill of these officers and men in their particular duties must unless backed up by the efficient working of the engines—all the skill and valour would be rendered practically useless. It appears to be unquestionable that the value of the service to be rendered the important position to which naval engineers may rise is fully recognised, but the facts remain, and the more they are fairly faced the better for the service.

When the numerous sons of our merchant princes is taken into consideration, it appears a most "penny wise and pound foolish" policy for higher naval personnels means to secure the services to our Navy of the most energetic and skilful engineers it can command. Admiralty authorities either do not, or will not, see this, and as a result it is evident that naval service is most unpopular amongst young-going engineers, and is almost universally execrated privately amongst the engineers now in the Navy. There has been recently circulated a printed statement in which the position of naval engineer officers of to-day, as regards rank and pay, is compared with that existing in 1865, and this document has received considerable attention from which that naval engineers are being fairly treated. From it it appears that, on the whole, engineer officers of to-day are in many respects worse off both as regards pay and position than they were eighteen years ago, while in any case the pay now given is far from being continuous especially—ridiculously inadequate when the responsibilities are taken into consideration. Altogether we maintain that the present position of engineer officers in our Navy deserves immediate and serious attention. As it is there are grounds for our Navy, and jealous of anything that militates against its efficiency, and under circumstances we trust that our Admiralty authorities may take an early opportunity of thoroughly reviewing the engineer branch of the service, and that they make such changes as will secure to engineer officers the rank and pay to which they are justly entitled, and will render naval service sought after instead of avoided by our most competent sea-going engineers.

ELECTRIC LIGHT IN THE CITY.

YESTERDAY evening was commenced throughout a large portion of the City of London a twelve months' trial of the application of electricity to street illumination, which is probably the most important and practical that has yet been made; and we venture to consider that the 31st of March, 1881, will on that account long be remembered as the beginning of a characteristic epoch in the history of electricity, and of the application of science to the requirements of the public.

Our readers will doubtless remember that as far ago as July last it was decided by the Commissioners of Sewers, after many negotiations, for some inscrutable though doubtless wise purposes, such matters seem) to invite tenders for the electric lighting of some of the main thoroughfares of the City, and on the 15th of the following month advertisements were issued by the Corporation, inviting tenders for lighting by means of the electric light "as an experiment" the following thoroughfares: New Bridge-street, Queen Victoria-street, Queen Street - place, and Queen - street, King William - street, Poultry, Cheapside, St. Paul's Church Yard (north side), Ludgate Hill, Blackfriars Bridge, Southwark Bridge, and London Bridge.

In reply to these advertisements, tenders were received from Messrs. Siemens Brothers, from the Anglo-American Electric Light Company (Brush system), from Mr. R. E. Crompton (Gramme), and from the Electric and Magnetic Company (Jablochkoff system), and in deference to wishes expressed by some of the competitors the area to be lighted was divided into three districts. The first or "Blackfriars Bridge district," included Blackfriars Bridge, New Bridge Street, Bridge Street, Ludgate Hill, St. Paul's Church Yard (north side), and that portion of Cheapside west of King-street. The second, or "Southwark Bridge district" comprised Southwark Bridge, Cannon-street Bridge, the lower part of Queen-street, and Queen Street-place, and in the third, or "London Bridge district" were comprised London Bridge, Adelaide-place, King William-street (including the open space round King William's statue, and St. Mary Woolnoth Church), the north side of the Royal Exchange, the lamps in front of the Poultry, that portion of Cheapside east of King-street, the upper part of Queen-street, King-street, and the Guildhall Yard; the three districts together presenting a line of streets to be illuminated of upwards of two miles and a half in length.

As we gave in these columns the particulars of the various tenders in our issue of the 19th of November last,* we need not enter them here further than to remind our readers that the contract for the Blackfriars Bridge district was given to the Brush Company, that for the Southwark Bridge district to the Jablochkoff Company, and that for the London Bridge district and Royal Exchange to Messrs. Siemens Brothers and Co. The particulars of the three accepted tenders were as follows:

District.	Number of Lights required.	Number of Lights to be Erected.	Total Cost.	Accepted Competitors.
1	600	750	1150	Anglo-American Electric Light Company (Brush system).
2	1500	1200	2000	Electric and Magnetic Company (Jablochkoff system).
3	2220	1455	3125	Siemens Brothers (Siemens-Gramme system).

Since these tenders were accepted the Jablochkoff Company, in consequence of legal difficulties, were compelled to withdraw from the competition, but they entered into arrangements with the Electric Lighting and Power Generation Company, who are the proprietors of the Lontin machine† and system to take up the contract for the Southwark Bridge district, and at the original estimated cost, namely 2000*l.*, and to light that district by the Lontin system. In consequence of this change of systems some little delay was unavoidable, but the company has undertakes to be in a position to light up the second district on the 1st of May next.

* See ENGINEERING, vol. xxx., page 501.
† *Ibid.* vol. xxviii., page 171.

covered with a sheathing of iron wires, as the cables lie along the broad outside ledge of the ballast track, and is not protected as the other circuits are by being laid underground. Adelaide-place, which forms a widened portion of King William-street, close to the north end of the bridge, is lighted by a single high light attached to the top of a very fine lattice pole, upwards of 120 ft. high, being fixed to the pavement of Thames-street, and rising to a height of over 80 ft. above the level of the approach to the bridge. The top of this slender and graceful pole is stayed by three ornamental iron wires to neighbouring buildings. In King William-street there are seven of the smaller lights, but the high light which illuminates the open space around the statue of William the Fourth, as well as that in front of the church of St Mary Woolnoth, contributes a large amount of the illumination to all the surrounding streets. Close to the Wellington Statue, in front of the Royal Exchange, rises a lattice pole, which supports a lamp which illuminates the great central space of the City bounded by the Royal Exchange, the Bank, and the Mansion House, and another is placed on the west side of Mr Tegetmeier's building and at the junction of Queen-street and the Poultry. Cheapside, including the Poultry, is lighted by four of the smaller lights in Queen-street by one, and King-street by two, while the space in front of the Guildhall is illuminated by one of the large lights supported on a lattice pole at the same elevation as the others. The light is the furthest from the generating station, being nearly three-quarters of a mile from Old Jewry-chambers, involving a length of electrical circuit of a mile and a half, that is to say, 3520 yards. The resistance of this, the largest length of cable in the installation, does not exceed one Siemens unit, which is a small fraction less than an ohm. We may add that the whole of the arrangements were carried out by Mr. Alexander Siemens.

[illegible] will complete a chain of electric lights extending from London Bridge station to Westminster Abbey, and a walk from London Bridge to Westminster and the Bank, Queen Victoria-street, Queen-street, Cheapside, Lombard-street, and the Thames Embankment would enable a person to compare the two systems of Siemens with one another, and with those of Lontin, Brush, Jamin, and Jablochkoff, coming to the British system again at Pelham Yard. Along the route, moreover, several points present themselves at which the several electric systems can be contrasted with the most recent improvements in gas illumination.

Besides the questions of effectiveness and economy of town illumination, there are other inquiries of interest upon which the coming trial will throw some light. It will, for instance, be interesting to know if the powerful electric currents, which will every night be flowing below the pavements in the City, will have any material inductive effect upon wires similarly laid carrying telegraph messages, or forming telephonic circuits. We should imagine that such currents must of necessity affect both telegraphic and telephonic instruments, and although the carrying of the return wire through the same piping would reduce the inductive effect to a minimum, still, unless the out-going and the return wires are twisted together, there must be many places at which the one wire, by being nearer to, would have a greater inductive effect than the other, and this, especially in the alternating circuits, would produce a vibratory inductive current in neighbouring telephonic circuits accompanied by a buzzing or humming in the telephones attached to it. We shall look forward with great interest to the tests which will be made on this point, as well as to the other results of this most interesting trial.

THE OTTO GAS ENGINE.

The action of Otto v. Linford, of the progress of the trial of which, before Vice-Chancellor Bacon, we gave a short note in our last impression, resulted on Wednesday last in favour of the plaintiff, but this decision is not necessarily final, and it is possible that the matter will be taken to the Court of Appeal. Under these circumstances it would of course be undesirable that we should express any opinion on the point in dispute, but merely place the general facts before our readers.

Many attempts have from time to time been made to convert the potential energy of a mixture of coal gas and air into useful mechanical work. When a mixture of coal gas with sufficient air to effect its complete combustion (which we shall call for a concentrated mixture) is ignited by an electric spark or flame, or other means, a chemical combination takes place which is attended with the development of a great amount of heat, which in its turn produces a sudden and violent increase of pressure of the products of combination. It follows, therefore, that the ignition of such a concentrated mixture within the cylinder of a gas engine must be attended with the following results, viz.: (1) A violent shock, requiring the parts of the engines to be very strong and heavy, and (2) a great elevation of temperature of the cylinder, the effects of which are twofold, viz., a considerable loss of heat and great wear and tear of the moving parts.

Engineering, May 1883.

ELECTRIC LIGHTING.

TO THE EDITOR OF ENGINEERING.

SIR,—Those people who have collected five years ago, when the directors of Paul Jablochkoff's Company were in Paris and London, almost simultaneously brilliant with the electric light, and the other discoveries of still greater interest which would follow, are now with each rapidity as to make it unsafe for the confidence of capitalists to advance in the adoption of the new terms for the purchase of the streets. There are at present no less than twenty-seven companies in the city of New York actively engaged in the business of transmitting electric energy along wires. Of these eleven are telegraph companies, having fire alarm and police telegraphs; four are electric light companies, including the Edison Company; one is a telephone company; and five are electric lighting and power companies. Several of these companies possess underground rights, and many have availed themselves of their franchises, notably the Edison Company, which has a complete system in successful operation under about sixteen miles of streets. It is clear, however, that twenty corporations, having substantially the same requirements, cannot follow the example of Edison Company and lay down independent mains, as the disfurnace of the streets would become an intolerable nuisance. It is the object of the committee, therefore, now on behalf of several corporations, to examine in the most thorough manner all such devices as are now before the public, and to report for the benefit of all of determining if a satisfactory system can be found, and if not, whether any system can be devised which will diminish the cost of installation to such an extent as to enable all to unite in a single system. Such a system, if perfected, would render it possible for a householder to be connected to either a burglar alarm, a messenger call, a telephone, an incandescent electric light main, a fire alarm, or telegraph wire without removal of the pavement.

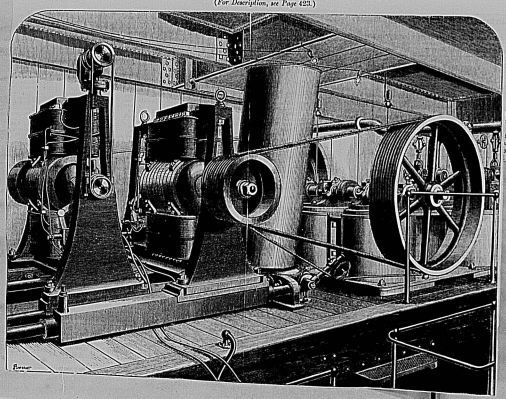
Yours obediently,
ALTERNATE CURRENT.

ELECTRIC LIGHTING NOTES.

A "committee of underground communication" has been formed in New York for the purpose of devising a feasible an ideal system under which every house can be supplied, on demand, with every form of electrical energy desirable, without delay, undue cost, or disfigurement of the streets. There are at present no less than twenty-seven companies in the city of New York actively engaged in the business of transmitting electric energy along wires. Of these eleven are telegraph companies, having fire alarm and police telegraphs; four are electric light companies, including the Edison Company; one is a telephone company; and five are electric lighting and power companies. Several of these companies possess underground rights, and many have availed themselves of their franchises, notably the Edison Company, which has a complete system in successful operation under about sixteen miles of streets. It is clear, however, that twenty corporations, having substantially the same requirements, cannot follow the example of Edison Company and lay down independent mains, as the disfurnace of the streets would become an intolerable nuisance. It is the object of the committee, therefore, now on behalf of several corporations, to examine in the most thorough manner all such devices as are now before the public, and to report for the benefit of all of determining if a satisfactory system can be found, and if not, whether any system can be devised which will diminish the cost of installation to such an extent as to enable all to unite in a single system. Such a system, if perfected, would render it possible for a householder to be connected to either a burglar alarm, a messenger call, a telephone, an incandescent electric light main, a fire alarm, or telegraph wire without removal of the pavement.

ELECTRIC LIGHTING ON THE S.S. "ARIZONA".

(For Description, see Page 423.)



which culminated in the financial difficulties of 1866 and following years, and the depression produced by the state of affairs rendered it impossible to carry out those lines. Soon after those lines were rendered unnecessary, for their abandonment. Mr. C. J. P. Cave, manager of the Brighton Railway, Mr. Grierson and Mr. Findlay, who represent on the Great Western and North-Western Railways respectively, decided to prove that if sanctioned the line could never be a financial success, that it under the most favourances could never be sufficient to pay the dividend upon the large capital required, and statistics founded on the instances of the existing line were put as traffic could not be counted upon large number of trains per day re-working arrangements. As soon as this been completed the town was cleared, misunderstood of the parties they were at the Committee were of opinion that had not been proved.

and Groombridge Railway Bill was

railways, each about twenty miles long, the first of those lines commences by a junction with the Berks and Hants line of the Great Western Company near Pewsey, and traversing the valley of the Avon, one of the most populous districts of Wiltshire, terminates by a junction with the Great Western Railway near Salisbury Station. This part of the scheme is chiefly local in character, and has similar objects to those of a scheme sanctioned in 1865 called the Wiltshire Railway, which, however, never made any substantial progress. The remainder of this year's scheme was a line from Salisbury to Southampton skirting the north side of the New Forest, and terminating by a junction with the Didcot and Newbury authorised line; by this a through Great Western route from the west, and eventually from South Wales to Southampton, would have been secured, but as far as the new line was concerned, an unnecessary duplication of railways in the hands of the South-Western Company would have resulted. These two companies, however, wisely entered into an agreement by which sufficiently independent access to Southampton has been secured to the Great Western Company by running powers over their rival lines for the greater part of the way, and by a junction between the line and the Didcot Company's line already referred to, which line is to be worked by the Great Western Company. This latter portion of the scheme has therefore been dropped, and, there being no opposition to the first portion, it has been referred to the committee on an unopposed Bills.

The Windsor, Ascot, and Aldershot Railway Bill is a similar to that which last year was the survivor of two introduced into the Commons, but was rejected by the Lords, and has for its object the construction by an entirely independent company (supported by the Great Western Company, who pay a portion of the cost of the application of it fails, but no portion if it successfully first of a line about ten miles long between Windsor and Ascot, joining the Great Western near Windsor and the South Western at Wood Station. In its route it passes near Clewer, Pittfield, and Winkfield, where there will be stations; thence from Ascot, in consequence of the decision of last year's Committee of the Commons, it will be parallel to the Reading and Reigate line of the South Eastern Company near Virginia Water, thence running powers over that line to Aldershot, and an alternative method of completing the communication between Ascot and Aldershot is provided for in the Bill, which asks for running powers over the South Western lines between those points. The South Western Company, whose Bill for a similar line was defeated last year, oppose, of course, as by this scheme access independent of their system would be given to Ascot, where at times there is considerable traffic. They are joined in their efforts by a gentleman owning an estate, which in his opinion would be detrimentally affected by the construction and working of the proposed line.

The Bill of the London and South-Western Railway Company is now under consideration by the Committee, of which Mr. Pertram is chairman, and the portion relating to the Netley and Fareham Railway has been passed subject to certain conditions to its compromise. The new short line about to be built long, connecting the Southampton and Netley and Hamble and Gosport lines of that company, thus completing another route between Southampton and Gosport and Portsmouth, avoiding the Eastleigh and Botley necessitated by that existing line of railway. There was some local opposition to the construction of this line, which, being the more direct course of a line sanctioned some years ago, and finally abandoned, but making a detour inland so as to cross the navigable waters of the River Hamble above an existing road bridge, and thus avoiding some of the principal points.

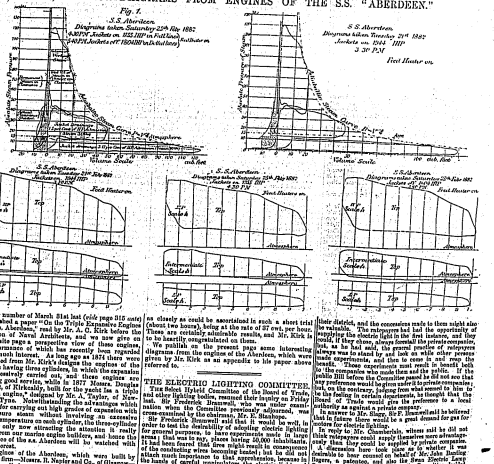
Mr. Lawson Gower's Committee have before them the East and West Yorkshire Railway Bill, which is another instance of the revival of a Bill of last session passed by the Commons but rejected by the Lords. By it a company is proposed to be incorporated to construct a main line about twenty miles long, which, commencing by a junction with the authorised Hull and Barnsley Railway near Drax, passes through Burton, Salmore, Lodmore, and Bedlewell, and terminates at Leeds. There are also branches to the Great Northern Railway at Ardsley and Lofthouse, and to the Midland Railway at Woodlesford. Between Burton, Salmore, and Leeds it traverses an extensive coalfield, and it is for the accommodation of this district that the line is chiefly directed. It has been stated that by it a saving of 2d. per ton would be saved in the carriage of coal to the port of Hull, and delays amounting to seven days in the journey of the trucks to and fro would be avoided. This line having laid out, for the whole length, parallel to, and at no point more than three miles distant from existing lines of the Lancashire and Yorkshire and North-Eastern Railways, those companies unanimously oppose its opposition.

By the Bill of the Midland, Birmingham, Wolverhampton, and Milford Junction Railway it is proposed to incorporate into a company a large number of subsidiary and gentlemen for the purpose of constructing railways of an aggregate length of some forty miles, with a capital amounting to rather more than a million and a half. The principal line commences near Craven Arms by a junction with the Craven Arms and Carmarthen line of the London and North-Western Railway Company, and passing through the town of Bridgenorth terminates by a junction with the Walsall and Wolverhampton line of the Midland Company near Willenhall. There are also junctions with the Central Wales Railway, the Shrewsbury and Hereford Railway, the Stour Valley, and main lines of the London and North-Western Railway. By these new railways, together with exclusive running powers over many lines in Wales, an important district would receive railway accommodation, and limestone would be brought from the Welsh quarries to the iron works near Wolverhampton. The route from the Cambrian system, by the aid of future extensions between Bishop's Castle and Montgomery, to manufacturing districts, would be shortened by twenty miles, and an alternative route as short as that at present by the Great Western Railway, would be opened up in the hands of the London and North-Western Railway between Llandeilo and Milford Haven.

THE ELECTRIC LIGHT ON BOARD SHIP.

There is no single field in which the electric light has attained as much success as in the lighting of passenger steamships. Its merits are recognised in its manifest means of decreasing the discomfort that always attends a voyage, as loss to a landsman, and gives it an immediate trial. Two great evils of ship life are the discomfort of space and want of ventilation, and both these are intensified after dark by the ordinary means of artificial light, as passengers congregate round the lamps, while there is no free overhead space into which the products of combustion can escape. Even in the Arctic Atlantic, with its temperate climate and constant air currents, this is severely felt, but it is only in the Red Sea or the tropics, where the heated air seems to stagnate, and the punkahs have to be kept at work over the heads of the passengers as they dine, to raise a semblance of a breeze, that the full significance of "the" smell of the lamps" can be realised. Consequently, while proprietors and manufacturers ashore have been waiting to see the course of events, and the progress of invention, shipowners have made larger and larger ventures until now it is understood that every new steamer of the leading lines shall be fitted throughout with electric light. This position has not been attained without great exertions on the part of manufacturers, for it is needless to say that an installation upon a ship is a very different affair from one on land. Instead of a large engine house with *plenty of space* for attendants and room for the use of long belts, there is usually assigned to the electrician a confined space partitioned off from a coal bunker, and in this both engines and dynamos must be arranged. In the early days this want of space was not so severely felt, because the illumination was effected by few lights, which, on quite comparatively little engine power, and hence it was usually possible to arrange the apparatus so that a belt of a reasonable length could be used to convey the motion from the engine to the generator. But the invention of the Swan lamp quickly changed all this; the power employed increased from 8 to 50 horse-power, while the available space grew no greater, and consequently other means of transmission had to be found. The Swan Company and Messrs. Siemens Brothers, between whom the bulk of this trade is divided, worked out the question in two different ways. The former firm adopted the Brotherhood three-cylinder engine, and coupling it direct to the axis of the dynamo-ring, dispensed

INDICATOR DIAGRAMS FROM ENGINES OF THE S.S. "ABERDEEN."



In our number of March 31st last (*vide* page 310 ante) we published a paper "On the Triple Expansive Engines of the s.s. *Aberdeen*," read by Mr. A. C. Kirk before the Institution of Naval Architects, and we now give on the opposite page a perspective view of those engines, the performance of which has recently been regarded with so much interest. As long ago as 1874 there were constructed from Mr. Kirk's plans the engines of the Propontis having three cylinders, in which the expansion was successively carried out, and those engines are still doing good service, while in 1877 Messrs. Douglas and Grant, of Kirkcaldy, built for the yacht of Mr. Ure a similar engine,* designed by Mr. A. C. Taylor, of Dunfermline-on-Tyne. Notwithstanding the advantages which it affords for carrying out high grades of expansion with high-pressure steam without traveling an excessive range of temperature on each cylinder, the three-cylinder system is only now attracting the attention it really deserves, and several marine engine builders, and hence the performances of the ss. Aberdeen will be watched with special interest.

The engines of the Aberdeen, which were built by Mr. Kirk's firm—Messrs. R. Napier and Co., of Glasgow—have three cylinders respectively 30 in., 51 in., and 70 in. in diameter, the stroke in each case being 4 ft. 6 in. The steam passes through the three cylinders successively, and is supplied at a boiler pressure of 125 lb. per square inch by two ordinary double-ended boilers, made entirely of steel, and each fitted with six of Fox's corrugated furnaces. The total heating surface is 7132 square feet, and there is no superheater.

As will be seen from our illustration, the three cylinders are placed in a fore and aft line, each cylinder having its own crank. The high-pressure cylinder is next jacketted, but the intermediate cylinder is jacketted with steam at 125 lb. pressure, and the low-pressure cylinder with steam at 15 lb. pressure above the atmosphere. The engine is fitted with Wolfe's feed-heater, and their general design, which is excellent, will be readily understood on reference to the illustration.

The Aberdeen is an iron ship 300 ft. long by 44 ft. beam, and 33 ft. depth, and when complete with 2000 tons of dead weight on board, a trial was made to ascertain and test the consumption with the engines developing 1400 horse power. Under these conditions the consumption of Pentfyrher Welsh coal was found to be but 1·29 lb. per indicated horse power per hour, the coal being weighed by Mr. Parker (of Lloyd's Register) and Mr. Dunlop, who happened to be on board. A further and shorter trial was subsequently made with the engines developing 2221 indicated horse power, the speed attained being 13·74 knots, and the consumption, as closely as could be ascertained in such a short trial (about two hours), being at the rate of 1·27 owt. per hour. These are certainly admirable results, and Mr. Kirk is to be heartily congratulated on them.

We publish on the present page some interesting diagrams from the engine of the Aberdeen, which were given by Mr. Kirk as an appendix to his paper above referred to.

* The engines of the Ina were illustrated in ENGINEERING, vol. xxvii., p. 194.

THE ELECTRIC LIGHTING COMMITTEE.

The Select Hybrid Committee of the Board of Trade, and other lighting bodies, resumed their inquiry on Friday last. Sir Frederick Bramwell, who was the principal witness when the Committee previously adjourned, was cross-examined by the chairman, Mr. E. Stanhope.

In reply to Mr. Dixon, Sir Frederick Bramwell said that in order to test the desirability of adopting electric lighting for general purposes, the Committee should insist that every area that was to be, places having 50,000 inhabitants. It had been feared that free wiring would be dangerous, but if the conducting wires becoming heated but to dull red attach much importance to that apprehension, because in the case of the careful manipulation the electric light could never give rise to such accidents. The same precaution existed against fire from gas, for that gas was introduced, and many persons lost their lives in consequence to have gas pipes laid in their houses. In no case did he think that any wires might be left exposed and really accessible with safety, though in other cases it would be dangerous to life to have any of them were not thoroughly insulated.

In answer to questions by Mr. Stroyan-Mackelyne, the witness said that the Committee should think that municipal authorities would be more likely to let either private companies or electric lighting companies do the work themselves, and when success had been obtained there would come in and buy out the companies who had been working them. The method of buying up the companies would probably be less than the amount expended in making the experiments.

In reply to Mr. Brooks the witness said that electric lighting was already established in Paris, Berlin, and New York. He could not say whether experiments on a large scale would be made in those cities. There was no doubt that the Government of France, in some cities, and in the electric light would there be in a position to offer places as the result of those experiments. It would be very desirable to experiment in all places where it was proposed to adopt electric lighting. He did not see that ratepayers would be injured by the introduction of electric companies established, even in competition with the local authority, because ratepayers did not supply themselves with gas, and the profits under the present time, although it was very likely that some companies granting of concessions to electric lighting companies, who, in consequence of making successful experiments, would have to be bought up, would sell their rights to local authorities at a ratepayers. It might be worth while for a corporation to pay a goodwill for the business of the private companies who wished to supply their district, and the concessions made to them might also be valuable. The ratepayers had had the opportunity of supplying the electric light from the underground mains, which, if they chose, they could themselves undertake, especially, as he had said, the general practice of ratepayers always was to stand by and look on while private trade experiments, and then to come in and reap the profits. These experiments must result in benefit both to the companies who made them and the public. If the public were to have the Committee put it to private companies, and if they were not willing to undertake the work, then, on the contrary, he would say that the Committee should recommend that the Board of Trade would give the preference to a local authority over a private company.

In answer to Mr. Hoare, Sir F. Bramwell said he believed that for electric lighting it would be a good thing to have a system for electric light and power.

In reply to Mr. Chamberlain, witness said he did not think ratepayers could supply themselves more advantageously than they could be supplied by private companies.

Mr. Chamberlain here read the clause in the Bill which enables the borough to lease the Local Electric Lighting Company's undertaking, and after consultation, the Committee decided not to hear Mr. Hopper. With respect to the Swan Company, as a new company had been introduced to the scheme, they decided to hear counsel on that, after the case for the Electric Lighting Company of the Strand Society.

Mr. Wm. Spottiswoode, Q.C., on behalf of the electric lighting committee of the Society of Arts, said that the Society of Arts had taken great interest in the progress of electric lighting for many years, especially during the last two years, and had been practically directing the experiments for lighting purposes, conducted by Messrs. Siemens, Crompton, and Swan. He would call Mr. Preece, the engineer-in-chief of the Post Office, to show that the Committee thought it would be better to encourage the system of particular inventors or companies as much as possible.

The witness, continuing his address, said he must be the last to say anything against the Board of Trade, and the word municipality might be the best, but private enterprise would be quicker. Their system went to prevent the electric lighting passed the experimental stage, and in lighting service passed the experimental stage, and in the general community. He could not say as to the Swan system, but the Committee had no connection with gas, although it was connected with the Edison system. Mr. Preece would be inclined to think there would be considerable advantage in connection with that of gas. He thought large buildings would be got by using the electric light, and that would be of great advantage to the public. The special advantages of the system of which he did not know a room, or within the limits of a second, and the witness thought that the system was agreeable. He thought that the Committee should not recommend that any special buildings should be allowed under the provisions, but that they should be left to the ordinary law. Any person, he thought, should be allowed to lay down electric lighting, and he had given notice of his intention to lay down a system in Brighton, and provisional orders are granted to him that if all parties consent, it was necessary to put the machinery of Parlia-

THE ELECTRIC LIGHT IN WARFARE.

During the winter of 1879-80 a great number of experiments were made at Chatham in order to test the efficacy of different electric lamps and machines for military purposes. Major Armstrong, Captain Abney, Lieutenants Barker, Darwin, and others were members of the Commission for carrying them on, and the well-known experimental ability of some of those gentlemen, coupled with the impartial character of the trials, give the results a special value. It is somewhat unfortunate, therefore, that the official account of those important experiments should first be made public in a foreign journal. We do not know how it has come about, but so far as we are aware, no English periodical has as yet been presented with the official report, while the French *Revue Industrielle* for April 27 contains a lengthy summary of it. To this article we must confine ourselves indebted for the following facts:

The dynamo-electric machines tested were those of Gramme, Siemens, and Wilde. The Gramme machines consisted of type D, driven directly by a three-cylinder Brotherhood engine of 14 horse power; type A, the ordinary pattern, driven directly by a three-cylinder engine; and type M similarly actuated. One Siemens machine of the large model was driven by a strap from an engine of 9 horse power; and two others of medium size were driven by a three-cylinder Brotherhood engine of 14 horse power. A Wilde machine of large size for giving alternating currents for the production of two lights was driven by a Brotherhood engine of 14 horse power, and a single-light Wilde, giving either a continuous or an alternating current was driven by a strap from a 6 horse power traction locomotive; in addition to these there was available an alternating-current Wilde machine capable of feeding six of Wilde's electric candles.

The lamps pitted against each other comprised Siemens' old and new patterns, the large Servia, Krupp's, Wilde's hand lamp, Sautter-Lemonnier's hand lamp (the lightest and simplest patterns), and the hand lamp of Captain Sales. The projectors were three of Siemens of 90, 60, and 30 centimetres (35½ inches, 24 in., and 12 in.) in diameter; of Siemens, of Wilde, and of Sautter-Lemonnier, Solomon, and Wilde. The carbons burned in the lamps were those of Sautter-Lemonnier, Siemens, Jolimon and Phillips, Carré, and Wilde.

The electrical measurements made were the electromotive forces of the generators, the intensity of the current producing the light, the difference of potentials between the two carbon points, and the consequently the resistance of the arc. Great care was taken to preserve the accuracy of these results, by a permanent system of apparatus, which was verified every day. The mechanical work absorbed by the generator was measured by an Allencock dynamometer; the intensity of the electric light was estimated by Rumford's method with red and green candles, the standard being an Argand burner with a Bengy regulator; and a telegraphic signal assured that the electric and photometric observations on the arc were made simultaneously. The carbon-points were also photographed to get the points of glowing surface.

The power of the projectors was gauged by shooting iron clad in red, white, and blue tinies at distance where the colours could be seen, confused, or plainly distinguished; but this method did not give sure results. A better plan consisted in erecting a screen 6 ft. square, and painted with letters about 900 yards distant, and turning it round the axis until the observers could just read the characters, when, at a given signal, the angle was measured. Like the former plan, this was dependant to some extent on the varying conditions of the atmosphere, and the best method was found to consist in planting poles in front of white screens and simultaneously comparing the depths of the shadows thrown by them on the screen when exposed to the projected beams of light. These methods, however, gave only relative results; and in order to get quantitative ones, the intensity of the shock of rays was measured at 600 yards from the projector by Rumford's photometer. In this way it has been demonstrated that Mangin's projector is much the best both in portability and power, and that the model of 90 centimetres in diameter throws twice more light than that of 60 centimetres.

The principal data furnished by the experiments are given in the two annexed Tables; the first showing the relations of speed, current, work consumed, and work utilised for the various machines tested; the second pointing out the relative merits of the machines as far as work utilised in the arc is concerned. It will be seen that the Gramme machines carry off the palm in this respect. It is noticeable also that diminishing the resistance of the arc produces a considerable increase in the work done in the other parts of the circuit, especially the machine, without producing a compensating increase in the light itself.

The advantages and disadvantages of the different machines are particularised in the official report on the trial. The two medium-sized Siemens machines are preferable for their yielding two distinct lights, of a brightness greater than the lights of other machines, with the exception of the C and D Grammes. But they are apt to burn up if not looked after; the coil warms up sooner than the electro-magnets; when they are combined the direction of the current readily changes, causing trouble and loss of time; and an irregular action of the lamp leads to strong sparks, to the waste of carbon, and consequently a rapid waste of time. In short, they require more experience to operate than the Gramme machines.

The Gramme gives a light conspicuously more intense than any other; and it can be entrusted to unskilful hands without fear of the wires being damaged or sparks produced. After going for six hours under the same conditions as the two combined Siemens machines, and with a current of 26.5 webers the temperature was only raised 60 deg. Fahr., whilst in the Siemens machines the rise of temperature was 110 deg. Fahr. at the coil and 50 deg. Fahr. at the electro-magnets, with a current of 55 webers. The electro-magnets of the Gramme machine heat faster than the coil or ring, therefore the machine is less likely to suffer from fear and wear. The high price of 3501, however, is an inconvenience, for it is once-and-a-half the price of the two Siemens machines.

The G Gramme is superior to all others in its simplicity of management, and it heats so lastily that, after going for six hours under the same conditions as the two Siemens, and the D Gramme, with a current of 83.15 webers, the temperature only rose some 30 deg. Fahr. The sparks are few, the efficiency is about 50 per cent.; the size of the machine is small, and its construction simple; the price (240l.) is about the same as the two Siemens machines, with their commutator; and the current can be utilised directly by means of a Siemens lamp. But the luminous intensity is only about 10,000 candles, or about the same as the two Siemens machines, and 80 per cent. less than given by the D Gramme. Further, the speed of 1200 turns per minute must bring about a rapid deterioration of the moveable parts of the machine.

The two combined *Gramme* machines of A type and only 170*l.*; they are free from excessive heating, and from sparks, besides yielding two lights; but the total quantity of light produced is only 18,600 candles, which is not enough for military purposes, and the direction of the current is apt to change, and cause trouble and loss of time.

Wilde's marine pattern has the advantage of connexions arranged to produce little waste of mechanism; it can be entrusted to persons little skilled in working it, the coils can be examined and re-wound without loss of time, and it furnishes two lights, but those lights are comparatively feeble.

As regards the lamps, the preference for military purposes is given, in that of Servia as the most convenient of the automatic sorts, and the inclined hand lamp of Sautter-Lemonnier is preferred for general purposes. These it will be seen, that the French apparatus has been found superior, not only as regards the machines, but the lamps, and also the projectors.

TABLE I.

Machines.	Number of Turns.	Intensity of Current.	Electromotive Force.	Work Absorbed in Brake Power.	Percentage of Work Utilised.	Percentage of Energy Lost in the Arc.	Luminous Intensity in Candles.	Time in Hours for Trial.	Remarks.
					per cent.				
Two Siemens, medium size excited	480	55.0	73.65	13.4	29.63	15.149	214		
Gramme, type D ...	1000	52.25	85.72	13.1	53	47.72	27.200	240	Photometric results taken with inclined carbons.
" C ...	1000	51.75	83.77	12.9	55	47.27	27.500	240	
" D ...	1200	51.25	69.9	9.53	55	51.65	19.000	240	
Two Gramme, type A coupled	1100	66.5	...	7.62	53	41.71	10.200	192	Total light of two lamps with carbons.
Wilde, marine type ...	600	...	...	2.84	...	...	3.700	480	

TABLE II.

Machines.	Work done in the Arc in Kilogrammetres per Second.	Total Work Given to the Circuit in Kilogrammetres per Second.	Electromotive Force in Volts.	Resistance of Arc in Ohms.	Intensity of the Current in Webers.	Number of Turns.	Figure of Merit (Work utilised in the Arc.
Gramme, D ...	4.33	9.09	81.11	0.467	83.79	450	I.
"	3.92	8.47	79.11	0.466	81.05	450	
"	3.82	7.97	77.11	0.468	77.72	450	
"	3.82	6.96	72.2	0.724	81.18	450	II.
Gramme, D ...	3.42	6.99	73.59	0.713	87.21	450	
"	3.42	7.52	76.07	0.656	90.65	...	
"	3.42	7.66	77.2	0.638	91.61	...	
"	3.42	8.07	80	0.605	92.79	450	III.
Gramme, C ...	3.56	5.57	62.9	0.927	81.32	1200	
"	3.56	5.65	63.6	0.917	81.72	1200	
"	3.56	5.74	64.6	0.918	82.2	1200	
"	3.562	5.93	61.56	0.699	74.66	600	
"	3.562	6.06	61.56	0.699	74.66	600	
"	3.42	5.56	57.6	0.746	72.01	600	
"	3.42	5.61	57.6	0.746	72.01	...	
"	3.42	5.65	...	0.746	72.01	...	
Siemens 240 and 272 ...	3.42	5.61	15.56	0.746	72.01	240	IV.
"	3.018	4.81	71.29	0.402	72.01	240	
"	3.018	4.81	71.29	0.402	72.01	...	
"	3.42	4.87	69.29	0.402	72.01	...	
"	3.4	4.87	69.29	0.402	72.01	240	
"	3.42	4.87	69.29	0.402	72.01	240	
Gramme, A ...	1.253	2.24	78.5	1.12	41.2	850	V.
"	1.253	2.24	78.5	1.12	41.2	850	
"	1.247	2.24	80.1	0.995	40.14	850	
Siemens 290 ...	1.247	2.89	70.06	0.793	46.36	600	
"	1.247	2.89	70.06	0.793	46.36	600	
Siemens, 272 ...	2.256	4.51	83.33	0.715	55.5	...	VI.
"	2.256	4.51	...	0.715	55.5	...	
Siemens, 290 ...	1.247	2.89	70.06	0.793	46.36	600	
Siemens, 272 ...	1.78	4.87	76.77	0.333	...	...	
"	1.78	4.87	76.77	0.333	42.69	...	
"	1.78	4.69	66.6	1.26	42.69	272	
Gramme, I ...	1.42	3.19	91.08	1.22	57.08	2400	VII.
"	1.42	3.19	91.08	1.22	57.08	2400	
"	1.42	3.08	88.8	1.224	57.08	2400	
Siemens, large size ...	2.84	4.86	73.71	0.45	73.79	450	
"	2.84	4.86	73.71	0.45	73.79	450	
Siemens, 272 and 302 ...	2.23	4.51	83.3	0.715	55.5	600	
Siemens, a single machine ...	2.23	4.18	83.3	0.801	53.35	600	
"	1.87	3.87	73.71	0.687	56.85	...	

* The supernum signifies "

* Regular resistance for continuous working.

† Not recommended, the construction of the electro-magnets is defective.

Engineering, Aug. 3rd 1883.

ELECTRIC LIGHTING NOTES.

THE Pilsen-Just and General Electric Light Company, Limited, have presented a petition for winding-up.

The Board of Trade having considered Major Marindin's report upon his examination at the New Leyton Vestry Hall, of the scheme for electric lighting promoted by the vestry, has decided not to sanction the same.

The New Zealand Electric Light and Power Company, which holds the Brush patents for that part of the world, has recently lighted the harbour of Lyttelton with sixteen lamps of 2000 candle-power (nominal), the contract price being 1000*l.*, subject to a two months' trial. Each lamp is fixed on a kauri pine, 30 ft. high, and protected by a reflecting hood. The conductor is laid underground in wooden piping for a distance of 1000 yards, and thence across the basin by a submarine cable.

Eberle's Restaurant, Dale-street, Liverpool, has been fitted up throughout with the electric light. The rooms are not lofty, and the incandescent lamps have been fixed to the moulded ceiling beams in conical reflecting shades of opal glass. The motive power is supplied by a gas engine, and a constant, steady light is insured by the use of Faure-Sellon-Volckmar accumulators. The work has been carried out by Messrs. Holmes and Veasey on behalf of the Liverpool Electric Supply Company.

On Saturday, July 21, Major Marindin, R.E., held an inquiry on behalf of the Board of Trade at the Vestry Hall, Walworth-road, with reference to the application of the Newington Vestry for a provisional order to supply the electric light within the parish. The vestry, ratepayers' committee, a working men's committee, and one or two property owners, were represented by counsel. It was explained that the order applied to the whole parish, but that it was only sought to make it compulsory over a small portion, the contemplated expenditure being 70,000*l.*, equal to an increase of the rates of about one penny in the pound. The opposition contended that it would be unfair to shopkeepers to light some districts and not others, while the property owners, who compulsion rates of their tenants, protested against having the latter increased. Mr. Shoolbred, the engineer to the vestry, defended his estimate, and declared that it would not increase the existing rates. The inquiry lasted seven hours, and at the close Major Marindin said he should report to the Board.

Among other schemes for enlarging the capacity for traffic of the Suez Canal is one which has been lately submitted to M. de Lesseps, and which aims at enabling ships to proceed through it with safety after dark, by defining the banks and the centre of the channel through the lakes. This project, which has been put forth by the National Company for the distribution of electricity by secondary generators, proposes to light the canal throughout the entire length of 102 kilometres by lamps placed on alternate sides every 250 metres, the total number of lamps required being 1360. The nature of the country through which the canal passes is such that it would be impossible, except at enormous expense, to effect the electric lighting of the locomotives in the usual way, being that special stations would have to be established every few miles for the supplies of engines and dynamos, and for the transportation of the steamboats charged with their crew and with the ship of supply. The engineers tested seven lamps, and at the close Major Marindin said he should report to his principals.

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The originators of the project propose to use the system of Messrs. Gaulard and Gibbs, which was described and illustrated in our issue of June 1, 1883, and which consists in employing the main current generated at the central station for the sole purpose of supplying other secondary currents at a pressure at which a lighting station is to be erected, in the manner of an ordinary signal post. The main current, which is alternating in character, is made at each subsidiary station to circulate in a conductor wound round an electro-magnet, while side by side with this primary conductor is another in which secondary currents are generated by the reversals of the polarity of the core and the alternations of the primary current. Thus the main source of the main current is to act as a carrier of energy from the central to the subsidiary stations, where it is transformed into electricity of another potential suited for the purpose to which it is to be applied. By the use of a current of very high potential and of moderate intensity, circuits of very great length may be worked with small loss, and hence it is proposed that the whole length of the canal should be lighted from one station. In each of the posts which would be erected on the banks, and on each of the existing beacons in the lakes, there would be placed a secondary generator of such a size that it would, under certain assumed conditions of the primary current, suffice to feed an incandescence lamp of 80 candle power. Two of these lamps would be enclosed in each globe, with an automatic appliance to switch the second into circuit, if the first failed, while at the passing places, where there are always a few employés stationed, there would be a liberal supply of arc lamps fed by generators of greater power than those used for the incandescence lamps. It is estimated that 830 horse-power would be required, and that there would be 80 miles of submarine cable and 80 miles of land-covered conductor. One of the directors of the Canal Company, M. de Parville, has been to this country to inspect the apparatus and has reported very favourably on it.

THE HAWKES ELECTRIC LIGHT.

THE electric arc light of Mr. George Hawkes, of 2, Victoria Chambers, Westminster, is one of the most recent in the field, and judging by its performance it is also one of the best. It appears to combine in itself all the advantages of the Pilsen, or a still greater steadiness, with the simplicity and brilliancy of the Brush. The simplicity of the lamp is an important practical advantage, and its economical working is secured by a governor. While strictly adhering to the working of his lamp, Mr. Hawkes has had an eye to the appearance as well, although that is a point very often neglected.

The mechanism of the Hawkes lamp is illustrated in Figs. 1 and 2, which represent it in action. It is a clutch lamp of a very perfect kind, and is adapted to burn long carbons if required, so that it can be used for the lighting of streets as well as halls, factories, engineering works, and so on.

Figs. 1 and 2 are two vertical sections of the lamp in planes crossing each other at right angles. Fig. 3 is a sectional plan of the lamp along the line 1—1 in Figs. 1 and 2, and Fig. 4 is a sectional plan taken in the line 2—2 of the same figures. Fig. 5 shows a special device for cutting the lamp out of circuit.

The frame of the lamp consists of three metal bars A, A′, and A″, rigidly connected by vertical stems A², A³, and A⁴. The stem A², which is in connexion by the terminal below with the positive wire from the generator, is insulated from the metal plates, and the stem A³, which is in connexion with the negative wire through the plates A, A′, is insulated from the upper plate A⁴ only. This plate supports the mechanism for feeding the carbons and regulating the advance of the upper carbon C and holder C′, while the plate A supports the mechanism for regulating the advance of the lower carbon D and its holder D′. The carbon traverses a long hole in D, passing from the bottom of the lamp, and is prolonged at D by a liquid reservoir and a pendent guide-chamber.

We shall first describe the striking of the arc and the regulation of the upper or positive carbon. When the current is switched on the lamp it passes by the stem A³ and terminal *p* to the plates A, A′, and thence by the terminal *p*′ to the plate A⁴, which is in metallic contact with the stem A². From this it traverses the carbons and completes its circuit through the lower holder D′ and the stem A³. The current in the double-coiled electro-magnet E, situated between the plates A and A′, is therefore the main current from the dynamo or dynamos. Mr. Hawkes, however, has not contented himself with the mere striking of the arc on the principle of this electro-magnet in the main circuit. He has also arranged that a shall regulate without the motion of the magnet C. To this end he employs the following device: H is a called spring surrounding the upper part of the holder C′ and rotatable between two collars A B′, which also surround the clutch holder. The spring H is suspended from the guide frame C² by means of pendant wire that has freely passed the holder of the guide frame, and are each provided with a head to take a bearing on the guide frame. The holder C′ is attached to a pair of guide rods which, after passing up through the guide frame C², are connected together by a crosshead, upon which rests a regulating screw I, which is provided with a milled head to enable it to be set by hand. The spring H is intended to press upon the spring J of the electro-magnet when it is at rest, and by means of the screw I it can be so adjusted as to press upon the spring J with a certain force, so that when the current passes through the coils of the electro-magnet when it is switched on the spring J is attracted with a force sufficient to overcome the pressure of the spring H, and to draw the upper carbon C with it. The carbon C is thus drawn up, and on the current passing through a widening of the arc, the spring comes into contact with the armature, and consequently downwards, until its further extension is checked by the pendent collar A′, after which the armature alone falls by its own weight, and the upper carbon drops into contact with the lower one, thereby closing the main circuit. The electro-magnet again comes into play and re-establishes the arc at the proper length; however, to the spring device just described this action is extremely slow, and is not noticeable.

The lower carbon is released to maintain the arc by the pull of the electro-magnet E upon the armature K, from the weights pressing over two pulleys and attached to the rod K′. The advance is controlled by a clutch device of the following construction. The carbon-holder D′ passes through a hole in the plates A′ A, and between these plates of an electro-magnet F, which is in shunt or derived circuit as shown by the letter W. Attached to the armature D of the latter electro-magnet is a gripping-piece K which is carried by a vertical piece, and has an opening through it for each of the five passage upwards of the carbon-holder when the armature K′ is attracted by the magnet, and the gripping piece is thereby raised as shown in Fig. 1. Should, however, the strength of the current in the electro-magnet become enfeebled owing to a too long arc of the carbon, the resulting fall of the spring P presses down the corresponding gripping piece K, and causes the latter to bind upon the carbon-holder until the arc is sufficiently widened, and the derived current in the electro-magnet F is its normal strength.

The lower carbon is then unlocked by the predominating action of the electro-magnet on the spring, and the carbon advances as before.

The action of the spring H is regulated so as to limit the upward play of the armature D′, and to prevent its being drawn to the poles of the magnet. To serve this double purpose a hollow regulating screw P′ is provided, the lower end of which forms a stop for the head of the screw on the called spring P′, which is made fast to the armature D′. The hollow screw is tapped to receive an elongated screw P², which projects down through the called spring so as to form a stop to the rising armature. By the adjustment of the screw P² the force of the spring is regulated so as to counterbalance the energy of the electro-magnet to any desired extent, and the play of the armature D′ between the poles limited. The piston P′ moving in a well (W) of viscous liquid, such as glycerine and water, gives additional smoothness to the working of the lamp.

The device employed by Mr. Hawkes to cut out a lamp from a circuit when some accident has befallen the carbons, is a very simple and ingenious one. It is attached from the top plate A⁴, and resting on it is a strip of metal K, which is in metallic connexion with the stem A³, and whose other end of the armature C′. A similar strip of insulated metal K² is connected to the other stem A². The armature D′ at the point which overlie the strips K K′ is fitted with platinum contacts. While the lamp is in action, the armature being held up by the attraction of its electro-magnet in clear of these insulated metal pieces, but as soon as an undue resistance is offered to the main current, the power of the electro-magnet is overcome by the spring H, and the armature is dropped down and short-circuits the current by the strips K, K², as shown in Fig. 5. The lamp is thus cut out of the general circuit.

HAWKE'S ELECTRIC LAMP.

Fig. 1.

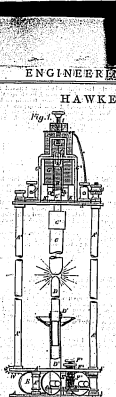


Fig. 2.

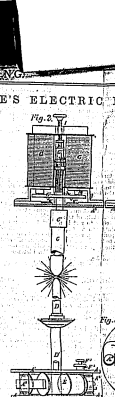


Fig. 3.

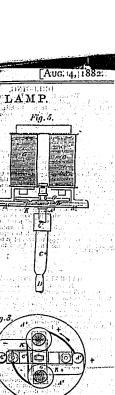


Fig. 5.

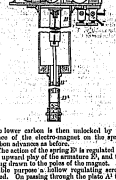
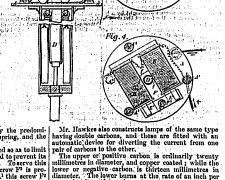


Fig. 4.



Mr. Hawkes also constructs lamps of the same type with double carbons, and those are fitted with an automatic device for diverting the current from one pair of carbons to the others.

The upper or positive carbon is ordinarily twenty millimetres in diameter, and copper coated; while the lower or negative carbon is thirteen millimetres in diameter. The lower burns at the rate of an inch per hour; but it can be made as long as to burn for forty or fifty hours. The lamp is stated to yield a light of 9000 candle power when fed by an A Gramme machine consuming 25 horse power.

MANCHESTER RAILWAY SIGNAL.—A new machine for the manufacture of railway spikes was recently exhibited in operation at the Manchester Exhibition of the American Union. A rod of metal is automatically fed into the machine from the rolls by means of a table and a "gripper," and at the end of the revolving of the handshaft, the spike blank is caught and firmly held by a suitable arrangement, while a pair of reciprocating cutters nibble off the rod, and the required length is measured. Next it forms the head, and the spike is then released, and carried forward to the die, where the point is finished, and the return motion the spike is thrown out of the blank holder by a rapidly acting "knocker," when it falls to the floor, and the table goes back to the cutter to receive the next spike. All these motions are completed in a single revolution, the speed of the machine being at the rate of 60 revolutions per minute. Three spikes per minute are produced by each machine. Three of these machines have been constructed, which, when set to be constructed, will be brought into operation at the works of the Andrew Clemens Iron and Steel Works, at Moundsville, West Virginia. For several years before his death the late Mr. Kloman spent a large amount of time and money in perfecting a machine of this kind, and the above is his invention completed and further improved by his successors.

Engineering, Sept. 28, 1883.

EDISON ELECTRIC LIGHT FITTINGS.

(For Description, see Page 396).

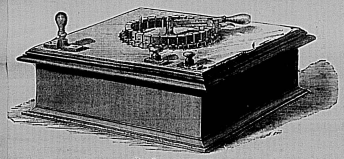


FIG. 1. RESISTANCE BOX.

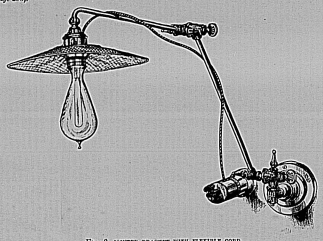


FIG. 2. JOINTED BRACKET WITH FLEXIBLE CORD.

FIG. 3. EPERGNE WITH FOUR LAMPS.

FIG. 4. COMBINED ELECTRIC AND GAS BRACKET.

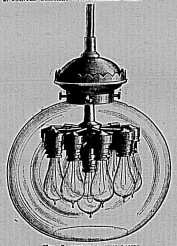


FIG. 5. GROUP OF TEN LAMPS.

All fittings of 10 lamps and upwards have the whole enclosed in large globe to protect them from dust and injury.

FIG. 3.

Engineering, Sept. 28, 1883.

EDISON ELECTRIC LIGHT FITTINGS.

The Edison generators are shunt wound, that is, the coils of the field magnets are excited from a derived circuit branching from the poles of the armature, and hence they are to a certain extent self regulating. But the regulation is far from perfect, and when any considerable proportion of the lamps are turned out, say, 20 per cent., there is a marked increased in the brilliancy of the remainder, and the current passing through them attains an intensity, which if allowed to continue would shorten the life of the filament. To prevent this a regulator is supplied with each installation, and this requires to be adjusted from time to time when the variations of a pilot light or the deflections of a galvanometer indicate that the difference of potential between the poles differs from the normal. This regulator (see p. 200, Fig. 1) consists of a box of resistance coils joined up in series, and so arranged that by the movement of the handle any number of them can be included in the field magnet circuit, and so add to its electrical resistance, causing a corresponding decrease in the current flowing through it, and consequently reducing the intensity of the magnetic field. From the junction between each adjacent pair of coils a conductor is led to a contact piece on the top of the box, just as in a Gramme ring a wire connects the coupling piece of each pair of bobbins to the commutator. The commencement of the first coil is connected to the first contact piece, and the end of the last coil to the last contact piece. The positive conductor from the pole of the armature is coupled also to the first contact piece, and the conductor leading to the coils is joined to the spindle upon which the handle turns. Thus, when the handle is at zero the current passes through it from the first contact piece without traversing any of the resistance coils; when it is moved (say) 90 deg. one-fourth of the coils are included in the circuit and the current must circulate through them before it can reach the handle and proceed to the magnets.

In this country the use of self-regulating generators is gradually displacing devices of this kind, but in theatres and places of amusement where many graduations of illumination are required, they will probably always be used. Fig. 4 illustrates a combined electric and gas bracket as erected in the Bijou Theatre, Boston, U.S.A., by the Edison Company for Isolated Lighting. The state of nervous apprehension which has been developed in large audiences by the fearful disasters which have occurred in theatres during the last few years, has rendered them peculiarly liable to panic, and there are but few cases where electric light installations are so organised that total extension is an impossibility. Therefore, as managers naturally decline to place entire dependence upon electricity, the Edison Company has boldly faced the situation and has brought out a fitting which admits of the use of both illuminants, either of which can be turned up or down with equal facility.

Figs. 2, 3, and 5 are illustrations of three other varieties of electric light fittings used by the Edison Company for Isolated Lighting. Fig. 2 shows an inexpensive form of jointed bracket with shade. The joints are mechanical, not electrical, the current being carried by a flexible cord, and they are provided with thumb-screws by which they can be set in any position, a very convenient provision; as it allows of the use of long branches. In designing such fittings there is much greater scope than in gas brackets, for, although it is both unhealthy and dangerous to bring a gas flame down to the level of the table, an incandescent lamp may be placed in the most convenient position which can be found, provided the direct rays are screened from the eye. Fig. 2 shows an epergne with four lamps, the design representing four luminous flowers, set in a bouquet of metal-work. Fig. 5 is a bell fitting of 10 lamps, the whole enclosed in large globe to protect them from dust and injury.

Engineering, Aug 31st 1883

THE EDISON CENTRAL STATION AT MILAN.

THE rapid development of industry in the last few years in Italy is well exemplified by the ready adoption in that country of telephones and of the electric light. In no country, America excepted, is the telephone so universally used, and the electric light is finding its way into many of the large stations and manufactories.

After the Paris Exhibition a committee of the principal banks at Milan investigated the subject of electric lighting. Professor Colombo and Mr. Gaul, engineer, both of Milan, were appointed as experts. They visited Paris and England, and the result has been that a central station has been constructed, which, with its single exception is that of Mr. Edison at New York, is the largest in the world.

The system adopted here has been also that of Mr. Edison. No company has yet been formed, and the plan proposed by the banks is very different to that pursued in the launching of companies in London. The Committee of the banks has devoted a sum sufficient to make an experiment with an installation of 6000 lamps. The entire work, however, is done upon the basis that it will be permanent. The company will only be launched after the plant has been worked long enough to prove what can actually be done upon a large scale. The speculators who formed the companies in England would undoubtedly look on such an operation with something of contempt, but the public and those who actually desire to see electric lighting succeed, can only bestow credit for this manner of procedure.

Had such methods been pursued in England, the discredit that has fallen upon electric lighting would have been avoided, not to speak of the financial aspect of the companies in this country, which is now generally understood; as many small installations have been made with agricultural ports to the engines and with ordinary engine-drivers as "engineers," that it is supposed to be necessary to have small lamps or gas somewhere to resume where electric lighting is used. An inspection of such an installation as the one it is proposed to describe here-in-after forwards convincing that electric lighting will be a commercial success; for the illumination is so much better than with gas, and the dirt usually attributed to electric lights so wanting, that the public would not be without the light at scarcely any price.

Many of the claims made for Edison by his supporters are ridiculous, but the allegations of those concerned in the industry of electric lighting are due to him, because at a time when are lighting was the only practical means and incandescent lamps impossible commercially, he must set himself to work to develop a complete system which could be used instead of gas.

Milan is peculiarly well adapted to electric light in its present state. The principal shops, theatres, cafés, and clubs are all in or near the magnificent "Galleria" of Victor Emmanuel. Nevertheless several kilometres of conductors are already laid. The station itself is a three-story building erected specially for the purpose on the site of the Theatre of Saint Radegonde. The lowest floor is three metres below the ground level. This floor is occupied by the dynamos and regulators, and by a test board for 1500 lamps. The boilers are located on the floor above, and are supported directly on cast-iron columns resting on a solid foundation. The upper floor is used as store-room, and a small portion is divided off for a laboratory. In a vaulted room under the courtyard is located an engine for driving a centrifugal blower, and a pump to be used as an adjunct to the Körting injectors feeding the boilers.

Four Edison dynamos, each capable of supplying 1200 Edison lamps, and of the type we illustrate on another page of the present issue, are already in place, and provision is made for adding several more, so that the design when carried out will embrace a greater number of lamps than even the station at New York. The armatures of the machines are 27 in. in diameter, and 61 in. long. The shaft is of steel 72 in. in diameter, and of a total length of 109 in. The journals are 6¼ in. in diameter, and 15 in. long, running in Babbitt metal bearings in brasses supplied with a continuous water circulation. Provision is made for an air blast to be applied to the armatures to keep it cool. The commutator is so nicely adjusted to its requirements, that notwithstanding the size of the current, no sparks of appreciable size are perceptible. The steam is furnished by Babcock and Wilcox boilers aggregating 1000 horse-power, and are worked under a pressure of 120 lb. All of the engines are connected directly to the shafts of the armatures. Two of the engines are Porter-Allen with cylinders 14¼ in. in diameter, 16 in. stroke, run at 300 revolutions per minute, and have a piston speed of 1023 ft. per minute. The other two engines already in use are by Armington and Sims. It is supposed that the latter will give better results when two dynamos are run together on the same circuit. They have 15 in. diameter cylinder and 15 in. stroke.

The weight of each dynamo with its engine is as follows:

	lb.
Base-plate	10,500
Dynamo	44,000
Engine	6,450
	61,450

The regulation is effected by changing the intensity of current circulating about the field magnets. The dynamos are all regulated together by means of a variable resistance introduced into the field. Each switch is driven by a lever and rod working into a corresponding gear keyed to a shaft. This gearing insures an even regulation. The indicator of the strength of the current passing into the lamps consists of a high resistance magnet, placed in derivation and balanced against a counterspring with variable adjustment. The magnet is supplied with "high" and "low" points working in separate lamp circuits through a small relay. Two coloured lamps are in these circuits; one or the other burns as the current is too strong or too weak. When either of the lamps is burning a vibrating bell sounds an alarm. A change in current sufficient to sound an alarm is known to scarcely sufficient to be noticeable to the eye. The conductors are copper rods with connections specially made for the purpose, so that no mistake can easily be made in laying them even by inexperienced workmen.

Professor Colombo is still the technical representative of the Committee, Mr. J. Lieb, formerly of the Brush Company of Cleveland, Ohio, and now of the Edison Company, is the engineer who has made the installation, and is now actually in charge. The effect of incandescent lighting in shops is well known to be particularly referred to, but when shop after shop has the group of incandescent lamps burning fruitlessly, and when the station from which the light is supplied is put up and watched with such care that it is difficult to see how any mishap can occur, the most sceptical must see that electric lighting can be made something more than "experimental."

Engineering, August 31st 1883.

ELECTRIC LIGHTING NOTES.

THE Edison Company for the Electric Lighting of Europe announce that they have erected 118 plants, aggregating a total of 41,780 lamps, and that there have been installed by other Edison companies in various parts of the world 138 plants with about 28,800 lamps, thus making 257 isolated plants with a total of 71,715 lamps.

The electric lighting of H.M.S. Alabaster, which has been carried out by the Edison Company, is effected by means of 16 dynamos upon which there are fixed 112 half lamps, (16 candle power) and 208 half lamps (8 candle power). There are 12 full lamps in the engine room, 16 in the lobby below, 7 in the shaft alley, and 47 in the upper saloon; 7 half lights on the saloon's access deck; 64 over the troops' mess tables forward, 27 in the saloon, 30 on the lower troop deck, and 26 on one of the pavilions.

The Edison Company, represented in Scotland by Mr. C. T. Grant, of Glasgow, has obtained the contract for lighting three fine steamers of the New Zealand Shipping Company's fleet. The first of these vessels, the Tongariro, has just been launched from Messrs. John Elder and Co.'s yard. The latest additions to the Clan Line have also been fitted with electric lighting plant by the same company, the new means of illumination being employed for side and cargo lights, as well as in the cabins.

Since the date of our article upon the electric lighting of the Fisheries Exhibition another arc lamp has made its appearance. It is the invention of Mr. F. L. Pyke, and six of them are suspended in the Western Quadrant, where they burn very satisfactorily. The feed of the carbon is controlled by a pendulum after the manner of the Siemens and Hochhausen lamps, which is in the means for holding and releasing the pendulum that the novelty lies. Instead of a detent, friction wheels are sometimes forced to lift, and catch a certain amount of friction, a varying magnetic attraction is brought to bear upon an armature attached to the pallets, the coils of the magnet being cut out of circuit by a defector relay when the lamp is running at normal resistance. By the use of double contacts, one of which is broken before the other, the additional effect of the spark which accompanies the rupture is confined to one pair of points only, and the other is always kept clean. The lamp is well and strongly made, and appears well adapted to stand rough or careless usage.

The system of town lighting by means of electric lamps mounted upon high masts or towers, which has found an extensive application in America, is now being tried in the Horticultural Gardens, South Kensington. A wooden framework 200 ft. high has been erected, and upon this an iron lattice pole 80 ft. in length is fixed, carrying a total height of about 280 ft. At the top of the tower there are suspended six Brockhouses arc lamps, fed from a generator in the night-light department of the Fisheries Exhibition, and each of 4000 candle power. Considering that on the dark clear nights there have prevailed, the light has have a most satisfactory appearance, and it is very easy to form an accurate judgment of their maximum effect. From the foot of the tower to the western quadrant is about 400 ft., and at that point it is possible to read a book printed in type of the size in which these notes appear, when the light falls directly upon it. This corresponds to the illumination afforded by a street lamp at a distance of about 60 ft. The gardens near the base of the tower are brilliantly lighted, and any kind of outdoor occupation might be carried on in them without difficulty. At about 300 ft. distance the shadows begin to be very distinctly noticeable, and great care is needed in passing from the patches of light into those of darkness, because the glare is for the moment too dense to be penetrated by the eye. While the grounds are put to their present pleasant uses, they are filled by a crowd who are enjoying the cool evening air and the music of the bands that play to advantage from other points, and, with a moonlight, effects of singular charm of this, the most agreeable entertainment which has been provided in London for many years. But if the space were devoted to business or rapid circulation it is evident that a much more useful result might be gained by distributing the lights more equally over the area. Unfortunately they are only half the height of those commonly used in America, and thus the shadows are longer and more obtrusive, but still they are higher than it would be practicable to keep them in this climate during nine months of the year. The experiment of the City lighting showed that even 50 ft. was too great an elevation during the winter, and that at little more than half that distance there was a loss of brilliancy.

Engineering, Sept 5, 1883.

THE EDISON SYSTEM IN NEW YORK.

After a long series of delays, the Edison Electric Lighting Company of New York has completed and put in use a system of house illumination extending over a part of that section of the city marked out about eighteen months ago, as the site for the first great experiment in public lighting from a central station. Of course we must wait to see how this experiment stands the test of a few months' experience before we can know whether Mr. Edison has really demonstrated the economic practicability of this mode of lighting. Meanwhile, it is worth while to place on record a few facts concerning this trial, the failure or success of which will be a matter of vast importance to gas manufacturers. The area to be lighted is about one square mile, but scarcely one-third of this is yet supplied. It comprises that part of New York between Ferry and Wall-streets on the north and south, and Nassau-street on the west, the eastern limit of the section being the East River. With the general details of the Edison system, our readers are well acquainted, though we may be sure that so fertile and restless an inventor will be constantly introducing new details and devices, so that the installation will possibly never reach its fullest stage of development. The general features of the station, the views of conductors and lamp fittings, may be described very briefly. A large building on Pearl-street, near Fulton Ferry, was acquired for the station, and contains the steam power, dynamo machines, and miscellaneous apparatus. The floors for the machinery are entirely independent of the building, and are carried up four stories in height. Six special generators of the largest size, and substantially of the type illustrated by us on page 377 of our last volume, are now at work. The armature is 27·6 in. in diameter and 6 ft. in length, it weighs over 4 tons. The total weight of each machine is somewhat over 30 tons, including the engine, which is coupled direct on to the armature shaft, and runs at a normal speed of 350 revolutions; these engines were made by the Porter-Allen Engine Company of Philadelphia, the engine bearing name-plates of factory built by the Edison Electric Light Company of New York. Steam is supplied by four Babcock and Wilcox boilers, each of 250 horse power. The maximum capacity of each generator is 1000 lamps of 16-candle power, though it is not intended to work them higher than 1200 lamps. The current runs from all six generators into two large copper bars, to which are connected the various conductors or street mains. Each dynamo can be cut out of the circuit by an ingeniously arranged switch, and visual demonstration of the efficient working of the generators can be made at any moment, as follows: In the station is placed a battery of a thousand 16-candle lamps, arranged in two groups, and these can be thrown into circuit with any one of the generators. If these lamps are brought up to the normal standard of brilliant incandescence, the generator is evidently working properly, and the cause of any interruption must be looked for elsewhere. The generators are also each provided with a series of resistance coils controlled by a steady switch, and an indicator enables the attendant to judge of the strength of the current. This indicator consists of two incandescent lamps, one enclosed in a blue, and the other in a red bulb. When the current-blue lamp becomes lighted, but when the field magnets are not sufficiently excited, the red lamp is brought to a state of incandescence. In normal working neither lamp is lighted. In the section now being lighted there are laid about fourteen miles of street conductors, which will supply the current through service wires to about 10,000 lamps, fitted up at present for the consumers. The arrangements within the houses are substantially those which we have described and illustrated, including the meter for recording the value of the electrical energy used by the lamps. On Monday last 5000 lamps were lighted up in various dwellings and offices, including the buildings of the *New York Herald* and *Times* newspapers. Probably it will be some time before all the subscribers on the section will be supplied, since the existing plant will have to be more than duplicated and will even then—if the working capacity of each generator be only 1200 lamps—be working with insufficient reserve power. It is claimed for this installation that the light will be supplied at a lower rate than gas, and this may easily be the case, for gas in New York is very costly. It is claimed also that the consumers will have no more difficulty or trouble in manipulating the lamps, than they have been accustomed to with gas-burners or oil lamps. This too remains to be seen, and if we are fortunate enough a few months hence, to obtain a really accurate statement of cost, of failures, and of practical difficulties, we believe it will be demonstrated that the Edison installation has not by any means thoroughly solved the problem of domestic electric lighting, but it will have rendered an invaluable service in developing defects and difficulties of which at present we are in ignorance. The question of cost is of high importance in this country, where, so far as experience indicates, the expense of electric lighting by incandescence is much greater than that of gas. On the other hand, it has advantages hard to over-value—coolness, purity and steadiness of light, and a total absence of vitiated air, destructive to many objects and detrimental to health. These are advantages for which a large body of consumers will be prepared to pay so soon as it is demonstrated that electric lighting by incandescence can be permanently relied upon.

Engineering, Sept. 30, 1881.

THE ELECTRIC LIGHT AT SOUTH KENSINGTON.

It is so difficult to obtain actual details of the cost of the electric light, and of its comparison with gas, that the following information will be read with considerable interest. It is extracted from the report just issued of the Science Reporting, Mr. the Assistant Director of the South Kensington Museum, who is specially entrusted with the lighting of the building.

"The total consumption of gas in the Museum schools, &c., at South Kensington, has been 20,000,000 cubic feet, nearly.

"The consumption at South Kensington shows a diminution of 1,750,000 feet with the previous year, of 2,750,000 ft. with 1879. The diminution is accounted for by the fact that since 30th September, 1880, the west side of the whole of the Lecture Theatre has been lighted by the electric light. The weather was unusually fine, and the lighter time in the previous year. The price was reduced from 3s. 6d. to 3s. 4d. on the first of January.

"Sir Frederick Leighton, P.R.A., having expressed his fears that the mural painting recently executed by him in the Lecture Theatre Court might be injured by the gas, it was decided to try the light in the court by the electric light. The 'Brush' system, which has been very largely introduced into this country from America, was applied, at the request to be that least suited for the purpose, and a dynamo-electric machine and eight lamps on this system were therefore purchased to light up the eastern half of the court. The machine was driven by the gas engine, and the result was the most satisfactory that it was determined to extend the lighting to the whole court. It was found that as the gas engine is not sufficiently powerful for this purpose, a semi-portable steam engine was purchased for the purpose from Messrs. Hammond, Ipswich, and placed in a temporary shed between the office building and the South Cities Museum, and towards the end of June the lighting of the whole court was commenced. On the 1st of July the whole court was lighted.

"The light is, as the whole audience can testify, that is not so nicely as could be wished, and it is quite unsuited in quantity of light to and perhaps to decoration. The present machine, however, is incapable of working more lamps. Three lamps are suspended from the roof, and are raised and lowered by means of cords, which have proved but an inconvenience at the court. It has, however, saving the expense of gas, done away with those cords, which will be applied after the present Exhibition is finally removed. This generally may now be taken as safely as the electric light has been worked without any accident for so long.

"Between the 23rd of June and the 31st of December the 16 lamps were at work on 97 nights for a total of 2320 hours; the total consumption of coal (Hartley), including what was used in lighting the fires, was 10 tons 13 cwt. 3 qrs. 14 lbs.'s work. The engine has been 20 and 21 horse power, but is capable of working up to double this power; it will therefore be well to drive a second machine as well, and no doubt we shall get a comparative diminution in the consumption of coal, which is even now lighter than on engine of this class. The nationalis expansion gear of Messrs. Hammond, which is the best of the kind we have had satisfactory account, the speed of the machine, as shown by the tachometer attached to it, being perfectly regular.

"The only actual calculation of the relative cost of the electric light has been to those of the stokers, which amount to 20s. a week. The engine fitter who looks after the engine has replaced a gasfitter.

"The working expenses referred to has been as follows:

	£ s. d.	£ s. d.	
Carbons ...	16 3 0 at	1	0 per hour of lighting.
Oil, cotton waste, &c. ...	4 11 6	0 3	,, ,,
Coal ...	11 14 6	0 0 8	,, ,,
	32 14 0		,, ,,
Wages ...	31 7 6	1 11	,, ,,
Total ...	63 2 0	3 10	,, ,,

"The consumption of gas when used to the rate of 10s. an hour would for the same period have been 2671. 6s. The saving in working expenses has therefore been 207l. 6s., or at the rate of about 63l. per annum.

"The costs are as follows:

	£
Cost of dynamo-electric machine ...	400
,, of lamps and fixing; conducting wires, &c.	284
Cost of steam engine and fixing; shafting, belting, &c....	420
	1104

"As, however, the steam engine is capable of driving two such machines, the cost of the machinery and apparatus for lighting the court may be said in round figures to have been 800l., on which outlay the saving at working expenses, as compared with gas, represents 42 per cent. per annum. The machinery at present shows no sign of deterioration from use, nor do I see any reason to expect any great expense on that account. I hope that, from our experience we may obtain greater steadiness in the light, and perhaps even some slight diminution of working expenses.

"I propose next to try similar lamps in some of the picture galleries, and in the Art Schools, in which latter there are great complaints of the bad state of the atmosphere in the evening from the use of gas. I hope also before long to be able to try some of the incandescence lamps of Swan or Lane Fox, which promise to be very suitable for the reading-room, and perhaps even for the Show."

Engineering Oct. 24th 1879

ELECTRIC LIGHTING.

The following resolution was placed on the agenda paper of the Court of Sewers, for discussion at the meeting of Tuesday last: "That the Commission, become the undertakers for the supply of electricity under the provisions of the Electric Lighting Act, 1882, and do apply for a provisional order or license, if as they may be advised, and that an intimation of the above course be given to the Board of Trade and the companies and persons who have served notices of their intention to supply, and that all other applications for provisional orders, so far as the City is concerned, be opposed accordingly."

In the course of the meeting, the Streets Committee stated that they had carefully considered the various applications that had been received for granting the right of private lighting to companies having contracts for street lighting in the City. One important point they had referred to an eminent electrician to report upon. This was whether it would be practical to lay in the same trench boxes of various companies working different systems, in such a way that any one act of conductors would not affect any other act, and also whether any type of conductor could be made use of for lighting by any system. The report of the committee following resolution was carried: "That the Commission become the undertakers for the supply of electricity under the provisions of the Electric Lighting Act, 1882, and do apply for a provisional order or license, as they may be advised; and that an intimation of their purpose be given to the Board of Trade and the companies and persons who have served notices on the Commission of their intentions to apply, and that all other applications for provisional orders or licenses, so far as the City is concerned, be opposed accordingly."

The following alterations have been made in the rules issued by the Board of Trade in August last in connection with Section 9 of the Electric Lighting Act, 1882:—Rule V.—The words "the lands which the undertakers are by law empowered to take for the purposes of the undertaking" have been omitted. Rule IX.—The wording of the first few lines of this rule have been altered in order to make the meaning more clear.

The Gas Committee of the Birmingham Town Council have approached the question of electric light in a very liberal and practical manner. Assuming that the introduction of it necessary to be attended by the Gas Undertaking agent, they do not fear that the vested interests will suffer. In order to secure the greatest advantage for electrical skill, they recommend that it should be tried under the following favourable conditions, and they distinctly point out that the success or failure of electric lighting elsewhere should not be allowed to prejudice the Birmingham experiment. Bearing in mind the importance of the problem, and the very probable benefits that may accrue to consumers by the substitution of electricity for gas, they recommend, irrespective of whatever action, might they propose to lose no time in putting the matter to a practical issue. They notify their intention of opposing all the various applications of different companies, and of placing the matter under Parliamentary control as early as possible. It is proposed that the Town Council should themselves experiments being carried out without loss of time, and on such a scale as to yield complete results from one or two central stations. The Gas Committee conclude their report with the following recommendations:

1. That no application be now made by the council for authority to supply electricity in the borough or in any part of the district of their gas supply, either by license or provisional order under the Electric Lighting Act, or by special Act of Parliament. 2. That the committee be authorised to enter into negotiations with the companies applying for powers to supply electricity within the borough for the purpose of obtaining the license or order sufficient provision for storing in tion by the council of the full control of the streets for subsidiary of suitable sites for the works, for the safety of the public, for insuring the completion of the works within a limited time, and for the limitation of the term of the concession. 3. That, subject to satisfactory conditions being arranged with the companies in this way, the committee be authorised to support on behalf of the council, applications to the Board of Trade by one or more of the companies for power to supply one or more limited areas within the borough. 4. That, subject to the foregoing recommendations, the committee be authorised to oppose all or any of the applications of which notice has been given to the council.

Some time ago (see ENGINEERING, November 11, 1881) we published a detailed description of the process of protecting conductors, carried out by MM. Berthoud, Borel, and Co., of Paris. Since that date the manufacture of these cables in England has passed into the hands of the Electrical Trailing Company, 3, Victoria Mansions, Westminster, as will be remembered, MM. Berthoud and Borel employ as "an insulating material, cotton treated with paraffin and colophane, the wire previously encased in cotton sheathing being passed through a bath of the above mixture at a temperature of 350 deg. From this bath the conductor is passed through suitable dies, and by hydraulic pressure a sheathing of lead is forced around it. A considerable thickness of this sheathing, which is made in great variety of types, has been employed for electric lighting with good results. The conductors vary in weight from 95*l*. lb. to nearly 3 tons a mile, including outer sheathing of lead, which is preferably tinned, laced to protect the solid sheathing. The following are the particulars of a cable which is one of those manufactured:—A telephonic cable with four conductors, each formed of three wires, 23 B.W.G., covered with three layers of fine cotton and insulated with the Berthoud and Borel compound. The thickness of the insulated wire was .043 in. and the length of the cable tested was 6.20 kils. (3834 ft.)

Temperature.		Resistance of Dielectric per Kilometre.	Electrostatic Capacity per Kilometre.
Cent.	Fahr.		
deg.	deg.	megohms.	microfarads.
0	32	4000	0.185
11.5	53.6	3650	0.205
20	68.2	3000	0.185
20	68	2750	0.190
20	68	2400	0.196
24	75.2	2200	0.196
27	80.6	2100	0.197
30	86	1750	0.197
33	91.4	1525	0.197
36	96.8	1300	0.197
39	102.2	1100	0.198
42	107.6	900	0.198
45	113	750	0.199
48	118.4	600	0.199
51	123.8	450	0.199
54	129.4	310	0.122

The resistances and capacities were determined in each case after one minute of electrification.

The large and very fine machine, the Gordon dynamo-electric generator, the design of which has occupied Mr. Gordon for a considerable time, is now in operation at the Telegraph Construction and Maintenance Company's Works, East Greenwich. The aim of the inventor has been to provide a generator of a size and power sufficient to supply from five to ten thousand incandescent lamps; being persuaded that such large machines are necessary in order to the more economical production of the electric light. It is constructed on the plan of revolving the electro-magnets and keeping the armature coils fixed. We shall publish next week a full and illustrated description of the machine, which contains many novel and ingenious features. On Wednesday evening the new generator was publicly exhibited by Mr. Gordon and Mr. R. Clapham, to a number of gentlemen interested in electric lighting; and the works of the Telegraph Construction and Maintenance Company were illuminated throughout by 1200 Swan lamps, maintained by it while working at a fraction of its full power.

The contract which the British Electric Light Company have had for the lighting of St. Enoch Station, Glasgow, for the past three or four years, is to come to a termination at the end of this month. All along there have been in use six powerful arc lights. For a considerable time the reception lamps were employed, but lately they were replaced by Brockie lamps, which have certainly never been a complete success. That may in some degree have been owing to the fact that the engine used to drive the dynamos is the one whose duty includes the working of the laundry belonging to the Station Hotel, so that the lights could not be always kept going at full pace. It is intended to continue the use of the electric light in the station, the new contract having already been placed with Messrs. Norman and Son, of Glasgow and Barrow-in-Furness; but as the dynamos have been arrived at very recently, it is possible that the new installation may not be completed for three or four weeks, in which case, not unlikely, the old gas will have again to be resorted to for a time. It is understood that Messrs. Norman and Son will employ in their installation four Crompton arc lamps of the most recent form, and numerous clusters of incandescent lamps. Messrs. Norman and Son have lately secured extensive premises in Argyll-street, Glasgow, in which several varieties of the Swan incandescent lamps will shortly be permanently installed. Already the firm have laid down on their premises three Crompton-Burgin dynamos, and a semi-portable compound engine, of 14 horse power, by Marshall and Co.

Messrs. Henry Bennett and Co., electric light engineers, Glasgow, have just started a very complete system of arc lighting at the works of Messrs. Gosselin and Co., tinsmiths, &c., and steel engravers, &c., Motherwell, which is the first electric light installation in the district. There are four Crompton lights in the installation, one of which is a semi-final light in the yard placed at a height of about 60 ft. from the ground, while the other three are placed in line in the spacious globe buildings shop. The power is obtained from an engine by Shanks, of Arbroath, and the lighting current is generated by a Crompton-Burgin dynamo machine running at a rate of 1,000 revolutions per minute. In consequence of the necessity of the travelling crane in this shop, the engines, machinery, lighting, and dynamo are fixed on a platform which is built on the tie beams of the roof of this building, and from the platform there is a gear for running the travelling crane. The gear for the purpose of readily getting at the individual lamps, in the event of any lamp becoming extinguished from the arcs having a similar installation to the one just referred to, has been fitted up somewhere on the Forth and Clyde Canal, near Glasgow, where Messrs. Morrison and Mason, engineers, are engaged in making a deviation of the canal. A portable engine by Brown and May is used to supply the power. Messrs. Watt and Wilson, contractors, Glasgow, are having fitted up by the same firm an electric lighting arrangement of a similar character at the railway lodges which they are constructing over the Forth and Allan. The light in this case is to be chiefly used by night in the sinking of the foundations, for which the piers are to be carried. A portable engine is also to be used in this installation for obtaining the necessary power.

On the motion of Lord Provost Ure, seconded by the predecessor in office, Sir William Collins, the Glasgow Corporation Gas Commission have obtained an applying forthwith to the Board of Trade for a provisional order to supply electricity within the burgh of Glasgow, under the Electricity Clauses of the Electric Lighting Act of 1882. The electric light has for several miles around the city are almost wholly supplied entirely by Glasgow Corporation Gas Commissioners, but the resolution which has just been passed is the first step which has been taken to go beyond the municipal boundaries in the matter of supply of the electric light; indeed, one of the resolutions passed when speaking upon the Lord Provost's motion did not hesitate to make the absurd statement that any one who thought of supplying electricity within the burgh understand that it could not be extended beyond half a mile from any one gas generating station.

MM. Egasse, Mangin, and Cloris-Baudet, of Paris, have recently introduced some interesting apparatus having for their object the development of a system of slight signalling by means of small captive balloons, to which are attached incandescent lamps. The balloon experimented upon was of 10 cubic metres capacity, and made of transparent impermeable rubber fitted with hydrogen. The lamps are suspended from the balloon by a Swan lamp. The balloon was allowed to ascend, and when the air the current was passed through the lamp, the effect being to illuminate the paper sphere to such an extent as to allow it to be visible for a very considerable distance. By suitable manœuvres a very perfect system of Morse signalling may be established, and messages transmitted at night with great facility. The great merit and real value of the arrangement must lies in the illumination by one or more incandescent lamps of a sphere large enough to be seen through considerable distances.

The French Minister of Marine has appointed a commission to investigate and report upon a new arrangement for illuminating submarine operations. A powerful arc lamp is enclosed in a water-tight case, the bottom of which is formed of a glass disc, and the case is provided with a reflector that will distribute the light over a circle about 197 ft. in diameter. The series of experiments, which it is intended shall be very complete, will be conducted at Marseilles. The divers will be in telephonic connection with the surface, and be able to direct the movements of the lamp, which will be suspended over the operations, and can be shifted at will.

A successful installation on the Solvit system has been made at Antwerp, where a 10-horse power portable engine is employed to drive a Type II. Gramme machine with separate exciter. This generator feeds two circuits, on each of which are six Solvit lamps; of these, one is placed in the first-class waiting-room of the Antwerp Railway station, six are in as adjoining café, four in a second café, and one is in the machine-room of the installation. The lamps have been running about six weeks and have given great satisfaction. During that time application for sixty more lights has been received by the company, who will probably extend their power station as soon as possible.

Engineering, Oct 20, 1882.

ELECTRIC LIGHTING.

A VERY important experiment is now being carried out at the Gare de l'Est, Paris, which will unite the station buildings in Paris and the whole of the line between that terminus and the Villette station, the railroad for that length being either in tunnel or between retaining walls. An important feature in this section are the traverse tables introduced for shifting carriages from one line to another, to facilitate the trestle, and the gas illumination for this purpose has always been found insufficient. The new installation is being carried out by the Société Lyonnaise des eaux et de l'Eclairage, and will comprise fifteen large arc lamps. Of these will be placed in the Partsistation, three will be on the goods depôt, and the others in the station yard. As the system will be employed, the generators being of the Gramme type, will be driven by a 15 horse power Weyher and Richemond engine at a speed of 340 revolutions per minute. The current will be of the double type, with certain 11 millimetres in diameter. The length of the exterior circuit is 4700 metres, the resistance of the circuit being 15 ohms. The intensity of the current feeding the lamps is from 10 to 10.5 ampères. The following photometric tests have been made with one of the lamps, the "Starr" candle and the Carcel standard having been used.

1. With *Standard Candle*:

Incidence of Rays	Nature of Light.	Luminous Intensity.	
90 deg.	Naked arc	444 candles	22 carcels
80 "	"	500 "	=101 "
70 "	In ground glass globe	277 "	= 57 "

2. With *Carcel Standard*:

0 deg.	In ground glass globe	49 Carcels	
10 "	"	66 "	
20 "	Naked "	79 "	
30 "	"	114 "	
50 "	"	101 "	
70 "	"	65 "	

These results, which appear to have been carefully obtained, do not agree with the more liberal allowance of luminous intensity usually accorded to this lamp.

Under the title of *Souvenirs de l'Exposition Internationale d'Electricité de Paris*, 1881, our excellent contemporary, *La Lumière Electrique*, has just issued a handsome volume, containing the admirable series of articles which on the first great electrical exhibition has been so fully devoted. The issue in question contains a number of finely executed engravings of the Palais de l'Industrie, comprising views of the exterior and interior; it is to be hoped that the report of the Exhibition published in our contemporary will be collected and published in a separate form.

In Germany, on the Frankfort and Fulda Railway, some interesting experiments are in progress on lighting trains with incandescence lamps. The experimental train consists of two first and second-class carriages, a saloon, a fourth-class carriage, and a brake van, in which latter is placed a Wilson dynamo-electric generator, and forty-four cells of accumulators, eleven of which are held in reserve. These are distributed through the train twenty-three Edison lamps. The generator is driven off one of the axles of the brake van, and being a dog lamp when the train is in motion, the current being taken from the accumulators, when it stops. So far the experiments have been encouraging, but they have developed a number of practical difficulties which will have to be overcome before the installation is successful.

Mr. James Gordon Bennett's yacht, the Namouna, now on a tour round the world, recently visited the Port of London. She is lighted throughout by 150 Edison incandescence lamps, fed by a 50 horse power generator, driven by belting from a special engine. On her way from New York she was exposed to very heavy weather, but no interruption to the lighting occurred, nor was there any instance of the belt slipping. This experience is a valuable one, and will probably serve to remove the distrust in belting for driving dynamos on board ship, where direct driving is generally preferred.

The steamships Tarawera and Waiilkore, now being built by Messrs. Denny and Co. for the Union Steamship Company, of New Zealand, will each be fitted with 150 Edison 16-candle lamps, fed by an Edison dynamo, driven direct by a Beckenbaud three-cylinder engine.

A meeting has been convened by the Vestry of Camberwell of the various South London vestries, to decide upon the most expedient action that should be taken in regard to the numerous notifications made by different electric light companies, of their intention to apply for provisional orders to empower them to distribute electricity throughout the South London parishes. The meeting will take place on Tuesday the 31st inst. It is intended that the vestries will arrive at some course of joint action which shall as far as possible protect the interests of the ratepayers.

The Wandsworth District Board of Works next Thursday week, by a majority but, agreed to the following recommendation of their General Purposes Committee: "The General Purposes Committee have considered the applications for the consent of the Board to Board of Trade licences or provisional orders being granted for the supply of electricity within the district, received from the following companies:—1. The Metropolitan Electric, the Gallery, Victoria Chambers, and the West Middlesex, and Messrs. Byrne and Thomson, and Isca; and recommend that the Board do not grant their consent to any of the proposed schemes. 2. That the applicants and the Board of Trade be informed accordingly; and that the Board of Trade be further informed that the Board have it in contemplation to apply for a license themselves for the supply of electricity in the district when the system of electric light is more matured.

The Sanitary Committee of the Bristol Town Council, acting as the Urban Sanitary Authority, have issued a circular recommending the council to apply to the Board of Trade for a provisional order for powers to establish electric lighting installations in the city of Bristol.

Engineering, Oct 20, 1882.

THE MUNICH ELECTRICAL EXHIBITION.

In less than four years, four electrical exhibitions have been held, and in most cases are in preparation to satisfy the overpowering demand for novelty so universally exacting. The first exhibition of this class was held at the Royal Albert Hall in 1879; its proportions were very modest compared to those which so rapidly succeeded it, but it formed a useful commencement to the labours of the Society, whereby but, agreed to the following recommendation of their General Purposes Committee: "The General Purposes Committee have considered the applications for the consent of the Board to Board of Trade licences or provisional orders being granted for the supply of electricity within the district, received from the following companies:—1. The Metropolitan Electric, the Gallery, Victoria Chambers, and the West Middlesex, and Messrs. Byrne and Thomson, and Isca; and recommend that the Board do not grant their consent to any of the proposed schemes. 2. That the applicants and the Board of Trade be informed accordingly; and that the Board of Trade be further informed that the Board have it in contemplation to apply for a license themselves for the supply of electricity in the district when the system of electric light is more matured.

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ELECTRO LIGHTING.

We obtain from various sources the following current notes referring to electric lighting. A special report of the directors of theatres in Germany has been formed to inquire into the question of electrically lighting theatres. This commission is pursuing its inquiries experimentally in the Electrical Exhibition now being held at Munich; for this purpose a theatre has been arranged, the upper part of the amphitheatre of which is now lighted with six Krizik lamps, while groups of Edison lamps are ranged round the walls. The stage is illuminated partly with Jaublochkoffs, partly with arc-lamps, the combination of which is found to be successful; experiments are here being made with effects produced by enclosing the lamps in Celestin lanterns.

The following are some notes of the Schultz (Strasbourg) secondary batteries shown at Munich. The lead plates composing the battery are grooved longitudinally and covered with sulphur; under the influence of heat sulphate of lead is formed. Several such plates, mounted parallel, are plunged in a lead-lined wooden trough containing dilute sulphuric acid. Each cell weighs about 17 lb., and according to the inventor can receive about 1,000 to 1,200,000 foot-pounds. It is stated that the batteries are easily "formed," an exposure to a current of four amperes during forty hours being sufficient for this purpose. The resistance of each cell when charged is .005 ohm, when not charged, .012 ohm. It is stated that these batteries have a very effective odour.

It is proposed to light the Munich Stadt-am Rosen to facilities for illumination during the Carnival.

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It is proposed to light the Munich Stadt-am Rosen to facilities for illumination during the Carnival. A railway station of the Isar-Loisach line is erected in one night, by the aid of four electric lamps enclosed in globes of different colours; a considerable amount of heavy earthwork is also completed.

In Berlin, the Place Potsdam and the Leipzig Strasse are at present illuminated by means of Siemens and Halske dynamo machines; the power station six conductors are laid underground along the Dorotheen Strasse, from the Friedrich Strasse to the Spree and three to the Place Potsdam. These cables are laid in cast-iron pipes in the streets, and covered with tiles; where they cross, they are carried in iron pipes; the total length of the conductors is about 1,200 yards. Two large Siemens machines illuminate the Place Potsdam, while 25 others are in use in the Friedrich Strasse. The machines are driven by gas engines. The installation is experimental, and the time of lighting is from sunset to midnight.

The Vendôme Hotel at Boston has recently been lighted with the Maxim lamps, and the Parliament Building at the Parliament Building at Capetown, constructed in London, appears to be giving excellent satisfaction. This installation comprises 44 lamps, 24 in the Assembly Hall and 20 in the gallery.

At Waterloo House, Pall Mall, has just been lighted by the Anglo-American (Brush) Electric Light Company; the installation consists of 16 arc lamps, and the power is a 12 horse-power Otto gas engine.

On Tuesday last, at a meeting of the Anglo-Austrian Brush Electric Company, it was stated by the chairman (Sir William Stephenson), it appears that the public had been very anxious to take up the company, 32,038 shares having been taken up. The company had realized its demands and had received 27,000*l.* in cash, and the balance (75,000*l.*) in shares. The property of the company consists of the Brush and Lane-Fox patents for Austria and Hungary, and in relation to the Lane-Fox patents it was pointed out that one was especially valuable, as it claimed that an system of dynamos, accumulators, and incandescent lamps could be used together except under a license from Mr. Lane-Fox, who has patented the combination. This claim may probably open up a wide field for litigation in the future. The company appears to have a position in Austria and Hungary by this company, though it is stated that many important contracts are soon to be entered into.

At a meeting of the City Commissioners of Sewers on Tuesday last, a report was presented by the Streets Committee on the various notices from the Electric Lighting Companies, of their intention to apply for provisional orders under the Electric Lighting Act of the present year; this report recommended that the Commissioners of Sewers' solicitor should report on the applications, and secure clauses protecting public and private rights.

The Vestry of the parish of St. George the Martyr, Southwark, are preparing to take active measures in regard to electric lighting. A meeting of the Board was held on Thursday evening last, at which it was resolved to oppose the application of electric lighting companies for powers under the Act, unless they are prepared to give a guarantee to divide all profits with the vestry, after allowing their shareholders a dividend of 7*l.* per cent. The object of this resolution is to reduce the local rates. This appears a very reasonable determination, and one which the companies will doubtless accept; it is doubtful, however, whether any appreciable reduction in the rates will be effected by this means for some time to come.

The Sheffield Corporation are proposing to apply for electric power powers under the Act during the coming year, the intention being to commence the lighting of the town in the streets and public buildings, as well as in private houses. Such an undertaking will be a very onerous one, and the Corporation consulted yesterday with the representatives of some of the principal electric lighting companies upon the best system to be employed. Mr. Colpell W. Cooke is acting as consulting engineer to the Corporation.

The experiment of lighting by electricity at Chesterfield has not so far proved successful. It will be remembered that about a year ago, owing to differences with the gas company, the Corporation determined to abandon gas for street lighting, and to illuminate all the streets with arc lamps. A contract was entered into by the Improved Company, and it was decided to use both arc and incandescence lamps. There is no doubt by the work has recently been handed over by the contractors as complete, but according to the Town Council it is little less than a climax before. It is better addressed to the papers yesterday. Alderman Gee says: "The Lane-Fox lamps which have been supplied by the Brush Company are most valuable in their lighting power, cheaper some are good, others only give a feeble light instead of a light equal to that of fifteen candles as expected. The Brush lamps have been good service of the large streets, but as a whole I think it has been fully demonstrated to the people of Chesterfield, that the field for arc lighting is very limited indeed." The inhabitants of the town are very much inclined in any other instance to condemn the system and the disappointment at the result of the misleading experiments is very general. Judging from the success that has attended the electric lighting of towns where we suspect that the fault has been with the mode of installation; the defective Lane-Fox lamps should be replaced by perfect ones and the system of a better distribution of the arc lights could be effected; many towns have been in a timely way to adopt an economical bodies are turning their attention actively to the question of abandoning gas.

The Town Council of Aberdeen, who have received notices from four or five companies having powers under the Act of their intention to apply for licenses to the Board of Trade to supply electric light to the town, have decided to protect the interests of the ratepayers and the owners of the town gas works, and to prevent any one company from obtaining an exclusive footing.

Progress in electric lighting is being made in Scotland to a variety of directions. Although not much that may result through the applications to Parliament for powers to take breath of fresh air. Already a year ago a local company was formed in Dundee under the name of the Dundee Electric Light, Power, and Accumulator Company, with the intention of supplying electric light and power by any apparatus that might be used, approved of; and it was stated that extensive installations are in process of being carried out by that company in Dundee and the neighbouring districts. Besides numerous exhibitions of incandescence installations of arc lamps, ranging from three to twelve lamps each, have been taken up by the Edinburgh, Glasgow, Dundee, and Bellshill Co-operative Societies, the installation of the 100 incandescent lamps, each lamp, completed in another Forfar factory, which one of our

Coventry, 13.1.82

ELECTRIC LIGHTING.

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The following are some notes of the Schnitz (Styria) lacery) electric lighting factories shown at Munich. The plates consisting the battery are grooved longitudinally and covered with sulphur; under the influence of heat a sulphate of lead is formed. Several such plates, mounted parallel, are placed in a lead-lined wooden box, and contain 17 lb., and accordingly the inventor can receive a charge equal to 250,000 foot-pounds. It is stated that these batteries are easily "formed," an operation to correct this purpose. The resistance of each cell when charged is 1600 ohm, when not charged, 312 ohm. It is stated that these batteries have a very effective use.

It is proposed by the Municipal Council at Rouen to utilise the Seine as a source of power to drive machinery for lighting the city, and the matter is now being technically investigated. The power stations would be at Pont de Pilmes, and dynamo engines would be laid throughout Rouen and Elbeuf. Gas lighting in the latter city would be discontinued, and a number of the spire of the cathedral, at a height of nearly 500 ft., powerful arc lamps, the light from which would be thrown over the streets by reflectors.

The military authorities at Belfort have been entrusted with the lighting by oil of the electric light. At Schneeberg arc lamps have been used, and recently there has been erected in the same manner. A railway viaduct about 130 yards long has also been lighted by arc lamps, with the aid of four electric lamps enclosed in globes of different colours; a considerable amount of heavy cannon can be seen from the viaduct.

In Berlin, the Place Potsdam and the Leipzig Strasse are lighted by the Siemens lamps, and the Leipzig Strasse partially. From the power stations arc conductors are laid underground along the Guillaume Strasse, thence going to the Frederic Strasse, and three to the Place Potsdam, and from these the lamps are hung along the streets, and covered with tiles; where they cross, they are suspended by cables. The length of arc conductors is about two miles. Ten large Siemens lamps illuminate the Leipzig Strasse, and are recently been lighted at the Parliament Building, and also the Edison installed in May last, appears to be giving much satisfaction. This installation comprises 400 lamps.

The Vienna Electrical Society has recently been lighted with 60 Edison lamps, and the Edison installation at the Parliament Building, Budapest, was installed in May last, appears to be giving much satisfaction. This installation comprises 400 lamps.

Waterloo House, Pall Mall, has just been lighted by the Metropolitan (Brush) Electric Light Company; the installation consists of 16 arc lamps, and the power is 12 horse-power gas engine.

On Tuesday last the general meeting of the Anglo-Austrian Brush Electrical Company was held, and across rather interesting statements were made by the chairman (Sir William Siemens), who said that since the public had submitted very actively to this company, 10,000 shares having been taken up. The vendor had reduced his demands and had accepted £70,000, and had also taken £30,000 in shares. The property of the company consists of the Brush patents for Austria and Hungary, and also of the Lane-Fox patents in reference to the Lane-Fox patents it was pointed out that one was especially valuable, as it claimed the entire system of dynamos, accumulators, and incandescent lamps could be used together except under a license from Mr. Lane-Fox, who has patented the combination. This claim may probably open up a wide field for litigation in the future. No business appears to have been done in Austria and Hungary by this company, though it is stated that many important contracts are soon to be closed.

At a meeting of the City Commissioners of Sewers on Tuesday last, a report was presented by the Streets Committee as to the various notices from different Electric Lighting Companies, of their intention to apply for provisional orders under the Electric Lighting Act of the present year; this report recommended that the Commissioners should oppose all similar schemes, and appointed a sub-committee to consider the matter and report on the private rights.

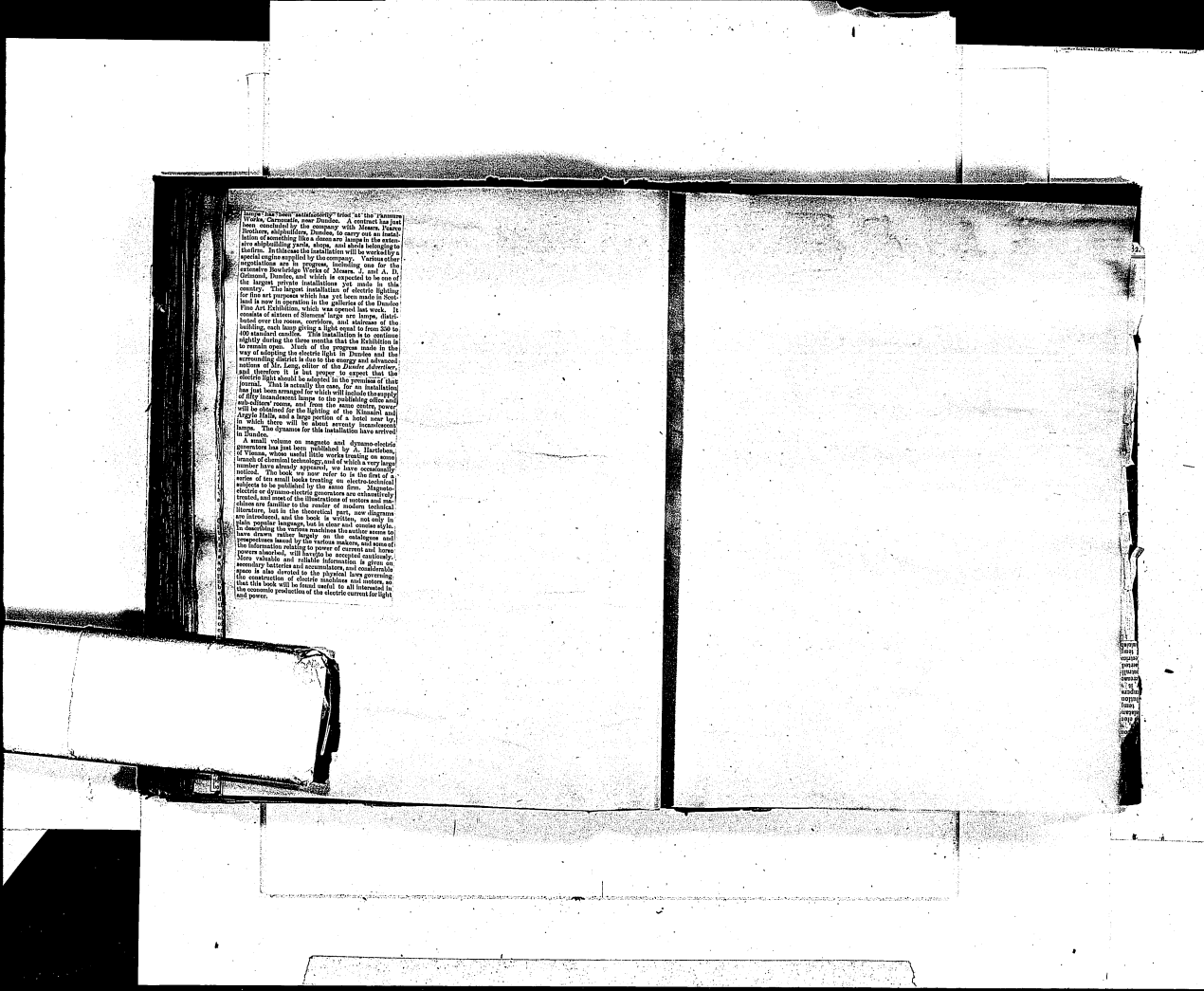
The vestry of the parish of St. George the Martyr, Southwark, are preparing to take active measures in regard to electric lighting. A meeting of the Board was held on Tuesday evening last, when it was resolved to oppose the application of electric lighting companies for powers under the Act, unless they are prepared to give a guarantee to divide all profits to the vestry, after paying their shareholders a dividend of 7 per cent. The object of this resolution is to reduce the local rates. This appears a very reasonable recommendation, and one which the company will doubtless accept; it is doubtful, however, whether any appreciable reduction in the rates will be effected by this means for some time to come.

The Sheffield Corporation are proposing to apply for extensive powers under the Act during the coming session, the intention being to supersede the lighting of the town, in the streets and public buildings, as well as in private houses. Such an undertaking will be a very serious one, and the Corporation consulted yesterday with the representatives of some of the leading electric lighting companies upon the best system to be employed. Mr. Conrad W. Cooke is acting as consulting engineer to the Corporation.

The experiment of lighting by electricity at Chesterfield has proved as far proved successful. It will be remembered that about a year ago, owing to differences with the gas company the question arose whether to continue to illuminate gas for street lighting, and to illuminate all the streets with gas lamps. The contract was entrusted to the Thomson-Houston Company, and it was decided to use both arc and incandescent lamps. After a long delay the work has recently been handed over by the contractors as complete, but owing to the Town Council it is little less than a disappointment. In a letter addressed to the papers yesterday, Alderman Cox says, "The Lane-Fox lamps which are now supplied by the Brush Company are most variable in their lighting power, whilst some are good, others only give a feeble light instead of a light equal to that of eight candles as expected. The arc lights are also giving bad service in some of the large streets, but as a whole the lighting has not been fairly demonstrated in a year's trial in Chesterfield, that the field for arc lighting is very limited indeed." The disinclination of the Council to appear inclined to any single instance to abandon gas, and the disappointment which many of this recent lighting experiment is very natural, judging from the success that has attended the electric lighting of towns elsewhere we suspect that the real cause lies chiefly with the mode of installation; the defective Lane-Fox lamps can scarcely be replaced by perfect ones, and probably a better distribution of the arc lights could be effected. Alderman Cox's letter is hardly one, now that so many municipal bodies are turning their attention seriously to the question of electric lighting.

The Town Council of Newbury, who have received offers from four or five electric lighting companies of their intention to apply for licenses from the Board of Trade to supply electric light to the town, are now taking steps to protect the interests of the Corporation as owners of the gas works, and to prevent any company obtaining a monopolistic footing.

Progress in electric lighting is being made in Scotland in a variety of directions, almost as great from anything that may result through the application of various municipal bodies to take Board of Trade licenses. About a year ago a local company was formed in Dundee under the name of we mistake not, of the Northern Electric Light, Power, and Application Company, with the intention of supplying electric light and power by any apparatus that might be most approved of; and it is now stated that extensive installations are in process of being carried out by that company in Dundee and the surrounding district. Numerous exhibitions of a temporary nature, installations of not large, ranging from three to eight lamps each, have been made in large factories in Perfar, Blairgowrie, Dundee, Bellshill, and an installation of 100 to 120 incandescent lamps has just been completed in another Perfar town, while one of are



THE ELECTRIC LIGHT PLANT ON THE S.S. "OREGON."

(For Description, see Page 336).

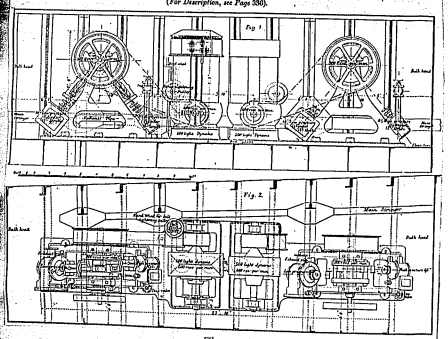


Fig. 1.

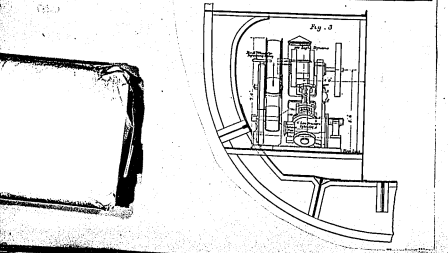


Fig. 2.

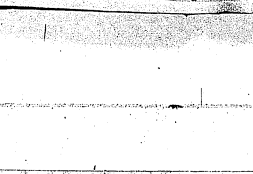


Fig. 3.

THE ELECTRIC LIGHTING OF THE S.S. "OREGON."

On page 332 will be found illustrations of the electric light plant recited by the Edison Company on the s.s. Oregon, the new ship of the Guion line, which has been built to out-run the famous Alaska. The machinery consists of ten Edison-Hopkinson dynamos, constructed by Messrs. Mather and Platt, of Salford, each of them capable of maintaining 800 incandescence lamps, or a little more than the total number (600) included in the installation, which is the largest yet erected on board ship. They are intended to run at 600 revolutions per minute and generate a current with an electromotive force of 110 volts. The two machines are erected face to face, and each is provided with a separate engine, so that the whole of the generating plant is in duplicate, affording a guarantee against stoppages from breakdown. The engine power is transmitted through belts which run under tightening pulleys carried in slides along which they can be moved by screws as the straps become slack.

The engines are of Messrs. Mather and Platt's compound diagonal type, with cylinders 8½ in. and 14 in. in diameter respectively, and are fitted with Arnold, Ten and Sinn's governors and valve gear. The slide valve consists of two pistons without rings, connected together by a hollow cylinder. Each piston serves as a short cylinder open at one end to the steam chest, and at the other to the exhaust pipe, and having at its centre a port leading to the end of the main slide cylinder. Each of the pistons of the valve has a port formed in it, in connexion with the hollow cylinder, and consequently, with each other, and these are so arranged that when the edge of the piston moves over the edge of a cylinder port to admit steam, a second supply of steam enters through a port in the opposite piston valve, passes through the connecting cylinder, and through the other valve port into the cylinder port. By this means steam is taken very nearly to the end of the movement of the stroke, and there is no dead centre. The automatic cut-off is effected by a governor mounted on the crankshaft, and acting directly on the eccentric. The engines run at 300 revolutions per minute.

ELECTRIC LIGHTING NOTES.

The Electric Lighting Contract and Maintenance Company, (in liquidation) held its final meeting on October 1. There have been two dividends paid to the shareholders, leaving a balance in hand of £1,000. It turned the whole of the subscribed capital, from £4 per cent., and backing to the quoted prices of many of the electrical companies' shares there seems little doubt that the shareholders must in consequence experience a feeling of gratitude towards their directors. The company was floated with the avowed object of furnishing electricity in the same way that gas companies distribute gas, and for many months it spared no pains in seeking for contracts or for a suitable site for the establishment of a central station, but after it became apparent that there was no remunerative field for this kind of business the directors advised voluntary winding-up. Of course they received numerous offers of the sale of patents, but under the advice of their engineer they wisely refused them all, and consequently their assets have returned nineteen shillings in the pound, which is probably more than they would have done if they had imbibed any grants of patent rights for electric lamps or dynamos.

The Edison electric light has been installed on board the fine new passenger steamer Paterna, built and engined by Messrs. A. and J. Inglis, Glasgow, for the Tasmanian Steam Navigation Company, of Hobart Town. The construction of the vessel was carried out under the supervision of Mr. H. R. Bellamy, who placed the electric lighting under the direction of Professor Jamieson, F.R.S.E., of the College of Science, Glasgow, who drew up the specifications and inspected and tested the work. The steam dynamo, of 3 type, is driven by a patent Westinghouse engine made by Messrs. Alley and M'Lellan, engineers, Glasgow. The peculiarity of this engine is that there are two single-acting inverted cylinders with steam and coupled direct to the connecting rods of the whole of the working parts below the cylinder bottoms, placed in an oil-tight tank with a very complete and perfect system of lubrication. The strokes is extremely short, the engine occupies very little space, and runs with great steadiness, freedom, and economy of steam at from 300 to 700 revolutions per minute, a speed which for several reasons, is as high as is advisable to employ for dynamos on board ship. The engine shaft is extended and connected direct to the dynamo spindles, thus doing away with all friction gearing or belting. The total space occupied by the engine and dynamo measures 7 ft. 6 in. from fore and aft by 3 ft. 6 in. athwart, and 4 ft. 6 in. high; they are placed on the same floor as the main engines so as to be under the supervision of the engine-room watch. The switches regulating the various circuits of the ship, such as saloon, cabins, engine-room, &c., are all placed close to the dynamo in a handy position. The main conductors are strands of seven No. 16 copper wire, made by the India-Rubber and Gutta Percha Company, and have telegraph insulation equal to 100 megohms per 1000 yards at 60 deg. Fahr. The leads throughout the whole ship have been kept apart by grooved wooden scantlings. There are 160 lamps in all; those on the saloon are hung independently from the sides of main oil lamp pendant chandeliers, 12 round-glass globes are employed, and the metal work is of artistic design. There are several other installations of the kind in progress in Glasgow.

Engineering, April, 1882.

STEAM ENGINES AND THE ELECTRIC LIGHT.

Answer the numerous side issues more or less connected with the successful introduction of electric lighting on a large scale, there is one which has not yet, we think, met with the attention it merits, although its importance is beginning to be felt by those actively engaged in the establishment of electric lighting installations. We allude to the provision of the motive power required. During the past year or so numerous companies have been formed for the purpose of introducing this or that system of electric illumination, and there have been subscribed large amounts of capital, portions of which it has been proposed to expend in laying down plant for the construction of dynamo-machines, lamps, &c. It appears, however, to have been very generally assumed that whatever the extent to which the introduction of the electric light developed, there would be no difficulty in obtaining the necessary motors, or in other words, it seems to have been taken for granted that our steam engine builders would at once be able to increase their output to meet any increased demand. That electric lighting tended to spread as rapidly as some of the sanguine promoters wished the public to believe, we venture to say, that before now matters would have been brought to a dead lock by the sheer impossibility of fitting up the power stations, while even as it is the introduction of electric lighting has had a very important effect on the market for stationary engines.

It is to be borne in mind that engines for driving electric light machinery have to satisfy special conditions. To give satisfaction they must possess sufficient power so as to obtain the greatest possible uniformity of speed under greatly varying loads, they must be capable of running a large number of consecutive hours without stopping for refitting, &c., and they must be economical steam users. Now while we have in this country a very large number of steam engine builders, the number of firms whose plants fulfil the above conditions is comparatively limited, and they are, moreover, most of them makers whose ordinary business consists in doing their manufacturing plant pretty fully employed. It is not surprising therefore that the demand of an entirely new source of demand like that which has now sprung up should have a material effect on the higher class of steam engine makers, and that if should at the present time be difficult to procure engines thoroughly suitable for electric lighting for any thing like prompt delivery.

So far most of the electric light installations which have been carried out have been on a very modest scale, but comparatively few necessitating the provision of 100 horse-power, and the majority of them being considerably less. If, however, the electric light is to take in the future anything like the position which there is at present every reason for supposing it will occupy, matters will be very different, engines developing many thousands of horse-powers will be required in our large towns. A few general figures may suffice to show more clearly how the matter stands.

We have not at command particulars of the total gas production in London during the past year, but in 1880 it reached about 1,700,000,000 cubic feet, and judging from the rate of increase in late years, the natural growth of the population, and the demands for improved lighting, it will certainly not be less than the round figure of 2,000,000,000 of cubic feet annually. The rate at which the consumption goes on naturally varies greatly at different periods of the day and of the year, but we shall probably be erring on the side of liberality if we assume that the hourly consumption frequently reaches one two-thousandth of the annual consumption, or say 10,000,000 cubic feet per hour. But one million cubic feet per hour will supply 200,000 of Edison's flat flame burners, giving a light equal to fifteen hundred candles each, while in ordinary practice this quantity of gas is probably on the average distributed between a considerably larger number of burners of less illuminating power. Let us, however, suppose that 200,000 burners are replaced by say 200,000 incandescent lights, and let us further assume that it is possible to supply the necessary current to eight of these lights for each horse power developed—a favourable assumption—then it will be seen that there would be required no less than 25,000 horse power to drive the incandescent lights necessary to replace but about one-tenth of the gas consumption in the metropolitan district. Of course, if an effective system of storage batteries can be employed the maximum horse power required at any one time would be reduced, but, on the other hand, the above estimate includes no allowance for the spare engines which must necessarily form part of a permanent electric lighting establishment. To replace about ten per cent. of the present gas lights in London alone by incandescent electric lights, would thus involve the expenditure on engines and boilers of about a quarter of a million sterling, and when it is considered how comparatively few are the firms by whom the necessary high class engines of large power can at present be turned out, it will be seen that the introduction of the electric light on a very large scale must necessarily take place very gradually even from this cause alone.

We have above stated some of the requirements of engines for driving electric light machinery, and we may point out here that the ultimate design which it will be found best to adopt for such engines will be materially affected by the question of whether or not storage batteries can be successfully employed on a large scale. If they can, the steam engines of electric light stations will be brought into the same category as pumping engines; it will be possible to keep them continuously at work, and except perhaps in a few districts where fuel is exceptionally cheap—it will be desirable to adopt very refined means for economy of fuel. On the other hand if storage batteries are not employed it will be necessary that the engines will be employed for but a very few hours daily, and the designer will be obliged to adopt types of engine even at the expense of a greater consumption of fuel. Altogether the introduction of the electric light promises to have an important effect on the development of our production of stationary steam engines; the influence has already strongly felt by the makers of engines of the smaller powers, and it will probably not be very long before the manufacturers of engines of the larger sizes are called upon to meet the demands which will be made upon them.

Nov. 24, 1882.

ENGINEERING.

ELECTRIC LIGHTING NOTES.

It will be remembered that a short time since the Streets Committee of the City Commissioners of Sewers gave instructions that the opinion of some leading electrician should be obtained on the practicability of laying in the main tubes, the conductors of various companies for lighting by different systems without any interference with each other, and whether the conductors of one system would be available for those of another system. The committee requested Mr. H. Preece to report on the subject, and at a special meeting of the commissioners, held yesterday, the report was laid upon the table. Mr. Preece gave it as his opinion that it would be practicable to lay conductors of different systems in the same tube, unless it was in a subway of considerable size. Considerable space of conductors laid for one system, by a contractor to one leading another system, Mr. Preece says in his report that the proper arrangement of wires for an electric light system is a very complicated matter, and that this whole question of electric lighting is entirely in a tentative condition. Mr. Preece considers that the corporations who have undertaken themselves to supply electricity have assumed a responsibility the extent of which they are ignorant, and which they will find it very difficult to discharge. After the report was read at the meeting, Mr. J. V. Moore moved the resolution: "That the Remembrancer be instructed to take all necessary steps to enable the Commission to become the undertakers for the supply of electricity to the City under the provisions of the Electric Lighting Act of 1882, and to obtain a provisional order under the regulations laid down by the Board of Trade, and on the opposes the applications of all other parties." To this resolution the following amendment was proposed: "That while the Commission is in favour of electric lighting in the streets, they are not prepared to enter further experiments to be conducted at the risk of the lighting companies, and not at the expense of the ratepayers." After a long discussion the amendment was carried as an actual resolution by 22 votes to 21.

The electric light is, we understand, to displace the old oil arc burners in the theatre of the Hospital Institution, Albemarle-street, during the forthcoming Christmas and Friday evening lectures. The Swan lamp is now fastened along the gallery front, being strung between the brackets which are representing a species of "Swan with two necks." Other lamps are fixed in the centre roof, their light being directed, by means of a parabolic reflector, straight upon the stage, upon the audience. The arrangement and details have been carried out by Messrs. Woodhouse, Rawson, & Co., of Leicester-square. It has been found that 40 incandescent lamps thus disposed, light the theatre to the extent of 100 candle jets hitherto employed.

On Tuesday of last week a special meeting of the Town Council of Edinburgh was held for the purpose of considering a report by the Lord Provost and Magistrates recommending the council to apply for a provisional order under the Electric Lighting Act, 1882, in the course of some remarks introducing the business, the Lord Provost said that a good deal of influence has been brought to bear upon him, and he had had different companies had intimated their intention to apply to the Board of Trade for powers to supply the electric light for the streets and private houses. Intimations had been given that the authority of the council should be refused to the applicants, and the further consideration of the subject has been remitted to the Lord Provost's Committee; and the result of the deliberations of that body was that the council should be recommended to resolve on asking the Board of Trade for a provisional order enabling them to supply electricity within the Parliamentary boundary of the burgh, for public and private purposes, as provided for in the Electric Lighting Act. The Lord Provost moved in terms of the Committee's report. Bailie Stallan, and Bailie Hall seconded the motion. Councillor Cowan, in doing so, said he would remark that if they had any intention of granting companies in making their applications for the express result could be got for something like 8d., exclusive of the lighting of lamps and battery notices. In the Edinburgh Police Act, 1879, they had power to light the city by any means they thought proper, by gas or by any other method; and it had been thought by the Lord Provost's Committee that if they got a provisional order for adopting the electric light at any time they thought proper, they should have the whole lighting of the city at their command; and instead of the profits going to a speculative company, they would go into the pockets of the ratepayers. Other towns, such as Manchester, had made large sums out of lighting by gas, and he thought that such a considerable should be an inducement for their adopting the motion. The next speaker seemed somewhat surprised at the council making application for a provisional order if their Police Act gave them the power mentioned by Bailie Hall. While expressing approval of the motion, Dr. Rossell said he looked upon the Electric Lighting Act as one of the most mischievous Acts that had been passed for a long time. They were driven into applying for an order, not because the citizens were of opinion that the time had come for them to adopt electric lighting, but simply to save themselves from a monopoly. They were told that they were asked because they were not allowed to dig up their own streets and their own lighting! If there was any intention of a corporation that was thicker than another, it was surely the lighting of the town; but here they had a department of the Government put in control of their lighting. After some further remarks in the same strain, he expressed his belief that under their own Act they had the right to light the town with electricity or any other means that might seem good to them, and he only assented to the proposal on the distinct understanding that it was a bidding form. He urged that when the committee further considered the matter, they would not themselves into communication with the corporations of other large cities with a view to some joint scheme being struck out for resisting this encroachment on their rights and privileges in the management of their own affairs. Several other speakers indulged in some rather strong language in reference to the Electric Lighting Act, and the motion was agreed to, Councillor Cowan alone dissenting. The Lord Provost, by way of calming the growing excitement, remarked that they would have now to say that if the question could have been postponed for some time, because perhaps it was scarcely a practical question yet; it was still very much in the hands of scientific men, but they hands had now freed by the companies applying for licenses. One of the most important questions was a set of ordinances ready to put their claws into them, to seize the city and make profit out of it. He also remarked that electricity was still in its swaddling clothes, and that it only realised a light for their feast on the benefit of the experience gained elsewhere, and would be able to adopt it in the best possible way. After the foregoing was written the sub-committee entrusted with the matter met, and a draft application order was have done so, and instructions have been given to have it presented next Saturday (25th inst.).

Edinburgh has already had some experience with the electric light in the street lighting case, but the experiment was so unsatisfactory and so costly that the municipal authorities have not any predisposition in favour of the new light. For a considerable portion of the Princes-street half of Waverley Street and the North Bridge were in the hands of the "Brush" Electric Light Company, at the expense of the Corporation, and there were various explanations at the time as to the cause of the failure of the unsatisfactory results. There is no need to repeat them now. The lighting experiment was carried out on a somewhat large scale, there being a sort of desire to show the electric light and put them to supply gas on more liberal terms. Almost the only result to the Corporation as payments, is a larger gas bill this year, but combined with a better system of street lighting by the liberal use of "Argo" gas lamps in a number of the leading thoroughfares. Some years ago the Corporation of Edinburgh, on the recommendation of the Town Council, let down the gas supply undertaking of the city, but that desire is now scarcely often referred to, and it may be incidentally mentioned that the Waverley Station of the North British Railway Company has for many months been, and still is, lighted by electricity—apparently to the satisfaction of the company and the public.

The municipal authorities of Paisley and Hamilton, in both of which burghs the gas supply is in the hands

of the corporations, have issued statutory notices announcing the intention of those bodies to apply for provisional orders under the Electric Lighting Act to supply electricity for public and private purposes.

Letters have been sent by Mr. David Forsyth, the town-clerk of Elgin, to the town-clerks of a number of burghs throughout Scotland, urging the desirability of a joint representation being made to the Board of Trade in favour of delay being granted to them in the operation of the compulsory clauses of the Electric Lighting Act; and it seems that a meeting of representatives of certain corporations has been held in Edinburgh with the view of asking that they should be allowed to take the Act under permissive conditions, subject to the stipulation that a certain part of the community (including the corporations) should have in their adoption of the electric light, thereafter, to them the right of appeal to the Board of Trade. It is anticipated that another meeting of the Corporation representatives will be held prior to the 21st proximo (the last day for lodging formal notice of provisional order applications), for the purpose of considering what ulterior steps should be taken.

The town-clerk of Stranraer has been in correspondence with the town-clerk of Chesterfield in reference to the advantages of electric lighting, so far as experience has been obtained in that town, and the letter sent to him by Mr. Dods (town-clerk, Chesterfield) says: "The majority of the Corporation of Chesterfield are satisfied with the lighting of the town by electricity on the ground of efficiency and economy. We have twenty-two Brush arc lights and one hundred and fifty incandescent lamps at a cost, for the present year, of 3600 in place of 700 gas-lamps costing 900l. per annum. The streets are thoroughly well lighted. It is well to have accurate and positive statements as to cost, efficiency, &c., and I shall be borne out in general electric lighting practice or not. At present, such a statement is not to hand, as the Chesterfield electric lighting experiment has not been previously published.

At a meeting of the Police Commissioners of Stirling, held on Monday, the Lighting Committee recommended that the Commission should not apply for a licence or provisional order to supply electricity within the burgh under the Electric Lighting Act. In moving the adoption of the recommendation, Provost Yellowlees said that it would not be proper to ask the Board of Trade for powers which they never intended to use. Even supposing the new light turned out to be a success, he reminded them that no company had power to run in existence for a longer period than twenty-one years, and that at the end of that time they were required, if desired by the local authority, to give up all their appliances, &c. The committee were, besides, following the example of the Birmingham Town Council, who, after coming to a resolution, had made a very full investigation into the matter. The recommendation was agreed to.

The experimental lighting of Commercial-street, Dundee, by the Scottish Brush Electric Light Company, was commenced on the evening of Wednesday, the 15th inst. Five arc lamps of 2000-candle power each were used, and the current was generated by means of a Robey engine. The lamps, erected on poles about 25 ft. high, were placed about one hundred yards apart, so that they extended over a total distance of nearly a quarter of a mile. This is the first experiment in electrical street lighting in Dundee, and it is to be continued every evening for a month, commencing at about half-past four o'clock and continuing till eleven o'clock each evening.

In our last issue we gave some of the results of a special testing committee of the electric arc lights at the Paris Electrical Exhibition of last year. The same committee have also tested the electric candles exhibited there, and we are now able to give a summary of their report. The candles tested were those of Jablochkoff, Debrun, and Jamin. The Debrun machine is a dynamo, made for eight Jablochkoff candles, but having the same on the same axis. It was employed to feed seven Debrun candles; but for this only one of the two currents was utilised. The results do not therefore truly indicate the efficiency of this machine. The action was irregular, and the electrometres force varied from 40 to 60 volts. The Debrun candles burn downwards, and photometric tests gave about 21 carcels as the horizontal intensity of their light. Twenty Jablochkoff candles were fed by a Gramme machine, giving alternating currents and divided into four circuits, each bearing five candles. The measurements of work done were very variable. For the complete machine and twenty candles the

Total work expended in horse power (French) was 15.22
Single transmission 2.35
Effective motive work for twenty candles ... 12.87
" " " sixteen candles ... 11.36
Mechanical effect in open circuit 1.78
Lighting machine with one circuit and twenty candles machines with closed circuit; the work of transmission being deducted 3.06
Work expended by the single exciting machine 1.78

The photometric determinations were very numerous and concordant, and were made at a right angle, including 45 deg. on either side of the horizon. Twenty-five Jablochkoff candles were also fed by a De Meritens of five discs, having sixteen bobbins connected in tension, and feeding five circuits of five candles each. The Jamin machine fed 32, 48, and 60 Jamin candles. It is a self-exciting Gramme with four rings thus tinsel, and giving a quieter note. The candles were arranged in four distinct circuits. The photometric tests were only taken along a horizontal line. The annexed Table shows the detailed results obtained.

La Lumière Electrique states that the works of M. Lazare Weiller, of Angoulême, comprising foundries, rolling mills and wire-drawing establishment, have recently been completely lighted by electricity. The principal shops are lighted by 6 Gramme lamps, and the engine-room, offices and laboratory by Swan lamps; the current is supplied from two Gramme machines.

An electric lighthouse is going to be erected in New York Harbour. In accordance with the recommendation of the committee of experts charged with the selection of a site for a light tower three miles off will be built at Hallet's Point, Hell Gate, Congress having voted a sum of 75,000 dols. for the purpose. The height of the tower will be 250 ft., and the light will be about 20,000 candles.

At Buenos Ayres the inspector of public lighting who had been instructed by the municipality to prepare a report on the various trials of electric lighting that have been made in various parts of the town, has recommended the adoption of the Brush system.

TABLE OF THE TESTS OF ELECTRIC CANDLES AT PARIS, 1881.

Remarks.	Formulæ.	Debrun.	Jablochkoff.		Jamin.		
			With Gramme Machine.	With De Meritens Machine.			
		7 Candles.	20 Candles.	25 Candles.	32 Candles.	48 Candles.	60 Candles.
Mechanical Observations.							
Speed of machine, turns per minute		2227	1264	464	2120	2300	2140
Total motive power	V (volts.)	13.43	10.60	4.05	10.00	13.00	11.00
Work with open circuit	V		1.78	2.03	1.52	1.52	1.52
Electric Observations.							
Resistance of the portion of the conductor between the circuit	r ohms	...	0.31	...	0.50	0.50	0.50
" " other	R	...	1.10	1.00	11.1	10.7	12.7
Intensity of the inducing current	C amperes	...	11.3	4.05	12.3	12.1	12.5
" " current exciting the light		...	13.7	...	25	48	60
Difference of potential at the lamps	E volts	10.0	7.3	2.4	4.1	3.1	2.3
		40.0	42	42	77	60	74
Electrical Calculations.							
Work of exciting the lighting machine	$\frac{rC^2}{E}$	...	90	...	32	32	32
" the first circuit	$\frac{RC^2}{E}$	...	27.54	28.78	48.2	33.7	15.9	
" other circuits	$\frac{nC^2R}{P}$	...	61.70	114.77	130.9	95.5	43.1
Observed work of the arc in kilogrammetres (1 kilogrammetre = 7.23 foot-pounds)		69.0	82.3	32.4	47.0	33.7	15.3
Calculated work of the arc	$\frac{EA}{I}$	...	92.0	36.4	47.0	35.0	25.4
Mean work of the arc	$\frac{E}{I}$	...	87.7	34.4	47.0	34.3	20.3
Work of the arc in horse power	$I = \frac{9.8}{75}$	0.07	0.76	11.47	20.27	22.01	20.64
Total electric work	W	...	11.15	13.0	23.09	15.61	11.83
Photometric Observations.							
Luminous intensity on horizontal line ...	Carcels	21.0	27.7	22.2	32.0	23.3	15.2
Luminous intensity, mean spherical ...	$I = \frac{1}{4}$	16.8	22.2	17.8	25.6	18.6	12.2
Total intensity, mean spherical	$L = 4\pi I$	211	280	225	322	234	153
Efficiencies.							
Total mechanical efficiency	$\frac{W}{T}$	...	0.87	0.32	0.92	0.66	0.65
Mechanical efficiency of arcs	$\frac{V}{T}$	0.44	0.68	0.67	0.76	0.69	0.62
Electric " " "	$\frac{VI}{W}$	...	0.78	0.87	0.83	0.92	0.94
Carcels per horse power	$\frac{L}{75}$	12.0	21.3	24.5	19.7	23.0	21.5
" electric horse power	$\frac{VI}{75}$	...	20.2	45.6	22.2	34.1	25.8
" horse power	$\frac{T}{75}$	25.6	46.3	51.6	31.3	51.5	32.3
" candles	$\frac{L}{T}$	3.71	5.60	5.79	5.02	5.41	5.03

It will be seen from this Table that the tests are in favour of the Jamin system.

Engineering, 14 July 1882

ELECTRIC LIGHTING IN THE CITY.

A REPORT to the Streets Committee of the Sewers Commissioners has recently been presented by Mr. William Haywood upon the prolonged experiment of street-electric lighting, which was commenced in April, 1881. This experiment was undertaken on the action of the Streets Committee, who were requested in March, 1880, to consider and report upon the adoption of an improved mode of lighting the City streets. This Committee considered it advisable that a trial should be given to the electric light, and in this view they were sustained by the Bridge House Estates Committee, who were also desirous of trying the experiment. These two bodies co-operating, decided upon lighting certain of the thoroughfares, including London, Southwark, and Blackfriars bridges, and it was arranged that while the Sewers Commissioners should undertake the management of the trial, the Bridge House Estates' Committee should pay the cost of lighting the bridges above mentioned. Acting upon this determination, tenders were applied for in the autumn of 1880, and were received from six different contractors. The area to be lighted was divided into three groups, and the tenders of three contractors were accepted. The main conditions of the experiment were, that it should extend over twelve months; that the lighting should continue each day from sunset to sunrise, and that no gas should be used, except as a substitute during the period of trial. The first district included a length of streets of 1648 yards, and an area of 98,887 square yards. It comprised Blackfriars Bridge; New Bridge-street; Ludgate-circus; Ludgate-hill; the north side of St. Paul's Churchyard; and Cheapside from its western end to King-street.

The second district, 1703 yards in street length and 87,264 square yards, comprised Southwark Bridge; Queen Victoria-street; Queen-street, Bowwark, to Victoria-street and Upper Thames-street; and Queen-street-place.

The third district, 1621 yards in length and 93,381 square yards in area, included London Bridge; Queen-street, between Queen Victoria-street and Cheapside; Cheapside, between King-street and the Poultry; King-street, Guildhall; and the Poultry; Mansion House-street; the open space in front of the Royal Exchange; King William-street, and Adelaide-place.

On August 1, 1880, the lighting of these three districts was allotted as follows: To the Anglo-American (Brush) Company, District No. 1, at a cost of 1410*l.*; to the Electric and Magnetic Company (Siebckhoff system), District No. 2, for 2920*l.*; to Messrs. Siemens Brothers, District No. 3, for 3720*l.* The second named company failed to carry out their contract, which was easily filled by Electric Light and Power Company, subject to much delay occurred before this company could begin the work that the twelve months of trial will not be completed before April next, so that the present report deals almost exclusively with Districts Nos. 1 and 3. Dividing the amount of each tender into per-manent works and cost of lighting, the three accepted tenders stood as follows:

	Per Weeks.	Per Lighting.	Total.
	£	£	£
District No. 1, Brush and No. 2, Electric Light and Power Company	720	690	1410
District No. 3, Siemens	1470	1450	2920
	1650	2270	3720
	3870	4290	8000

The quantity of light given for each district did not vary in anything like the proportion of the cost, as will be seen from the accompanying Table:

	Number of Lamps.	Nominal Candle Power per Lamp.	Total Nominal Power.
District No. 1	33	1000	33,000
,, No. 2	22	1000	22,000
,, No. 3	6 of large	2000	12,000
	126 small	300	37,800
	99		103,800

These lights replaced 166, 157, and 129 gas lamps respectively, each giving 14 candles, and represented a total illuminating power of 6328 candles, so that the electric light was about 16.3 times greater, while the total cost for gas during the year would have been 2026*l.*, as compared with the 1410*l.* for the electric light; rather more than twice the cost of gas for sixteen times the quantity of light. In making this comparison, however, it is only fair to point out the great difference in the prices charged by the various contractors; thus for the three districts, the relative cost of gas and electricity stood as follows:

	Cost of Gas.	Cost of Electric Light.
	£	£
District No. 1, Brush	690	690
,, 2, Lontin	390	1560
,, 3, Siemens	612	2772

The Brush lamps gave approximately 15 times as much light as the standard gas lamps; Lontin gave 14½ times, and Siemens 89 times as much light. The area thus illuminated was in all 1,090,410 square yards, or 1015 square yards on an average for each of the 99 lamps; the former lighted by gas averaged 929 square yards per lamp. It is not necessary to describe here the different modes by which each company carried out its work, for this we refer the reader to Engineering, vol. xxxi., page 335. But we may mention that the Brush Company and the Electric Light and Power Generator Company were very favourably situated, inasmuch as they were enabled to feed the lamps from their factories, while Messrs. Siemens were obliged to establish a special power station. Considering that each of the contending companies furnished nearly the same quantity of light, it is not easy to understand the wide difference that existed in the prices charged. The most interesting part of Mr. Haywood's report is that referring to the defects observed during the year. For the reason above stated, only Districts Nos. 1 and 3—Brush and Siemens—are reported on, the results in district No. 2 being incomplete. In District No. 1 there were 33 lamps in operation, each burning, on an average, 3030 hours, or 141,900 hours in all. There was a total of 620 failures reported, the aggregate resting, time of the light having equalled 3142 hours of a single lamp, or 2.21 per cent. of the entire year's lighting. In District No. 3 (Siemens) there were 81 lamps burning for a total of 140,800 hours during the year. In this district the total number of failures was 930, equal to an aggregate of 837 lamp-hours, or .57 per cent. of the total lighting.

On analysing these stoppages we shall find that considerable deductions must be made from each, before estimating the practical value of the systems for street lighting. The Brush lamps were started on the 25th of April, and on the 2nd of May it was found that the insulation of the main conductor was defective, and a new cable had to be substituted; this caused a delay of, seventeen days, on nine of which the system was not in operation, and a total loss of 2650 lamp-hours occurred. In the third district also, five days after starting, the [illegible] was damaged by [illegible] under London Bridge, and a total of 340 hours were lost in the illumination. It is clear, that the extinction from these causes have to be eliminated, as they were due to no defect in the systems, but to imperfect installation. These was, therefore, during the year, apart from these accidents, a loss of 612 hours in the Brush district, and of 372 in the Siemens, showing a slight advantage to the latter system, though for all practical purposes both were identical. It will be interesting to classify roughly the reported causes and extent of these interruptions:

	Brush. Hours.	Siemens. Hours.
Accidents to driving machinery through sudden	200.20	18.0
Defective	23	6.0
... ... or dirty lamps ...	6.10	214.0
Carelessness of attendants ...	110.0	144.0
Broken lamp-posts	163.0	6.0
Carbons burnt out	18.40	5.0
Short circuiting	9.0	7.20

The number of lamps affected by the delays as explained by the companies are as follows, exclusive of the accidents to conductors already referred to:

	Brush. Hours.	Siemens. Hours.
Defective machinery	24	122
,, carbons	24	121
Miscellaneous	24	7

The most striking feature in the above statement is the difference in the delays to the two systems caused by the carbons. In the Brush only 24 instances were recorded, involving a little more than six hours' delay on the year, which is practically nothing. On the other hand, the Siemens lamps were interfered with 104 times, and for 214 lamp-hours, or more than 30 days as much as the Brush. This is simply a question of detail, and proves what has always been claimed for the Brush system—the excellence of its carbons. It proves also that so far as carbons are concerned there is no difficulty in the solution of the problem of efficient street-lighting by electricity. On the whole, the total delays arising from breakdown of machinery, motors, or generators, only 128 hours' delay occurred in the Siemens system as compared with 209 in the Brush, and it is evident that while accidents are unavoidable, if proper precaution be taken in duplicating machinery, the delays arising from this cause can be reduced to such an extent as to be practically inappreciable. Still more striking is the difference in the trouble caused by carelessness, for while only the last 92 hours from this cause, Siemens lost no time at all. Of one of the systems, the broken lamp-posts, which resulted in 163 hours' delay in No. 1 district, it is clear that this cannot be charged to the unavoidable contingencies, although it must be borne in mind that the extinction of an electric lamp is a far more important matter than that of a gas lamp with regard to the streets.

It will be seen we think that the comparison made between the two systems after this extended trial is very satisfactory, because it proves that the chief proportion of the causes of extinction are easily to be avoided, excepting perhaps as regards the lamp mechanism which will probably be simplified as time goes on. It will be noticed that the delays from this cause were nearly equal in both systems, but while the majority in the Brush arose from defective mechanism, nearly all the Siemens are reported as "Lamps required cleaning."

It may be mentioned as an interesting fact that the total number of gas lamps in the city of London is 2326, and the number of lamps defective lights noticed during 1881 was 2505, a very large proportion, but which is neither so noticeable nor so important as a much smaller amount of defectiveness in the electric lights, on account, as above mentioned, of their greater power and more equable [illegible]

Concluding remarks was managed by Siemens [illegible] under London Bridge, and a total of 340 hours were lost in the illumination. It is clear, that the extinction from these causes have to be eliminated, as they were due to no defect in the systems, but to imperfect installation. There was, therefore, during the year, apart from these accidents, a loss of 612 hours in the Brush district, and of 372 in the Siemens, showing a slight advantage to the latter system, though for all practical purposes both were identical. It will be interesting to classify roughly the reported causes and extent of these interruptions:

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In a report of the Streets Committee to the Commissioners of Sewers, some detailed information is [illegible] on a proposed project to extend the experiment of electric lighting in the streets to four districts, one of which is the District No. 3 of last year. Eight tenders for this work were submitted, with the following general result:

	Tenders ranged from	Cost of Gas.
District No. 1	2190 to 6750	510
,, ,, 2	2250 to 6700	360
,, ,, 3	2470 to 5000	241
,, ,, 4	2000 to 4350	312

Some of the contractors coupled with their tender the request to be allowed to light private premises within the districts, and in one case the company offered to make the charge for lighting (not including installation) 20 per cent. more than the cost of the gas saved. None of the proposals made were of such a character as to justify the Streets Committee in recommending an extension of the experiment, particularly as by the Bill now before Parliament, and the amendments suggested by the Board of Trade, it is proposed to give power to local authorities to supply electricity not only for public but for private use; until this important question has been settled, the Committee deem it unwise to incur further expense in the matter.

It has been decided, however, to continue the lighting of District No. 3 for another year, the Anglo-American (Brush) Company having undertaken the work for 800*l.* An offer made to Messrs. Siemens to continue the lighting of District No. 3 for twelve months further, for which they asked 2400*l.*) was considered too high, and the Commissioners have returned to gas in this district. We should mention in conclusion that Mr. Haywood speaks very favourably of the Holborn Viaduct lighting on the Holborn Viaduct, and promises a special report on this installation, as well as on the District No. 3, which is being lighted with Weston lamps by the Electric Light and Power Generator Company.

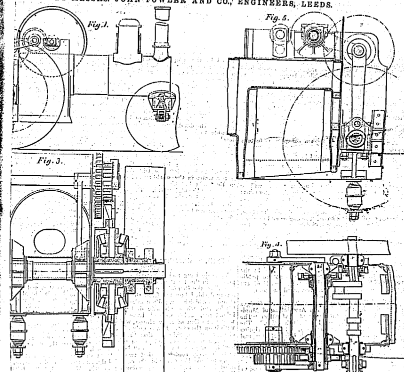
Engineering, July 6, 1883.

On Friday evening last, by permission of the First Commissioner of Works, the Swan United Electric Light Company gave a reception at the Royal Courts of Justice, to show the efficiency and success of their installation there, which consists of 625 incandescence lamps and six Crompton arc lamps of the kind illustrated in ENGINEERING, vol. xxxv., page 246. There are from 22 to 24 Swan lamps arranged in each of the 20 courts, and the remainder are distributed through the cloisters, staircases, robing rooms, &c. Each court and its anterooms is on a separate circuit, and the whole of the circuits on each side of the building converge to a switch board, where they can be turned on and off as desired. The generating machinery is temporarily situated in an iron building on the west side of the courts. It is not decided whether the machinery will remain in this position or whether it will be transferred to the crypt under the Great Hall. If kept at or near its present position it is intended to sink it below the surface of the ground and arch it over. The plant consists of a semi-portable compound engine by Messrs. Marshall and Co., and eight Crompton-Burgin dynamos. Six of these latter are compound wound and deliver their current into the main leads that connected the engine-room to the switch boards in the vaults of the main building. The generators will not feed the whole of the lamps at the same time, and they are supplemented by 80 two horse-power Faure-Sellon-Volckmar accumulators, which are charged during the daytime. These, when fully charged, are sufficient to light six of the courts for eight hours. The result of thus dividing the machinery has been that there has not been the slightest interruption of the light due to any failure or breakdown since the installation was put in operation at the opening ceremony on December 10. It is estimated that the cost of maintenance will not exceed 25s. per hour, whereas the cost of lighting by gas would have been upwards of 2*l*. We believe that the Judges and the Bar have uniformly expressed themselves extremely satisfied with the result of the lighting.

The Marquis of Salisbury has recently applied the electric light to the reception rooms in his house in Arlington-street. The marble staircase is lighted by fifty-one Swan lamps arranged on a dark bronze chandelier, and leads into a corridor in which the lamps are hung from gilt crowns under a vaulted roof. In the first reception room there is a magnificent chandelier in dead gold, carrying 104 lights, and in the second, or Pompeian room, there is a similar fitting with 99 lamps. Formerly wax candles were used, and the sockets in which they were held have been removed and replaced by incandescence lamp-holders, the greatest care being taken to hide all the connexions. As the branches were not hollow it was necessary to carry the conductors outside them, but they have been carefully bent to follow the same lines of curvature, and have been overspun with silk of the same colour as the metal, bright or dead gold or bronze, so that very close scrutiny is needed to detect their presence. The globes of the lamps are slightly frosted, but beyond this they are entirely without shades of any kind, and appear all the better for the omission. The brightness of the illumination increases gradually from room to room so that the visitor is naturally led to proceed forwards towards the more ornate apartments, which are the most vividly lighted. The current is generated by a compound wound Siemens' dynamo, situated in an outbuilding and driven by an Otto gas engine of 16 nominal horse-power, which is being driven to nearly $2\frac{1}{2}$ times that amount. Very careful arrangements have been made to secure steady motion; there are two exceedingly heavy flywheels on the engine, a second on the crankshaft, and a third of unusual size on the flywheel, and by these means very good results have been attained. The installation, which is probably the largest and certainly the most successful of any hitherto erected in a private house, has been entirely designed and carried out by Mr. Shillito, the marquis's engineer, and reflects great credit upon his skill and artistic feeling. As many of our readers are aware, this is not Mr. Shillito's first essay in electric lighting, for he had under his charge at Hatfield Park both Brush, Gramme and Siemens generators with their respective lamps. The power is there derived from a waterwheel two miles from the house, and the current is made to do a good deal of work on the estate. As long as two years ago it was employed in pile-driving, pumping, and sawing, and now it is in contemplation to use it in dredging the ornamental waters and in driving the reaping machine. When these latter objects are accomplished we shall publish a description of the apparatus employed by Mr. Shillito, who appears to be one of the very few people who have succeeded in making a practical success of the electrical transmission of power.

EIGHT-HORSE COMPOUND TRACTION ENGINE.

UCTED BY MESSRS. JOHN FOWLER AND CO., ENGINEERS, LEEDS.



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similar direction, but always moving parallel with and at a constant distance from the centre of the second motion shaft, so that the action of the gear coupling the second and third motion shafts is not interfered with. At the same time it will be noticed that the driving axle is left free on the side opposite to that on which the driving gear is situated, so that this axle can, if necessary, yield to accommodate inequalities of the road, and the consequent variation in the deflection of the springs on the two sides of the engine.

ELECTRIC LIGHTING NOTES.

THE number of arc lamps actually in use in the United States is stated to be above 75,000.

The new Chinese ironclad Ting-Ynen is to be lit by 240 Edison lamps.

The new palace of the King of Bavaria, at Neuschwanenstein, is entirely lit by electricity, Jablockoff candles being employed outside, and Edison lamps within.

The road from Montreal to Back River (a fashionable summer resort) is about to be lighted by electricity. It is a straight line of nine miles, and the effect of the illumination is expected to be very fine.

During the stay of the Russian Emperor at Moscow, the large Kremlin Palace was every night illuminated by sixteen electric arc lamps of the Brush type, eight being employed to light the front while the remainder illuminate the extensive yards inside. In the carriage entrance were fitted sixty-five incandescence lamps of the Lane-Fox type. The imperial stables at the Kalymashny Dwon, are also lighted by ten Brush arc lamps. These installations were carried out by Mr. Kirkham, the representative of the Brush Company.

Messrs. Siemens Brothers are fitting electric light apparatus to the s.s. City of Chicago, the latest boat of the Inman Company. It is to have 214 incandescence lamps driven by two machines, one being an alternate current machine capable of supplying 200 lights, and the latter a compound wound dynamo feeding 60 lights. The latter will serve to light the engine and boiler rooms all night, the passenger and other parts of the ship in which it is desired to maintain a constant illumination during the hours of darkness. Messrs. Siemens Brothers have already equipped several vessels of the same line with great success.

A new way of making incandescence lamps has been patented by Messrs. Soward, Probert, and Boulton. They take a glass bulb with two electrodes through it at a suitable distance apart, and either solid or tubular. A carbonaceous gas is then inserted into the bulb, and the electrodes connected to a generator of high tension. Sparks pass through the gas inside the globe between the electrodes and decompose the gas, so as to build up an arch or loop of carbon between the electrodes. This bridge is the filament, and after exhausting the globe of air the lamp is ready for use. Whether the filament is sufficiently dense and fine to rival those of Swan and Edison will be evident on trial.

The hospital of Lausanne has been entirely lighted by electricity. Two turbines, each of twenty horse-power, actuate two Edison machines, going at 900 revolutions per second and giving 60 ampères in a circuit of 1.66 ohms and an E.M.F. of 100 volts. The number of lamps is about 230, of which the intensities are 4, 8, 16 or 32 candles. The current is led to the hospital from a distance of 400 metres by four conductors of two centimetres diameter. Each flat is lit by two circuits, each belonging to one machine. In case of accident to one machine there is thus no chance of total extinction of the light. During the night only one machine is kept at work. The installation also includes a reserve turbine in case of accident.

On the Continent the electric light continues to make

Engineering, July 14, 1882.

ELECTRIC LIGHTING.

Lauriston House, Dromley, the residence of Mr. Swan, is lighted throughout with electricity, and forms one of the most interesting private installations yet made. It is remarkable for its completeness, every room and closet being lighted by the current; even the coal cellars, and the gate lamps. The lights are all commanded by small switches suitably placed so that a person entering a room, say a bed-room or closet, can light it up before going and darken it on leaving again. The switches for this purpose are placed near the doors either outside or just within. Again, if a light is wanted at the bedside or the writing-desk it can be had in a moment by touching the proper switch. One of the beds has a reading lamp just over the pillows for an invalid who desires to read, and the switch is ready to his hand. The gate lamps are controlled by switches in the engine-house. The drawing-room is lighted by three very elegant chandeliers made by Formley. They are of brass work, and each holds six lamps shaded with blue glass cups. The lamps are controlled by switches, one for each chandelier, fitted into the wall. Besides this there are six wall bracket lamps with crystal reflectors behind. Each of these and in the dining-room, fashed throughout the whole house, the lamps are fitted up with great taste, and at the same time economy. In the dining-room the chandelier and brackets are by Elkington, the globes being of the new crinkled glass, which has a very pretty effect, like rough ice. The illuminants in all cases, except where naked lights are used in the cellars, are units shaded from the rays by the ground glass or crinkled globes. In the drawing-room this effect is produced by having the bulbs themselves of ground glass. The dining-room table is further lighted by two brass standard lamps which are placed on it when required and connected by wires through the tablecloth, table, and floor. These connexions are made by leaklins running through the tablecloth into the table. Moreover, a large Japanese calabash filled with roses and used as a centrepiece has several lamps hid amongst the flowers; and these are lighted up in the same way, producing a very pretty effect, the lamps resembling yellow roses. An artificial lemon-tree has its fruit lighted internally in the same way. By means of a small Thompson motor Mr. Swan also employs the current from a lamp at will to drive a sewing machine or coffee mill. Light for candles, or fire for the cigar is also obtained from the lamp's current by means of a small device invented by Mr. J. E. H. Gordon. This consists of an ebonite handle, with a disc gaunt, like a finger buff, and having in front of the disc, where the blade should be, a spiral of bare platinum wire terminating in a plug of fire-clay. When the current from a lamp is sent through this wire by means of insulated wires running through the haft, the platinum gets heated up and a light can be obtained from it. There are between sixty and seventy lights on Mr. Swan's premises, including two in the engine house. They are supplied by two Otto gas engines, each of 4 horse-power nominal, but capable of developing 6 horse-power. Each drives a Siemens continuous current dynamo of the smallest size, and thirty Peare-Selion-Volckmar accumulators are charged for an hour before the lighting begins. These accumulators serve to supply extra lamps when wanted, the two dynamos only supplying thirty lamps when running on their alone. The accumulators can be kept partially charged by a by-circuit while the machines are running. They maintain the extra lamps required on special occasions, and also yield occasional lights during day. The engines consume 76 cubic feet of gas per hour, and this expended in gas lighting would give thirty gas jets of 16 candle-power; but the electric lights are rather over 16 candles (they are 20-candle lamps) and the light is far more pure, agreeable, and healthy.

ELECTRIC LIGHTING NOTES.

During the last trip to America and back of the City of Rome, the electric light machinery supplying the lamps in the boiler and engine-room was run continuously during the whole voyage with a single stoppage of twenty minutes for inspection in New York Harbour. This is probably the longest trial of the kind, and speaks well for the endurance of the Siemens apparatus on board, and for the care of the engineers to whom it is intrusted.

The Maxim-Weston Electric Light Company have decided to abandon their City circuit pending the time when the Commissioners will be in a position to parcel out the City in large sections. The cause of this determination is stated to be the great expense of maintaining a central station to supply so few lights. These are of the firms who originally undertook to light the City of London have acknowledged that the contract price was quite inadequate to repay them their actual disbursements. The third contractors, the Brush Company, are much more favourably situated than the other two, as their lights are driven from their own works by a single machine, hence the cost for rent and attendance is extremely small. At the same time it is not to be supposed that the charge they make to the City, 600l. a year, indemnifies them.

The Criterion Theatre, Piccadilly, is to be lighted throughout with about 600 Edison incandescent lamps, the generating plant will comprise two Lumington and Sims' horizontal high speed engines, having 13 in. cylinder by 13 in. stroke, running at 275 revolutions per minute, and driving on to countershafting from which will be run four Edison-Hopkinson dynamos, each capable of sustaining 150 sixteen-candle lamps. Each engine will be capable of indicating eighty-four horse-power at 70 lb. pressure, and either engine will thus be able to take the whole load in the event of accident or repairs to the other. The wiring will be arranged on the three-wire system, under independent control by means of a specially designed regulator capable of lowering or raising the intensity of the lamps from normal candle power to nil. The contract for the work, which will be carried out by the Edison Electric

Engineering, Nov. 16, 1882.

ELECTRIC LIGHTING NOTES.

A very complete system of incandescence lighting has just been carried out on the Tasmania, the first of the magnificent steamers constructed for the Messrs. Robert Napier and Sons, Glasgow, intended for the passage and mail service between Adelaide and the Continent of Europe. The whole of the electric lighting plant required in connection with the specification and under the immediate superintendence of Professor A. Jamieson, C.E., F.R.S.E., of the Glasgow and West of Scotland Technical College, and the contract has been executed by Mr. Richard Miller, electric lighting engineer, Glasgow. There are about 1200 Swan lamps in the installation, each of 20-candle power; and the current is obtained from one or other of two Siemens dynamos, compound wound dynamos, which are capable of developing a normal, an electromotive force of 60 volts. These machines are worked by independent and separate engines. The larger of the two dynamos is capable of running 200 lights, and the other, which is kept in reserve for working the night circuit, or brought into use when the large machine is being overhauled, is powerful enough to work about 50 lamps. In laying down the leading wires the method adopted has been to carry the ship as an "earth" return, and in consequence extra precautions were taken, not only in obtaining the very best insulated electric light leading wire in the market, but also in securing the slip throughout against possible danger. The whole of Company's best insulated cables and Gutta Percha no instance are there more than 50 lamps under the control of any main switch, in order that minimum the number of lamps switched on or off; and in all cases they are placed under the control of one or other of the petty officers of the ship, or those of the steward's staff; each lamp is provided with two leads of flexible wire, and may be turned out without any regard to the other lamps in the circuit. The main cables is provided with all fuses in the usual way. These are gold-plated, and are suspended one above the main table, electric lamps are disposed in pairs on opposite sides of the oil lamps, and are fitted with Swan's latest form of lamp-holder. Wherever it has been found possible in the state rooms, the Edison switches &c., the lamps are placed in neat translucent lanterns (the shoe being flat and formed of ground glass), which are so disposed as to light two rooms. In the engine room and stokehole a special form of lantern, specially designed, consisting of a hemispherical glass case fixed to the bulkhead by means of screws, in the centre of convenient ideas for showing the working parts of the engines, the gauge glasses of the boilers &c. The engines for driving the dynamos, which have been fitted with Pickering's governor, were made by the firm of Ashworth, while the gearing requisite for distributing the necessary speed was devised by Mr. A. C. Kirk of Messrs. Napier and Sons, and made by Messrs. C. and A. Harvey, the well-known machine tool manufacturers. The dynamos are carefully insulated for the ship and engines by means of an insulated coupling and bedplate. Steam is supplied to the engines from the main boilers at a pressure of 140 lb. per square inch, which is the highest pressure yet employed on any large steamer. The engines used for the large dynamo, is capable of developing about 75 horse-power, and the other is equal to from 7 to 8 horse-power.

THE EDISON SYSTEM OF ELECTRIC ILLUMINATION.

We now come to refer to the very ingenious apparatus employed under the Edison system* for measuring and recording the quantity of electricity that has been transmitted from the central station into the electric mains for utilization in the various circuits, as well as that for indicating the quantity of current that has been used by any one consumer, and upon the indication of which the company's account against him is made out. The principle of action of both the instruments employed, depends upon the fact that the weight of metal deposited per unit of time in an electro-plating bath by electrolysis is proportioned to the quantity of electricity passing through it in the same period, or, in other words, to the strength of the current, and as the amount of this electro-deposition is equal at all points of a circuit, it follows that by placing an electrolytic cell in any part of a circuit, the amount of electricity transmitted by the cell in a given time can be determined by observing the quantity of metal deposited within the same period.

The apparatus employed in the Edison system in connexion with the service of a house is illustrated in Figs. 1 and 2 (see next page).

The house meter consists generally of two electrolytic cells so connected as to form together a shunt to the lighting current, and also so arranged that one cell is capable of transmitting a greater quantity of electricity than the other, the proportion between them, however, remaining the same. The two cells are fitted into a small cast-iron cabinet, as shown in Fig. 1, and below them is a simple automatic arrangement, to be after described, for preventing the temperature of the cells from falling below a certain degree.

In the earlier form of meters devised by Mr. Edison the cells employed were a solution of copper sulphate, the electrodes being of pure copper, but in the more recent instruments the copper solution has been replaced by a solution of zinc sulphate and electrodes of zinc, by which arrangement most objectionable currents are reduced to a minimum and many other results are insured.

Referring now to Fig. 2, V and V' are the two electrolytic cells, each of which is filled with a solution of zinc sulphate, in which is immersed a pair of amalgamated zinc plates. The two cells are precisely alike, save in the fact that the one cell is short-circuited by a shunt having one-fourth the resistance of the coil by which the other is short-circuited, the quantity of electricity passing through the former is consequently four times that which is transmitted by the other, and therefore, within a given period, the quantity of metallic zinc deposited on the receiving plate of the one cell is four times that which is deposited on that of the other. The short-circuiting shunts are shown at S, and consist of a corrugated band of German silver, of which the twelve corrugations towards the left of the figure constitute the shunt of the cell V, while the remaining four corrugations belong to the right-hand cell V'. L is an ordinary Edison incandescence lamp, at the point A, and this is effected by the bending downwards of the compound expansion bar A B, which is so constructed and adjusted as automatically to throw the lamp into circuit whenever the temperature within the instrument falls below a certain point. The radiant heat from the lamp then raises the temperature of the air within the apparatus until by the upward curling of the compound bar, the lamp is again put out of circuit; r and r' are wire, which are included in the branch circuit of the electrolytic cells, their object being to keep the resistance of the apparatus uniform under variations of temperature, for, as the resistance of the zinc solution within the cells is diminished by a rise of temperature, the quantity of electricity transmitted by it would be greater as the temperature was increased unless this increase were compensated or neutralized. To effect this a coil of copper wire is inserted in the circuit of each cell, and as the electrical resistance of copper increases with a rise of temperature, while that of the zinc solution diminishes, it is only necessary to make the length of the copper wire such that its resistance rises under an increase of temperature as much as that of its corresponding cell diminishes, in order to compensate the apparatus for variations of temperature. The method by which the various parts of the apparatus are coupled up will be understood by

* See Engineering, page 407 ante,

referring to the diagram Fig. 2, which also illustrates the position of a lamp circuit with respect to the meter.

The object of having two cells instead of one is to enable the supplying company to keep a check upon the inspectors, and also to guard against fraud on the part of dishonest consumers, for while the left-hand division of the meter is accessible to the ordinary inspectors, and in some cases to the consumers themselves, the right-hand portion is under the sole control of the company through their superior inspectors, and the readings of the two cells should always be in the same proportion to one another. Again, the object of causing the one cell to deposit slower than the other is that while the ordinary inspectors go their rounds once a month, the upper inspectors visit the meters once a quarter; the one cell is therefore depositing for four weeks between two inspections, while the other is in action for thirteen weeks before its plates are weighed again; and, by causing the three months' cell to deposit slower than the one month cell, the amount deposited in each between any two inspections is more nearly equalized.

The zinc plates are shown in detail in Fig. 4; they are 3 in. long, 1 in. wide and ¼ in. thick, fixed at a distance of .24 of an inch by fastening two little ebonite blocks of that thickness between the plates, the one at the top and the other at the bottom (as shown in the figure), and then holding the whole together by an ebonite screw passing through the middle of the plates before being put together, however, a coating of chemically pure zinc is deposited by electrolysis upon the surface of each plate so as to reduce local action to a minimum, this operation being performed in a chemically pure solution of zinc sulphate, and the plates are afterwards amalgamated with pure mercury.

When the apparatus is set into action also by dissolved off the one plate of each pair and deposited upon the other, and the quantity of zinc transferred from the one plate to the other is proportional to the total quantity of electricity which has passed through the cell and is independent of the time, if it be only necessary periodically to weigh the plates in order to ascertain the quantity of electricity which has been utilized, and it is immaterial whether a current of one weber flows for ten hours, or one of two webers for five hours, or of five webers for two hours, or of ten webers for one hour, the transfer and deposition of metal will in all cases be the same.

The consumer is charged so much per weber of current passed through the meter per hour. The inspectors go round once a month collecting the cells and substituting fresh ones in their place; each cell on being removed from the meter is placed in a separate compartment of a basket, its number being carefully noted. The cells as removed are taken to the central station, where the pairs of plates are separated and accurately weighed in a delicate balance, the results being entered in the meter-book, of which a specimen page is given below. The weber current that has passed through a "25 light" meter since the last observation is calculated by the following formula:

$$\text{Webers} = \frac{W}{1{,}232}$$

in which V represents the weber current that has passed per hour, and W the increase in weight of the receiving plate since the last observation, the figure 1,232 being the number of milligrammes of zinc deposited per weber per hour. It must be supposed that a set of zinc plates before being put into action weigh as follows: that in the monthly cell, 92,800 milligrammes, and that in the accompanying quarterly cell, 92,000 milligrammes, and that after having been in use for a month in an installation of twenty lights burning about four hours a day they weigh as follows:

	Milligrammes.
Monthly cell	95,307
Quarterly cell	95,255·3

Subtracting these weights from the first we get a difference in the monthly cell of 2517 milligrammes, and in the quarterly cell of 629·2 milligrammes, and if all has been working well the increase in the weight of the quarterly zinc should be about one-fourth that of the monthly plate. Applying the above formula to these figures we get the figure 1,833 as the number of webers passed through the apparatus per hour, and it is upon this figure that the consumer is charged. The following is a specimen page of a meter book, showing the general form of the entries and the principle upon which they are made:

Meter Number.		Name of Consumer.		Address of Consumer.	
Plates put in.	Weight of Plates.		Plates taken out.	Weight of Plates.		Gain.		Webers Consumed.
	Monthly.	Quarterly.		Monthly.	Quarterly.	Monthly.	Quarterly.	
January 20 ...	90,500	90,400	Feb. 20 ...	91,400	...	1100	...	833·3
February 17 ...								
March 17 ...								
April 14 ...								
May 12 ...								
June 9 ...								

The Edison meters of the form illustrated in Fig. 1 are at present constructed in two sizes, the one for currents of twenty-five lights, and the other for fifty lights is a circuit. In the former apparatus the monthly cell deposits per webers 1.356 milligrams per hour, the deposit in the quarterly cell being about one-fourth of that amount. In the fifty-light meter the rate of deposit is 1.277 instead of 1.356. The zinc solution is made as follows: 90 parts by weight of pure zinc sulphate is dissolved in 100 parts by weight of distilled water, and if the solution has been properly made, a hydrometer should show a specific gravity of 1.33 at a temperature of 15 deg. Cent. We may mention here that Mr. Francis Jehl, who has been associated with Mr. Edison throughout the development of his very interesting meters, has recently been contributing a very careful series of experiments upon the specific resistance of various solutions of zinc salts, and on another page of our present issue we give the results of some of Mr. Jehl's experiments.

The most interesting and elaborate apparatus of this kind designed by Mr. Edison is the automatic motor or electric counter represented in Fig. 5, and which is rather suited to the laboratory of the central station, where it can be in proper and intelligent hands, than to house or factory installations, where it might soon be put out of order. The apparatus consists of two electrolytic cells, each containing a solution of copper sulphate, and in each of them is immersed a hollow cylinder of copper. Within this cylinder is suspended from the end of the beam of a small-size balance, another copper cylinder; the two cylinders in each cell constitute the electrodes of an electro-depositing bath, and according as to whether the current traversing the cell is in one direction or the other, so will the metallic copper be transferred from the fixed cylinder to the suspended cylinder, and *vice versâ*, and the connexions are so made that while the apparatus is depositing copper on the inner cylinder of the one cell, metal is being dissolved from the inner cylinder of the other cell; thus while the one is, during the passage of the current, becoming heavier, the other is losing weight. It is clear from this construction that a time must occur when the one will overbalance the other, and the beam will then depress its deflector; in this state the current is automatically reversed, and, traversing the cells in the opposite direction, the process is

THE EDISON SYSTEM OF ELECTRIC ILLUMINATION.

electromagnet being diverted from the heavier suspended cylinder, while the other is receiving a deposition in the other cell until it overbalances the first, causing the beam to be depressed, and again reversing the current sets the instrument to its original position; the process is thus repeated and repeated again, as long as the current passes. Connected to the beam by suitable mechanism of an ordinary counter, by which the number of oscillations of the beam is recorded, and as each oscillation represents a deposition of copper to a certain weight, and that weight is a measure of the quantity of electricity flowing through the instrument, the current is measured by a process almost identical mechanically with the method by which the quantity of gas being utilized in an establishment is recorded. The above is a description of the general principle upon which the automatic meter works. It will be seen, however, on reference to the illustration, that there are certain electro-magnetic attachments and switches. The principal object of these accessories is to insure the beam tumbling over to one side or the other the moment that the quantity of metal to which the instrument is adjusted has been transferred from the one electrode to the other, for as the electro-light action is very gradual, it would be quite possible for the beam to stop at its central position when equilibrium has been established between the two balanced electrodes, and contact might be broken on one side without being made on the other, and the action of the instrument would cease, although the current might be utilized throughout the installation. By the electro-magnetic attachment, however, the apparatus can be so adjusted that the very slightest motion of the beam to one side or the other of a certain fixed point makes an electrical contact, thereby throwing one or other of the electro-magnets into circuit, and by the attraction of an armature causing the beam to fall over. There are other interesting details in Mr. Edison's meters, but they are hardly important to the subject of these articles, whose object is rather to describe a system of electric illumination than the details of every piece of apparatus employed in connexion with it.

Connected with the system, however, there are several interesting accessory instruments, one of the most original and curious of them being the apparatus illustrated in Fig. 6, which is a very ingenious and interesting form of resistance "box" devised by Mr. Edison, and which has on the top the usual set of connecting plugs and contact pieces; instead, however, of coils of wire forming the resistance, the lower part of the upper table is pierced with lamp sockets, the two terminals of each being connected to a corresponding pair of contiguous contact pieces. Into these sockets are screwed as many lamps, and the carbon filaments of which constitute the resistance can be thrown into or out of circuit by removing or inserting the connecting pegs in the usual way.

In the instrument shown in the figure there are ten lamps, and these can be thrown into a circuit in exactly the same way as are the coils of a resistance box. It is not claimed for this instrument that it is an accurate measure of resistance, but it is very useful and convenient for increasing or diminishing the resistance of a circuit by the equivalent of so many lamps inserted either in the circuit or as a shunt, and it may also be used for testing lamps and ascertaining how many may be used in any particular circuit.

With this apparatus we shall bring this series of articles to a close. We shall, however, notice any interesting improvements or additions which may from time to time be made to this important and rising system of electric illumination introduced by Mr. Edison.

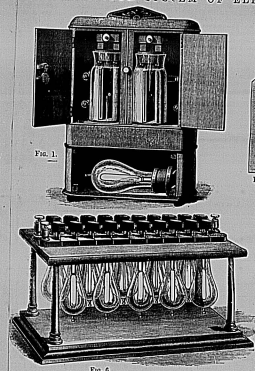


Fig. 1.

Fig. 4.

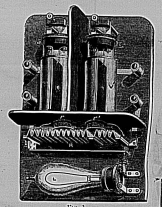


Fig. 2.

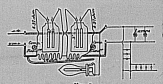


Fig. 3.

Fig. 6.

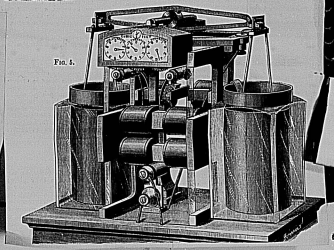
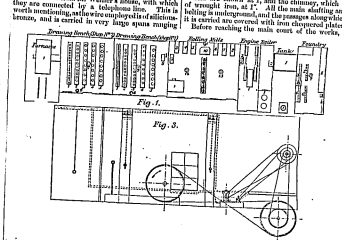


Fig. 5.

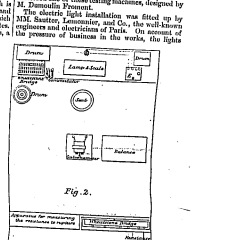
AN ELECTRIC LIGHT INSTALLATION.

We have on several occasions referred to the phosphor, and silicium-bronze telegraph and telephone wires manufactured by M. Lazare Weiller, of Angoulême, and have published the very interesting results obtained by him with them. The demand for wire of this kind has become so extensive that M. Weiller has recently constructed entirely new works adapted for a very considerable output, and in them he has mustered a large number of special tools and experimental apparatus. The Fresnays Works are situated in one of the suburbs of Angoulême and at a distance of some miles from M. Weiller's house, with which they are connected by a telephonic line. This is worth mentioning, as the wire employed is of silicium-bronze, and is carried in very large spans ranging from 600 ft. to 1000 ft. We need not stop here to consider the various processes of manufacture of the phosphor and silicium-bronze, nor their conversion into wire. The various operations involve very skilled labour, and special processes, some of which are kept secret. On the present occasion we have especially to do with the electric lighting installation, and the instruments for electrical measurement, and we may appropriately give in this connection some description of the arrangement of the works. The establishment of M. Weiller consists of two main buildings, which are shown in the diagram plan, Fig. 1. On the left of this diagram will be seen a rectangular building with two wings, 295 ft. 7 long and 52 ft. 6 in. wide, divided into five parts, which are respectively: 1, the engine room; 2, the rolling mills; 3, 3, the two wire-drawing shops; 4, the forges; 5, the annealing furnaces. The second portion arranged transverse to, and at the end of, the first one, is separated from it by a space of 33 ft. It is 39 ft. 9 in. wide and 52 ft. 6 in. long, and forms the foundry. In front of these two buildings, which are of stone, and well lighted and ventilated, is a large court-yard, around which are placed accessory buildings. One of these comprises the chemical laboratory, in which are made the analyses of copper and bronze. In an annexe to the building are prepared the alloys used for the deoxidation of the bronze (phosphor or silicium), and adjoining it are the drawing and general offices. Finally, opposite the foundry, and about 200 ft. from it, is a small wooden building, containing the apparatus used to measure the electrical and mechanical resistances of the wire. The former forms a separate shop, in which the ingots and other castings of phosphor-bronze are produced. It furnishes besides about two tons of alloy per day, which are cast in bars and passed on to the wire-drawing shops for making conductors. It contains 12 furnaces in two groups of six (2, 4) separated by a chimney. In front is a casting pit (6, 6) containing the ingot moulds. The drying ovens are shown at 3; 9 is a shears, and at 7 is an electric lamp, of which we shall speak presently. The rolling mills and the drawing benches occupy the central part of the large building. In the former shop, as shown in the plan, are placed the annealing ovens, 1; the drums, 2 to 8; the counter shafting and the rolling mills, 10, 11; while 12, 13 are two drawing shops contain the benches, 1—5; the electric lamps, 7; and a pointing machine, 8. In this part of the factory are carried out all special work for the production of telegraphic and telephonic wires. The rolling mills and drawing shop have two wings, the first of which contains annealing ovens, supplied by a small reverberatory; the second forms an engine room, the engine being 200 horse-power compound, made by MM. Weyher and Richemond, of Pantin. The boilers are shown at 1, and the chimney, which is 90 ft. of wrought iron, at 1'. All the main shafting and belting is underground, and the passages along which it is carried are covered with iron chequered plates.

Before reaching the main court of the works, a



garden has to be traversed, which forms part of the works. Between the garden and the courts is a small river called the Jequienne, on which are situated the washing establishments of the ore before the pickling and subsequent annealing of the wire is performed. These latter operations have a special importance, and require quite a series of separate buildings. A little above, a covered bridge has been formed, leading off a part of the water from the river across the court into the factory, where it passes into a filter and then into a well from which it is taken into the boiler. Before this, however, it is raised by a Gwynne pump into a large iron tank, containing about 1800 gallons. This tank is carried at a height above the ground of 32 ft. 9 in. on twelve cast-iron columns. From this it goes to the boiler, while the condensing water passes back to the river, at a point below the works. The electric installation comprises a laboratory for tests, and a lighting plant. The former has been established under the direction of an eminent electrician, M. Ledoux, professor of electricity at the school of submarine defence works, at Boyardville. The general arrangement is indicated on the sketch plan, Fig. 2. In the middle of the room is fixed a heavy stone pedestal, surmounted by a pyramid of wood, which carries a Thomson mirror galvanometer. To this are led the wires from the various measuring instruments in the room: those instruments are placed on two tables along the whole width of the laboratory, in front of, and behind the galvanometer. The wires are insulated, and lie in grooves made in the floor, and in the side of the pyramid carrying the galvanometer. To each apparatus belongs a double direction galvanometer, by which the current can be passed in any desired circuit. Above are placed cylinders with helicoidal grooves, round which are wound the wires subjected to trial. The circumference of the cylinders being known, the number of convolutions of the wire, give the length by observation. The wire is rolled upon a second drum, whence it is led to the grooved cylinders. In this way tests of considerable length of wire can be made. Opposite the galvanometer, and 23.62 in. above one of the tables, is fixed the graduated scale with its lamps. The other apparatus include Wheatstone bridges,



resistance coils, &c. The measures chiefly made in this laboratory are those relating to the conductibility of the various wires of copper, phosphor and silicious bronze, steel, iron, &c. In the same room are also effected the tests relating to the mechanical resistances of the wires, their extension under a given load, the number and extent of bendings they will sustain, and the general tests of their quality as required by the specifications of the Government railway companies and other purchasers. We have already on a previous occasion described one of these testing machines, designed by M. Deneulin Froment.

The electric light installation was fitted up by MM. Sautter, Lemonnier, and Co., the well-known engineers and electricians of Paris. On account of the pressure of business in the works, the lights have been in operation nearly all night for some months past, and have given great satisfaction, both on account of the luminous value produced, and the economy obtained. Two Gramme generators are employed; one of these, a Gramme B machine with diet electro-magnets, feeds five Gramme lamps; the other, a small Gramme machine, supplies the current to 15 Swan incandescence lamps. The power required to drive the dynamos is taken off the main countershaft which is in the same room with the regulators as shown in the general plan. The main shaft is driven at 200 revolutions, and on it are two pulleys, one 27.79 in. in diameter for the large generator, and the other 23.61 in. for the small one. These are driven as shown in Fig. 3, and give a speed, the first, of 1000 revolutions with a pulley 7.87 in. in diameter, and the second of 2000 revolutions with one of 5.94 in. In reforming once more to the well-known reputs of MM. Mascart, Joubert, &c., we find that with a speed of 1406 revolutions an F. C. Gramme machine absorbs about 8 horse-power, and gives out 44 the lamp the following intensities:

112	carcels,	horizontally
166	"	maximum
97	"	mean spherical.

At the Fresnays Works the power absorbed in somewhat less (6 to 6 horse-power), and the luminous values would, therefore, be somewhat inferior. The Swan lamps have each a luminous intensity of about 1 carcel (8.6 candles), and the motor supplying them uses 1½ horse-power. The Gramme lamps take a current of 16 amperes; the Swan lamps one of 2 amperes. The five Gramme lights are distributed as follows: One in the foundry, two in the rolling mill shop, and two in the wire-drawing shop. The engine-room is lighted by four Swan lamps, and these also serve as signal lights to check the proper working of the generator. The others are divided between the laboratory and testing room and the offices. As the generators are driven off the main engine, and as the load on this engine is very variable, it has been found necessary, especially for the small generator, to interpose a resistance commutator, adjusted by hand, so that a constant luminous intensity can be obtained. The appliances described, produce a total luminous value of 560 carcels from the five arc lamps, and 15 carcels from the Swan lights, in all 575 carcels, or nearly

ELECTRIC LIGHTING NOTES.

The Journals des Printemps in Paris, which was destroyed by fire about two years ago, has been rebuilt on a magnificent scale, and will shortly be opened. It will be lighted by Jablochkoff candles.

The establishment of Messrs. Keys Brothers and Sims, of Donegal, have been lighted by four Fillan arc lamps, and candles, and the remainder inside the building. The installation has given great satisfaction; it was carried out by Messrs. Woodhouse and Rawson, of 11, Queen Victoria-street, London.

Messrs. Siemens Brothers and Co., 10, Great George-street, Westminster, London, agents for the Siemens United Electric Light Company, are exhibiting at the Royal Aquarium Exhibition, about 200 Swan, incandescent lamps of various sizes from two to fifty candle power. These light their court, a portion of which is divided off and furnished as a complete modern dwelling-room. The current for maintaining these lights is derived from a Siemens' 200-light alternating-current dynamo-machine and feeder, worked from the main shafting in the engine-room. The same firm are also exhibiting a Siemens' 50-light dynamo-machine, maintaining the lights in the drawing-room, the first current being supplied by a Siemens' direct current dynamo-machine driven by a 3½ horse-power Otto gas engine, which is worked by means of Bowman's gas manufactured in the Exhibition by the Bowman's Economic Gas Company. The whole of the furniture and fittings are carried out by the exhibitors, being either manufactured by them or expressly for them. Finally, Messrs. Elmenhorst exhibit from one of their outside towers a 4000-candle power arc light, in a fireproof lantern, as used for lighthouse purposes, and for throwing a parallel beam to the horizon. The current for this is obtained from a Siemens machine, and the lamp used is of the Serrin type.

The Electric Exhibition at the Crystal Palace is still very disappointing. Although it has now been open for two months, many of the promised exhibitors have not as yet put in an appearance, and it may fairly be said to consist, as at contemplative ding so. While the gas-engines are running, the steam crowded with exhibits, and the manufacturers' representatives are busily engaged in explaining to the public the nature of the work exhibited by them. This is as it should be, but the great success, the guiding department were an aspect that suggests that the companies have either nothing to show from it, or are better employed elsewhere. Nevertheless, the date of our former notice a certain amount of progress has been made, and the Exhibition in its present form will probably be pronounced to the work to be done. The Vredenburgh has extended his installation by the fixing of seven additional arc lamps, mounted upon gilt lights, different types of machine are in operation. The Wallace-Farmer machine has now been in use for some time, and the Crompton machine has just arrived, Mr. Gilles' apparatus is fed by a steam engine, although it is capable of being worked electrically. The rest of the novel, and at present inscrutable machine, is exhibited by the Company. These incandescence lamps, arranged in parallel arc, and can which there are also a few Crooker incandescent lamps, are driven by a dynamo machine in the basement, in furnish a current that may be graduated to any desired extent. Court for a further display of the same commodity, although but little is actually completed. Prepartions are being made in the Eccle-docence. Among the other exhibitors there is Mr. Crompton, who has a number of his dynamo machines at work, and a machine has been fitted up in the nave where the experiment of handling the electric current may be made. In the Gallery system the incandescents are arranged in parallel circuit between the mains, and after the manner adopted in incandescence lamps, and consequently the difference of potential between the two conductors is only that corresponding to the electromotive force necessary to maintain an arc. By this arrangement arc and incandescent lamps may be burnt on the same circuit, if the resistances of the latter be not too great. In the central portion of this nave there hang six Brockie's new compensating lamps, exhibited by its Inventor, Electric Light Company, and fed from a Gramme generator in the basement. The lamps contain a device for automatically altering the regulating mechanism to compensate for the decrease in the resistance of the carbons as they burn. This is effected by changing the tension of the regulating spring. The transept opposite the high-level entrance, and a portion of the south nave, contain fourteen Gramme lamps, driven by a Siemens' alternate current machine, and a Gerard machine. In this latter, as our readers will remember, the field magnets revolve and the armature is stationary. Each coil of the latter is connected to an independent terminal, so that they can be grouped in any fashionable manner. A chamber in the Renaissance style, situated in the nave, is illuminated by ten Swinburne Pyke Main incandescence lamps, fed from a Gramme generator in the west corridor. This concludes the list of new exhibits in the department of electric lighting, added since our former notice. Unfortunately, they are nearly all well-known examples, and do not show that the progress has been made under precious share of last spring. In looking through the catalogue we come across many unfamiliar names, but the whole of them prove to be absent when sought for in the Palace. Perhaps these inventions were only in the paper stage when the Exhibition was projected, and have not yet got beyond it.

The preparations for the Electric Light Exhibition at the Westminster Aquarium have made substantial progress during the last fortnight. On Wednesday evening Messrs. Ferranti, Thompson, and Ince made a preliminary experiment with the current supplying the Grosvenor Gallery, and lighted a running gate into order. As this is their first appearance in the field of the great electrical illumination is therefore impossible to say. Time only will show whether the Aquarium is capable of being worked by the Ferranti machines with the same success as at the Grosvenor Gallery. The Edison method is complete installation, and the arch just in without mishap during the past week, and it is hoped that the machines will be ready for work by the end of the month. The Edison method is equally applicable to the Ferranti machines, and the Swan system is quite capable of being worked by the Ferranti machines. It has a wide driving pulley at each end of the axis, and on the centre-shaft there are two pulleys, each 5 ft. in diameter, and wide enough to take a 30-in. belt. If all manufactured belt-roads each liberal provision in the post we should have heard less of electric light failures. The lamps to be fed from this generator are situated in the swimming annex, and are 220 in number. The stand of Mr. Hiram Gibbs is also fully completed, and each day his system of electrical illumination is displayed. Owing to questions relating to his foreign patents we are unable to illustrate his apparatus at present, but we may explain that his object is to carry the electrical current through the gas-burning tube in the usual manner, and is to be utilised in the most economical form, that is to say, with the least waste of light-potential. Mr. Gibbs has also employed the electric current in the generation of other currents, whose intensity and quantity can be varied at will. The whole of the work to be done. The Swinburne-Pyke system is also represented in the Aquarium by a Gramme machine, which is fed from a common source, and permits that in town gas has been made, and the remainder inside the building. The installation has given great satisfaction; it was carried out by Messrs. Woodhouse and Rawson, of 11, Queen Victoria-street, London.

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FOREIGN TECHNICAL LITERATURE.

REVIEWING the work of the past year, the *Bulletin of the American Iron and Steel Association* (Philadelphia, January 3 and 10) remarks with regard to the iron building, that it appears to be slowly growing, notwithstanding a general impression to the contrary. The Delaware yards were busy, whilst those of Messrs. Cramp and Sons launched a tonnage of 18,331.

The Overland Summary (Calcutta, January 2) says that the Government of the Punjab intends to make a direct bridge in the coast-wrought iron between the Ravi canal and the railway, in the northern part of the Montgomery district. Two engineers have been employed to conduct the preliminary operations, and funds have been provided. The Ravi has formerly flowed through this district, and then it was fertile and thickly populated.

L'Industrie Belge (Brussels, January 21) contains an extract from the report of the Minister of Public Works with regard to the railways during 1881. The total length in operation on December 31 of that year was 2280 miles, 44 miles of which had been constructed during the year; 992 miles of the distance are worked by private companies, the remainder being by the Brussels and Rhine. The total amount expended by the States on the construction of the lines and their equipment was 41,580,320*l*., and the capital and the capitalised value of the annuities which the Government has to pay as the price of certain companies (which must be added to the above amount) 5,000,000*l*. The receipts of the State railways during the year were 2,028,320*l*., to which must be added a sum of 1,000,000*l*. paid by private lines on account of the use of working—including the 1,000,000*l*. All the above receipts had to pay the working expenses, which amounted to 1,353,240*l*. This, however, was not sufficient to meet the annuities due by the Treasury and the capital locked up in the payments to the companies whose lines had been purchased by the State, and the result was that the year's working showed a deficit of 228,105*l*.

The well-known Italian engineer, Sig. Garoia, contributes a long letter to the *Giornale del Genio Civile* (Rome, January 17), endeavouring to dispel the fears which have been entertained regarding the Mont Cenis tunnel. He is sure to the advantage of Fréjus that if the tunnel is to be pierced on that line, it will be the shortest of the three, and it is in order to enable their Atlantic ports to receive the international through traffic. The opening of the Gothard tunnel, and that if any part is injured by it, it will be Marseilles and not Genoa that will suffer. The opening of the tunnel would enable Frenchmen to the Lake to undersell English coal in the Italian markets, and would open the ports to powers that if the principal traffic over the Alpine lines is in trade between England and Belgium on the one hand, and Italy on the other; and that the international trade of England, which was expected to be largely increased by comparatively insignificant. He considers that the death of Mr. Gladstone would be a great blow to the Simplon project, of which he was a supporter, and that the probabilities are in favour of the Mont Blanc tunnel.

Army and Navy Journal (New York, January 13) publishes a table of the report made by the United States Naval Advisory Board to the Secretary of the Navy, on the system of defence during forts for monitors, designed by N. B. Clarke, Esq., of Washington. The report says that the monitors would require to be of which exhibits them to thorough experimental tests. The Board has been carried out the Board will soon give any recommendation for the adoption of the system. The report also declares that an appropriation of 50,000 dollars should be made for the purpose.

The Chief of the Bureau of Steam Engineering has prepared a report, showing the average speed per hour on the several vessels of the American Navy during its commission during the year 1882, when steaming at the ordinary current of service, and the consumption of coal per hour for each horse-power indicated. Of the 48 vessels commissioned in the year given, the average speed was 7·1 knots, while 26 vessels, with an aggregate of 37 lbs. of coal; four others above speed were 10 knots to the 1 knot, the coal consumed varying from 3·1 lb. to 4·9 lb.; and the remainder varying in speed from 8·3 knots to 9·5 knots per hour. The highest consumption of coal is that of the Minnesota, which required 7·2 lb. to attain a speed of 6·6 knots.

THE ELECTRIC LIGHTING ON H.M.S. "HIMALAYA."

DURING the conveyance of the army to and from Egypt, the government officials had considerable opportunities of observing the advantages to be obtained from the use of the electric light in troop ships. The *Orontes* was fitted, just before she sailed, with a large number of incandescence lamps in the men's quarters, in addition to those that she previously had in the saloon and staterooms. As the troops were carried in all parts of the vessel, even on the orlop deck, which of course receives no daylight at all, the superiority of the new light over the usual oil lamps was most marked, both as regards its greater brilliancy and freedom from heat and smell.

In the same way during the winter, tenders were asked for the erection and fitting of the troopship Himalaya, and the Swan United Electric Light Company obtained the contract, which was completed on December 17th last, in spite of considerable delay in the arrival of the machinery, which was expected in consequence of great trials and other work that was going on in the adjacent docks.

The installation consists of 121 lamps, each of twenty candle power, and 78, each of ten-candle power, fed by two Siemens' alternate current machines, with an ordinary large exciter. The armatures of each machine and the exciter are arranged upon the same shaft, so that the two may be driven together by a three-cylinder engine of the horizontal type, coupled direct to them. Each set of machines, with its engine, is mounted upon a carriage of its own, which is placed over an 8 in. teak keel firmly bolted to the framing of the ship.

The maximum speed of the generators is 640 revolutions per minute, but ordinarily they are run at 480 revolutions only, the following page we give four deck plans of the ship, showing the position occupied by the various parts of the installation, and by taking a portion of one of the deck beams adjacent to the engine-room, and enlarging it to 12 in. to 1 ft. (fig. 6).

The distribution of the lights through the ship is illustrated in the plans, while the principal fittings are shown in the detached views.

There are seven circuits, all of which are centralised from a main switch-board (Fig. 3) placed on the electrical-room, as shown in Fig. 2. From the latter seven branches or brass plates, numbered 6 to 12, each bearing the name of the part of the ship with which its respective leading wire communicates. Around this cluster of plates are arranged eight plates, 1 and 5, each provided with two set-screws for connection. At the upper part of the board are three plates, 2, 3, and 4, which 1 and 2 are connected to the generators, and are to the return circuit. Six cables, each of seven No. 16 B.W.G. wires, lead from the board to the various decks, and the current from the generators to the eight plates 4, 5, three to each, and four cables leading off to the detached lamps, and the return current from the plates 1, 3, back to the generators. Each of the cables that is led into lines to the left of the figure run from the plates 6 to 12 to the various parts of the ship, and are led in the same order to dotted lines, carry the return current to the plates 1.

All the parts are shown in the engraving all the circuit being disconnected from the generators, but if a wire be carried between plates 1 and 2 all the return leads will be connected with the latter, and by placing a plug between each of the plates 6 to 12 and the plate 4 will then connect the generators with the circuits, and the other terminals of the generators and one portion of the ship will be supplied with light. Each of the metal plugs on the board is large, and when all the circuits may be put in action. Similarly if a plug be inserted between plates 2 and 3 the return leads will be connected to the other generator, and the outward leads can be attached to the same or to several brass plugs of the left hand side of the board. If plugs be placed in both ends of a plate, as No. 5, the corresponding current would be coupled up to both generators, and would thus give double power. In case of a short circuit, the result would be quite satisfactory, as only that circuit would be put out of action, and the rest would be allowed to go on exactly as the same speed, the current being automatically cut off by the fusible wire.

The brasswork is secured down to a strong backing of vulcanised fibre, which is set in a teak moulding, supported by two iron brackets, arranged to suit the bend at an angle of about 30 degrees with the bulkhead. The grooved teak casing, in which the cables are placed in the electrical room, is brought up to and finished off at the switch board, which measures 18 in. by 8 in. over the screw-ends, and was manufactured by Messrs. C. Mayr and Co., of Liverpool.

The arrangement of the main switch board there are twelve plates, arranged to turn out all the lights except those which are in the cabins of the officers. Small switches from one or two lights are placed in all the cabins, and in any other parts where it is required to prevent the lights in detail, each small switch being provided with a lead cut-out. The main leads are of Siemens' Bullivan make, of nineteen wires of No. 16 B.W.G., heavily insulated with tape and india-rubber; the branch wires are a single No. 16 B.W.G., specially made for ship work by the Gutta Percha and India-rubber Company. The leads and returns are laid in grooved wood casings half an inch apart, and the greatest care has been taken throughout the ship to avoid any possibility of short circuits. Lead cut-outs are inserted at the junctions of all branch wires.

We give illustrations of three of the lamp fittings, which have been specially designed, and most of these supplied by Messrs. Faraday and Sons. In the saloon each light is placed in front of a mirror with bevelled

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SWING BRIDGE AT HAMBURG.

We publish this week a two-page engraving, illustrating the arrangement of turning gear of the swing bridge over the Niederbaum Dock at Hamburg. In an early issue we shall publish further details and a complete description of the work.

LONDON ASSOCIATION OF FOREIGN ENGINEERS.—Sir James N. Douglass, C.E., has consented to preside at the Thirtieth Anniversary Festival of this society, to be held at the Cannon-street Hotel, on Saturday, April 21st, and he will be supported by Mr. Joseph Newton, C.E., past president, and others.

Engineering Feb. 2, 1883.

ELECTRIC LIGHTING NOTES.

THE system of street lighting by means of electric lamps erected upon high lattice poles or towers is extending rapidly in the United States. The towers employed are tapering skeleton frames, square or triangular in plan, built of iron tubes, united by special fittings of malleable iron, and terminated by diagonal struts and tie-rods. The towers are usually 160 ft. in height, and are hinged at the centre and also at their ends. The weight of the towers appears to vary considerably, and ranges from 100 to 250 lb. The cost also appears to depend upon the height and the proximity of the towers, but is usually two or three hundred times generally of the brush pattern. The local newspapers speak very highly of the success of the plan wherever it has been adopted, and say that it gives sufficient light when the towers are judiciously arranged to avoid shadows, for the ordinary purposes of walking and driving. The system seems hitherto to have been chiefly applied to Western towns, in which the street lighting was mainly confined to the central portion, the suburban and residential districts being devoid of artificial illumination, and this perhaps accounts for the somewhat florid descriptions that we have received of places in which the total amount of illumination, however distributed, was obviously insufficient according to English ideas. But it must be remembered that the amount of light required is largely dependent upon the state of the atmosphere, and that in this country a very large proportion is lost in the mist and fog that so often prevails. The same cause would also prevent our placing lights upon very high poles, because every fact of fog through which the light is projected quenches it, and consequently the higher the lamp the greater the fog and which no supernatural light would be practically useless. Whilst moderate ranges the plan of highly elevated lights has been tried in this country. In front of the Mansion House ten 50 ft. poles, each bearing a Gaulle power light, were erected, but it was found that the best results were obtained when the lamps were only hoisted 30 ft. Above this level too much of the light was shot over the neighbouring roofs. The Albert Dock at North Woolwich is illuminated for a length of one-and-a-half miles by 600 candle power lights raised 80 ft. above the ground, and the Holyhead Harbour has five lights, each of 6000 candle power, at the same elevation. The experiments gained in these and similar installations seems to show that from 50 to 60 ft. is the maximum height to electric lights in average English weather, and that although in exceptionally clear nights a greater elevation might be used, yet the American plan of suspending lighted elements intensely, such as the Brush lamps, 250 ft. above the pavement, would never be of practical utility in this country.

The preparations for the Electric Light Exhibition at the Westminster Aquarium are now proceeding very rapidly, and, although there is not much visible to the public, the heaviest part of the work is already accomplished. Three machinery annexes have been built on pieces of waste ground, and engines erected in them whose total indicated horse-power is 450, which it is proposed to increase to 550 if it should be found desirable. The first annexe, situated at the corner of the building the most remote from Westminster Abbey, contains one engine of 150 indicated horse-power by Davey Paxman and Co., one 90 indicated horse-power engine, by Hornsby and Son, and two 30 horse-power engines by the same makers, and is designed to receive another 90 indicated horse-power engine. There are already two Brush machines at work in this annexe, feeding 500 Swan lamps in the Imperial Theatre arranged partly in parallel arc and partly in series or three. The experience gained so far in this installation seems to show that the Brush machine is not well adapted for incandescence lighting. Active preparations are being made by the Jablochkoff Company, the Gulcher Company, Crompton and Co., Lane Fox, and the Swan Company for fixing generators in the second annexe. The second annexe lies at the north-east corner of the building and is allotted to Messrs. Ferranti, Thompson, and Ince, the Standard Fyfe Main Company, and the Edison Company. The power is derived from two Davey Paxman semi-portable engines, a Burkett caloric engine, and a gas-engine driven by Bowman and Co. The third annexe is under the smoking gallery, and contains the Siemens generator, by which the Aquarium has been lighted for some time past. In addition to this it has a 40-horse power Davey Paxman compound semi-portable engine of a new design, and is further intended to receive a number of Hadden's rotary engines. The total number of lights that will be in operation at the Aquarium, not counting dashlight premises, will be 2?4 arcs, and 2100 incandescence lamps, of which latter 500 are in the theatre. When the sun sets in Victoria he contrasted with that of the Palace, in Hyde Park, or of the Crystal Palace, it is evident that the Exhibition will equal, if it does not surpass in brilliancy any of its predecessors; and, as its central position and its nearness to the large railway terminal, under it for visitors accessible than Spitalfields. The catalogue of exhibitors shows an influential list of names, nearly all the leading manufacturers of electric light machinery being included. The Edison Company have secured a large display, the greater part of the gallery opposite the orchestra being allotted to them; it is being divided into courts, one of which will be filled with scientific objects illustrating the manufacture of electric lamps and generators; another shows the Edison lamp adapted to the illuminating of elaborately decorated interiors, while a third is being transformed by Messrs. Dick Radclyffe, and Co., into a beautiful grotto and palm-house. The Ferranti, Thompson, and Ince Company have secured the building in which the swimming exhibitions formerly took place, and will light it with 320 incandescence lights. As this is almost their first public display they are sure to attract much attention. The cave will be lighted by arc lamps of the Pilsen, Gulcher, Siemens, Gerard Lescuyer, and Patterson types, the luncheon gallery by Lorraine lamps, the reading room by 200 incandescence lights, the cellars and the ground floor by Jablochkoff candles, and the entrance by Standard Fyfe Main lamps. Edmundson and Co. are showing a large assortment of ornamental fittings, and are lighting two furnished rooms by Swan lamps. The space under the dining-room is allotted to the Pilsen Joel Company, and the smoking gallery to Messrs. Patterson and Cooper, who will erect there 200 incandescence lights. One curious feature of the Exhibition will be the market thereon the ground floor, which will be lighted by Swan lamps. Among the arcs there are four lamps shown by M. Lontin, and incandescence lamps and constant batteries by Messrs. Shipway and Coad, by Colonel F. Bolton, and by Mr. Dimm. The names we have mentioned by no means exhaust the list even of leading firms, but are sufficient to warrant the expectation that this long delayed Exhibition will prove a success at last. The only stand that appears to be complete at present is that of Mr. Dimm Gülke, who shows a new method of distributing electric energy, of which we shall have more to say in an early issue. Briefly it consists in using the main current to generate an induced current at the spot where it is required by means of an apparatus on the principle of the induction coil. By this means is it possible to work with a main current of high electromotive force, and to generate currents of various potentials according to the purpose for which they are required.

The general meeting of the Anglo-American Brush Electric Light Corporation terminated, as we announced last week, in an amendment being carried to the effect that a committee of shareholders should be appointed to consider and report upon the affairs of the company. It will now be remembered, and was fired for last Tuesday, at the noon time the directors issued a circular in which they declared their desire to court all possible investigation, but deprecating the publication of a report, which, however, was issued to the shareholders of the corporation. Having regard, they said, to the rival interests involved, the numerous companies with which the corporation has to transact business, and the complicated questions which were pending, and might at any time arise, between the corporation and others, the delicacy and difficulty of the task cast upon the committee would be obvious, and if any member should happen—as was the case with many who attended and voted at the recent meeting—to be interested in the companies owning concessions, or in rival companies having antagonistic interests, the injury that might result to the permanent interests of the corporation would, in the opinion of the directors, be vital, and possibly irreparable. They therefore determined to treat the result of the poll as an evidence of confidence, or the reverse, and if they were entitled to resign their positions at the earliest opportunity. In answer to some of the allegations made at the meeting, they said that, during the past six months, they had been engaged in perfecting the manufacture of a new class of economical machine for incandescence lighting, that of apparatus of various descriptions essential to the successful and economic lighting. On Tuesday last the votes were taken, and at the close the chairman moved a resolution adjourning the meeting until Monday, February 5, for the declaration of the numbers, and for concluding the business. It was stated by Mr. Braithwaite that the poll showed a large majority in favour of the directors.

During the festivities connected with the laying of the foundation stone of the infirmary at Cardiff and visiting the first set of the new dock, Lord Bute's castle has been lighted by nearly 200 Swan lamps with so successful a result that it is intended to convert them into a permanent installation. The whole arrangement was managed by Mr. W. T. Lewis, the marquis's chief agent, who retained Mr. W. H. Massey, of Twyford, to carry out the work.

ELECTRIC LIGHTING NOTES.

At the Friday evening opening lecture of this year's session at the Royal Institution, when Professor Tyndall addressed a crowded audience on "The Rainbow," the library was lighted by one of Mr. Rose's primary batteries. The hall of the Institution is now added to its own permanent installation, Messrs. Faraday and Son having supplied Grecian pendants, harmonising with the architecture.

The Committee of Inquiry appointed by the shareholders of the Metropolitan Brush Electric Lighting Company have filed a petition for the winding up of the company. In reply the directors have issued a circular to the shareholders, stating that this course is an entirely mistaken one, and affirming that their belief in the values of their numerous provisional orders is evidenced by the favourable proposals they have received for taking some of them over. The directors state that they have no doubt of being able, at the proper time, to make satisfactory disposals of their policy, which does not necessitate a call, as implied by the circular of the committee. For the present they merely advise the shareholders to refrain from signing any proxies, and from pledging themselves to any further action until they have seen, not only the report which the committee are about to issue, but also the reply of the directors thereto.

Messrs. Tangye Brothers have lighted their premises at Newcastle on the Swan system. The work was intrusted to the firm of Messrs. J. H. Holmes and Co., 67, Westgate-road, who have, with the exception of the engine and boiler, supplied and erected the whole of the machinery and apparatus required, and who have had most of the elaborate fittings specially manufactured to their own designs. The show-room has been fitted with four pendants, each of which carries five 20-candle-power Swan lamps and a reflector, so as to utilise the upward rays of light. Those in the front windows, being longer than the rest, have a novel and handsome form of reflector, the sides of the cells being of glass. The offices are lighted by ten lamps of the same power. The machine used is one of Siemens' self-lighting dynamos, and is capable of running forty 20-candle-power lamps when arranged in parallel circuit. The engine is of Messrs. Tangye's "Cubus" type, nominally 10 h.p., and of a "Cubicle" boiler, and when running the lights develop about 4 horse-power.

It will be within the recollection of many of our readers that twelve months ago Mr. Octavius C. Goode wrote a letter to the *Times*, in which he gave the particulars of the electric light installation at his house (Beechcroft Hall), and compared the system with that of gas. At that time the light had been in use for three months, and upon the data obtained during that period of working, Mr. Coope estimated that it would cost him 50*l.* or 4 farthings per burner per light. Now, after the lapse of a year, he has written again, comparing the actual expenses with the figures of his estimate, and he finds that his expectations have been more than realised, and that the actual cost per burner has been .35 of a farthing. The total cost of the installation was 1,400*l.*, and the year's expenses have been as follows:—Coals (small 13s. 6d. a ton, mixed with slack 18s. 9d. a ton), 27*l.* 14s.; wages (engineer and half boy), 78*l.* 14s.; interest on lamps (200 at 5s.) 75*l.*; oil, waste, &c., 3*l.*; repairs, &c., 5*l.* 14*s.*; sundries, 7*l.* 10*s.* 8*d.*; depreciation, 82*l.*; total, 279*l.* 18*s.* 8*d.* There are 200 lamps, and as they have been used for 4,224 hours, the cost works out to .35 farthing, as stated above. The plant consists of four Siemens dynamos, and a 12-horse engine. The lamps are mostly required singly, and in the hall and dining-room are hung by pendants from the ceilings by silk cords. Mr. Coope is quite enthusiastic in his praise of the healthfulness, safety, and economy of the lighting, but he does not make it quite clear how it is that the whole of the lamps were burning on an average five hours a day all the year round; the inference to be drawn from his letter is that every lamp was put in action at dusk and kept alight until nearly midnight, in all the rooms; so that the house was perfectly lighted all over, and darkness was abolished within it, until the engine stopped for the night. No doubt this is a very charming arrangement, and it is one that is peculiarly favourable to electric lighting, when estimated per lamp-hour; but it must be remembered that it is a very expensive one. A farthing per lamp-hour looks a very small sum, but 200*l.* per year for lighting a single country house is no amount not very often paid, we should imagine. We have pointed out again and again, that when an electric light plant can work at full capacity for 1500 hours a year, it may compete with gas, and that it is seldom that this condition can be fulfilled.

named officials of the deaths that ensued. 4. That the driver of the local special train which was late the standing train, did not keep a proper look out, and consequently failed to use the means at his command—the Westinghouse brake —to stop his train, and so avert the collision. 5. That the superintendent of the New York Central and Hudson River Railroad had failed to provide proper safeguards at the dangerous point where the accident occurred, and that he prescribed a dangerous rate of speed—twenty miles an hour—at a place where it was impossible to see more than 50 ft. ahead. Both these officials were also declared responsible for the deaths that occurred. Then we see that so far from the brake—which was found after the accident to be in good order—having caused this accident, it resulted from the foolish trick of a drunken passenger, followed by the thoughtlessness of the engine drivers, the neglect of the rear guard, and in a less degree to the want of care on the part of the driver of the train that ran into the one that was wrecked.

The jury also condemned the practice of placing it in the power of a passenger to stop a train by his own act, instead of merely announcing to the driver the necessity—real or imaginary—for stopping.

We are glad to see that the *New York Railroad Gazette* fully endorses the verdict of the jury.

A PHOTOGRAPHIC EXHIBITION.

During the last five or six years a new method of making negatives on glass has been gradually coming into use among amateurs; and, at the present time, this new method bids fair to soon render the old process with collodion and the silver bath a thing of the past. In the case of the ordinary wet collodion method a film is first coated with collodion containing soluble iodides and bromides, and when nearly dry is then immersed in a solution of silver nitrate, so that the sensitive mixture of insoluble silver iodide is formed in the film. The new gelatine-bromide method is different, a kind of wash being made of the sensitive salts and gelatine, and it is merely necessary to coat the glass plates, after which they are dried in a horizontal position. Such plates will keep indefinitely, and are consequently always ready for use in the most portable point of advantage in their extreme sensitiveness; in properly prepared, gelatine-bromide plates only requiring an exposure in the camera about one-twentieth as long as would be necessary in the case of a wet collodion film. Hence we now have not only any striking examples of rapid or so-called instantaneous photography—like that of a bird flying, alighting in full sail, machinery taken while in motion, and other similar subjects—but

Then circumstances, together with the ease with which the gelatine-bromide plates can be used, have united have tended to largely increase the scale of amateur photography, and to give it a great deal of general interest in the subject.

The Council of the Society of Arts have endeavoured to meet the requirements of the period by asking Captain Abney to deliver a course of Cantor lectures on Recent Advances in Photography, and Mr. Trueman Wood to give a course of the lectures by a technical exhibition bearing on photographic matters. In carrying out this idea Mr. Wood has received no small effection contributions. We are pleased to see that the literature of the gelatine-bromide process is not neglected, as side by side with an interesting series of exhibits showing the rapid advance of the new process we notice Dr. Eder's extensive work on "Modern Dry Plates," and the "Year Book of Photography;" this latter is be a comprehensive annual record of progress; both these works being issued in connexion with our contemporary the *Photographic News*. Those of our readers who take any interest in photography should not fail to visit this most important and complete exhibition, and we are told that tickets may be obtained by applying to the secretary of the Society of Arts.

THE WEATHER, JANUARY, 1882.

JANUARY has been dry and gloomy with an unprecedented prevalence of fog. At extreme positions of the British Isles, to which the Isle of Man is central, the mean atmospherical pressure and temperature were as tabulated above:

Atmospheric pressure has been uniformly above the average, and though the excess is remarkably high, still this distribution should theoretically be accompanied with normal winds. The resultant of the daily general directions of the winds is south-west by west, which is exactly the same as the normal resultant. In fact, there was very little

Positions.	Mean Pressure.	Difference from Normal.	Mean Temperature.	Difference from Normal.
	In.	In.	°	°
North ...	29.82	above 0.01	42	above 1
South ...	29.82	" 0.01	44	" 2
East ...	29.81	" .02	43	" 2
West ...	29.81	" .02	44	" 2
Central ...	29.81	" .02	43	" 2

cresting in the wind during the month. The temperature was above the normal, especially in the west and north. The distribution of rain may be inferred from the following statement:

Hants.	Rainy Days.	Amount.	Difference from Normal.
		In.	In.
Scarborough Head ...	25	3.25	above 0.25
Delft ...	16	2.00	below 0.25
Valentia	26	6.00	" 2.50
Portsmouth	17	2.50	" 0.50

The rainfall in the north seems to have exceeded the usual quantity, but elsewhere it was very deficient. The dryness is evidently related to the high barometric pressure, and the mildness to the south-westerly winds and the constant state of sky, which was unfavourable to radiation of heat from the ground or lower air. During the first week severe gales prevailed in the north. On the 6th a violent gale was attended with lightning and thunder for hours, and caused disastrous floods in Ayrshire. At Glasgow the wind had a pressure of 51 lb. to the square foot and a velocity of 80 miles per hour, about 1000 trees being uprooted anemometers. The fall of barometers was very rapid to 28.4 in. On the 18th the barometer stood nearly at 31 in.

During the latter half of the month, atmospheric pressure continued remarkably high, especially on the south and east of England. On the 25th the maximum temperature at Nottingham was 69 deg.; on the 26th at Oxford the minimum was 20 deg. A little snow fell in the north of England towards the end of the month. On the 1st, 1.20 in. of rain was measured at Valencia; on the 5th, 1.05 in. at Roches Point; and 0.93 in. at Selby on the 18th. Among the contrasts of simultaneous temperatures exposed surprising were the following: On the 16th, Nairn 54 deg., London 36 deg.; 17th, Sunburgh 50 deg., London 32 deg.; 18th, Nairn 51 deg., London 31 deg.; 19th, Sunburgh 48 deg., Nottingham 31 deg.; 24th, Stornoway 50 deg., London 31 deg.; 25th, Stornoway 50 deg., Oxford 25 deg. The instances of temperature in the most southerly west exceeding that in the east and south-east, are also very surprising, as the former have a maritime winter climate, and the latter rather a Continental. Bright sunshine was most frequent in the south-east, where, during the five weeks ending the 30th, 30 per cent. of the possible duration was registered, while south Ireland had 28 per cent., north-east England 27 per cent., north Ireland 26 per cent., south-west England 19 per cent., west Scotland and north-west England 11 per cent, and south England only 9 per cent.

By referring to the summary of the weather for January, 1881, it will be seen that the weather of the past month was quite a contrast to it, which may be illustrated by what happened on the 26th last year; barometer below 29 in., piercingly cold easterly gale, force reaching 75 lb., lids 5 ft. above due height at Westminster, deep fall of snow; this year, barometer 31 in., light airs from S.W., and dense fog. January, 1882, was about 11 deg. warmer than January, 1881.

THE MAXIM ELECTRIC LIGHT.

The Electrical Exhibition in Paris is already beginning to bear fruit, thanks to the combinations made by which some of the more important systems of electric lighting fall into the hands of powerful companies. It was in this way that the Compagnie Générale d'Electricité (which we believe is about to undergo a third change, by being formed into a new society with a capital of 75,000,000 francs) has recently under one larger arrangement, the Jablochkoff candle, the Jamin, Werdermann, and Heyder lamps, the Jarger regulator, the Maxim incandescence light, and the Gramme generator, so that it can now supply any system of illumination that may be desired, from the lamp of a few candle power,

ELECTRIC LIGHTING MISCELLANEA.

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Ten paper read by Mr. Esplin, of Forfar, before the North "not dependent." Seeing that it was the first time he had British Association of Gas Managers can scarcely be com- pact the shareholders under these circumstances, despondency mended. He was asked to contribute a paper; he did not would have been somewhat premature. Of course the Chair- know what to write upon; therefore he chose the electric- man had him at the Electric Lighting Act and the Man- light—presumably because he did not know much about it, chester Corporation. What Directors of lighting Electric and thought his colleagues knew less, and would consequently Lighting Companies would do for an excuse if they had not be interested in anything he could find to tell them on the the Board of Trade scapegoat, it is difficult to imagine. With subject. This was not a promising beginning; and it did not unanimously satisfactory the Chairman announced that the improve. Mr. Esplin had obtained one fact—that a manu- payment to the parent Company for the Manchester license facturer had tried Brush lighting in a certain department and had been reduced from £20,000 to £10,000. So far, good: a cost of £120 per annum as compared with £75 for gas; but it is too evident that fuel fasts justified their early hopes, leaving out the cost of motive power. This is a kind of the Directors would rather have paid the larger sum. When estimate, or rather of record, similar to that sometimes people accept £10,000 for something that was sold for heard of in regard to certain patented gas-making machines £50,000, it is evidently dear at any price.

used in mills and factories, when the cost of gas is always brought down to about eighteenpence per thousand cubic feet, by leaving out a few items which figure largely in Gas Companies' accounts. As though this statement were not sufficiently favourable to electricity, moreover, Mr. Esplin went on to cite one or two electricians' estimates for work not executed; which, of course, showed a saving as against gas. This was pushing magnanimity to excess, even for a gas manager when spending of electric lighting. It is regret- table also that the author should have repeated without question the oft-refuted assumption that Brush lamps give 2000 candles illuminating power. It is a relief to turn to the straightforward utterances of Mr. Smith, of Aberdeen, who at least spoke from his own knowledge. We can well believe that Mr. Smith, like Mr. Clare, of Blackpool, has done his best to make electric lighting successful. The result, however, is always the same—the boy will work if somebody sits up all night with it, and looks after it as he would a sick child. Otherwise there will be trouble, as people have everywhere found to their cost.

The Birmingham and Warwickshire (Brush) Electric Light- ing Company have held their second ordinary general meeting—in George Yard, Lombard Street. It is curious that this concern, which is nothing if not local, should not have been able to find a habitation in the scene of its sup- posed labours. This is only according to the fashion of many other country and district Brush Companies, whose practice is closely modelled on that of the celebrated Ethiopian minstrels who "never perform out of London." The mere fact of keeping the head-quarters of this particular Company out of Birmingham speaks for itself of the pros- pects of business in the town and district. Mr. G. M. Pelham presided over the meeting, and "expressed disappointment " at the results of the working." Of course he claimed, on behalf of the Company, to have sufficed merely from the action of the Legislature and the Board of Trade, "by which, " serious conditions had been imposed on them, and many " of the rights which they had thought they held had been " taken away from them." As to the former complaint, it is sufficiently justified by the Chairman's subsequent admission, that they had no money to make the deposit required for a Provisional Order. What prospect there might have been of the Company doing good work, if they are so short of capital as to be unable to find cash on money, the Chairman did not explain. It is rich also to read of the second complaint, when it is notorious that the electricians had no rights whatever before the Electric Lighting Act was passed, and therefore could not have lost anything by it. It is scarcely necessary to say there was no dividend, nor is there hope of any in future.

There is an Edison Company in Manchester, although their existence would never be suspected; and they have held their first general meeting. This was actually convened in the city whence the Company are named, and Mr. Y. K. Armitage presided. The Chairman, following the usual formula, regretted that the report and statement of accounts were not more satisfactory; but declared that at their next

ELECTRIC LIGHTING NOTES.

The British Electric Light Company has petitioned the Privy Council for a prolongation of the Grosnene Road, dated June 8, 1876.

The Edison Company is said to have 22,500 lamps in use on the Continent, of which 7000 are in Germany, 2200 in France, 4000 in Austro-Hungary, 3000 in Russia, and 2200 in Italy.

Messrs. William Penny Brothers, Lever Shipyard, Dumbarton, have added an electrical department to their extensive works, which will be completely lighted by electricity. Mr. R. B. Smillie, of Glasgow, has been placed in charge of the department.

The Committee of Underground Communication, New York, U.S.A., has examined 400 patents and designs relative to the question before them, but has not found a single one, any system which answers their re- quirements, if they seek a plan by which electric con- ductors of all kinds can be placed in the same under- ground pipe or channel, without injuriously influ- encing each other, and in such a manner that they may be easily accessible at all times.

The New Hotel de Ville, in Paris is lighted by Edison incandescence lamps, and is ventilated by fans driven by electro-motors of the Crompton type. The current is provided by two following systems, each furnishing from 175 to 200 horse-power, and absorbing about 30 horse-power. They are driven by two com- pound engines, constructed by MM. Weyher et Richemond, and situated, together with the boilers, in the basement of the building. The conductors from the machines are carried to a switchboard, from which three pairs of wires run, one to feed the lamps in the wing by the Rue de Rivoli, another to the towers surmounting the court of Louis XIV., and the third to the façade. All these circuits mount directly to the second story, and then circulate under the floors, passing through the ceiling of the first floor at the places where the lamps are situated. Each subsidiary circuit starts from a switchboard, a flexible cord-out being placed in each branch of it. The circuit around the court is divided into three, which serve three-sixths of the square; that of the façade into four, of which one feeds the remaining six of the court, as well as the vestibule and corridor of the council chamber. The three other branches go to switch- boards on the first floor.

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ELECTRIC LIGHTING FOR STREETS.

To the Editors of ENGINEERING.

Sirs,—The subject heads which, for a considerable time, have appeared in your columns, and other papers, involving electric light companies to the supply of the light- ing of various thoroughfares within the City of London, and the comparative value of the last two years in the way of novelty or improvement of any note bearing upon electric lighting, I think should appear in leaflets that we have issued, which is the history when it is time to deal with, it as it is, are simply suggestive. I suggest a review of the whole question on a republished illustration. Of the incan- descent system, whatever may be the merits of the Edison, Swan, or Brush lamps, and the preserving hopes of its advocates to make it the general illuminant of the future, I think I am not expressing the general opinion when I say that, as regards street lighting, it is out of the question. Of the Brush system, which has received the public and street commissioners' favourable and liberal notice, adopted to maintain or increase its popularity, has failed to prove itself better than, or as cheap as gas, can hardly be sug- gested to replace it on the sole recommendation of its hygienic advantages, more particularly in open air places, needless to say, they are altogether inappre- ciable.

It is to the arc light companies, consequently, that we must look for the improved lighting of our streets for long and hotly asked for, and the task of rendering it, at all likely to compete for the privilege has become rela- tively easy; their number, since the unsatisfactory at- tempt of the first Company was to pay a rent for the whole at the rate of £300 per mile. The rights are all that charging the batteries, for the lighting was unsatisfactory, dear, probably, to local rates in the business, and is now discontinued.

During the past twelve months Mr. Haworth, Messrs. Simpson Brothers' resident agent in Manchester, has effected installations of the electric light in the Arkwright Arms Hotel, Hatton Garden, in the Union Inn, Newmarket, and in the Alexandra Theatre, Salford. The Duke of Edinburgh, Lyceum, Alexandra, Opera Comique, Prince of Wales, Savoy, Criterion, Empire, Gaiety, Globe, Royalty, Strand, Vaudeville, Standard, Shoreditch, Pavilion, Metropolitan, Princess's, Sadler's Wells, Surrey, Grand, Olympic, Novelty, Imperial, Court, Avenue, Prince of Wales, Trafalgar, Folly, Comedy, Toole's

The s.s. *City of Paris* has been very unfortunate in the matter of electric lighting. She was originally fitted with a Siemens W1 alternate current machine, an exciter, eight lamps, and an engine without a governor. Before she left the Mersey the engine ran away and severely damaged itself; it was replaced by a second, also without a governor. Ere the vessel reached *New York* a second running away occurred, this time the machine being destroyed by the excessive speed. When the ship returned home a new generator was placed in position, and a small governor added to the engine, and things went better until the governor was allowed to get out of order. Then, one day, when an officer in conducting a party of visitors round the ship extinguished a light by way of experiment, the increased speed threw off the belt of the driving pulley. The resistance of the main machine being thus considerably relieved, the engine again ran away and destroyed another armature. Since then the vessel has been placed in the hands of Messrs. Siemens Brothers to be fitted up according to their system. A powerful Hibbering governor has been added to the engine, and rope driving has been substituted in place of transmission by straps. In the forward engine room both exciter and generator are actuated by belts of the same rope, consequently a broken splice affects both equally.

An electric lighting plant for a cotton mill in one of the smaller Australian republics has just been supplied by Messrs. Siemens Brothers to a Manchester firm. It comprises seven arc lamps, 238 Swan high resistance lamps, one dynamo machine (8 D.), and one alternate current machine (W.). The whole has been so arranged that it can be put together on the spot by persons without any special knowledge. The general system adopted for the incandescence lights follows that in vogue in gas lighting establishments in this country. A channel will run lengthwise of the mill, replacing the usual gas pipe, just below the level of the ceiling, and at a point will depend from it carrying a lamp at a little about 6 ft. 3 in. from the floor. The main conductor lies in the channel, and a branch is brought from it down the pipe to each lamp. The parts of the channel and the pendants are clipped together so that the latter can be put on wherever required. The details of the installation have been designed by Messrs. Siemens Brothers' agent in Manchester.

Mr. Preece has been appointed to the Committee of Works of the St. George, Hanover-square, vestry, in the room of Mr. Spagnoletti, who resigned notice of the room is 120 ft. from the theatre and the lamps are Brush and Swan companies have been employed. The general terms of the report were opposed to the schemes of the companies, and a recommendation was added that the applications should be opposed. Similar objections were raised against the applications of the Metropolitan Electric Light and Power Company, for the parishes of St. Mary Abbot, Kensington, St. Pancras, Westminster, and St. Martin-in-the-Fields, and it was determined to insist upon extensive modifications in the terms of the provisional orders to protect the interests of the parishioners.

Mr. W. C. Glen, and Mr. A. Ellens have published a little book called "The Electric Lighting Act, 1882, and other Acts incorporated therewith, also the Rules of the Board of Trade, of October, 1882; with Introduction, Notes, and Index." The object of the book is to furnish those interested in public electric lighting with a knowledge of the legislative provisions laid down for their guidance. It comprises, in addition to the recent Act, those of the Gas Works Clauses Act, 1847; the Metropolis Management Act, 1855; the Tramways Act, 1870; the Gas Works Clauses Act, 1871; the Board of Trade Arbitration, &c., Act, 1874; the Public Health Act, 1875; the Local Loans Act, 1875; the Telegraph Act, 1878; and the rules of the Board of Trade (October, 1882). All these Acts are either partly incorporated with or referred to in the Electric Lighting Act, and need to be consulted as aids to the interpretation of some of its provisions; but with this help much most remarkable clearness and lucidity is illustrated what line of action will be followed by the Board of Trade, who have power to make rules aimed at their discretion. As an instance it may be cited that it cannot be determined from the Act whether more than one licence or provisional order can be granted for the same area, and, if not, what considerations will guide the authorities in enrolling out a district among the various applicants. In the case in point seven different companies have applied for power to light it, and as yet no one knows whether, subject to satisfactory guarantees, the Board of Trade is willing to divide it among them, or whether it will undertake the task of deciding which of the seven is best fitted to do the work. The critics of the book have added notes and cross references, where they seemed requisite or likely to be useful, and have given a copious index, so that the operation of one Act upon another may be easily followed.

Our contemporary *La Lumière Electrique* publishes an interesting letter from a correspondent, in which the lighting of the Alhambra Theatre, Havana, Cuba, on the Edison system is described. The number of lamps is 185, of which 162 are in the Carcel and 14 of two Carcels, or 3 and 12 candles. These have replaced 312 gas-burners, an excessive number rendered necessary by the inferior quality of the gas supplied; the difference of temperature within and without the theatre now and all conditions of lighting is 14 deg. Fahr. The lamps are arranged as follows:

Positights	Lamps.
Two feet low for lighting the stage, each 10 lamps	20 at 1 ,,
Two feet low for lighting the stage, each 6 lamps	12 at 1 ,,
Three rows of brackets round the three galleries, each having two lamps	72 at 1 ,,
Four brackets, each with four lamps on each side of the stage	16 at 1 ,,
Twenty-four brackets on the outer four corridors	24 at 1 ,,
Ten brackets in the boxes	10 at 1 ,,
Eight brackets in the vestibule	8 at 1 ,,
Three lamps in front of the theatre	3 at 2 ,,
Total	185

Besides these there are seven 10-candle lamps for lighting the machine-room, which contains two Edison generators, type No. 6, which are also to feed 60 lamps of two Carcels, or 120 of one Carcel each. They are driven by a 14-horse power engine. The machine-room is 120 ft. from the theatre and the lamps are from 50 ft. to 80 ft. to switchboard. The lamps are grouped in two separate circuits, one lighting the façade, vestibule, boxes, corridors, and one line of lamps round the house; the other, the other tiers, the stage, and vestibule, the last two being all the stage lights. This arrangement was employed in order that if an accident occurred to one of the generators the house should not be left in darkness. The conductors are taken from the machine-room across the street at a height of about 20 ft., the diameter of these conductors is 5.5 millimetres. In running the building the current is divided among a number of smaller conductors of 2.40, 2.77, 2.11, and 1.21 millimetres in diameter, and through fuses to the lamps. From an experience extending over eight months it has been found that the same duration of each lamp exceeds 800 hours. The cost of the installation did not exceed 8000*l.*, and the daily expenses are as follows:

	£	s.	d.
Anthracite coal (200 kilos.) at 47 Francs, a. d. to 50 Francs (20.) per ton	3.5s	7	2
Engineer	20	—21	0
Fireman	12.5s	16	0
Cleaning, oil, &c.	2.5s	2	0
	54.0	47	7.2

The yearly expenses are shown below:

	Francs.	£.
Deterioration of plant 10 per cent.	2,000	80
Interest on capital 10 per cent.	2,000	80
Renewal of lamps (average life, 800 hours = 225 hours of burning, the hours = 225 hours renewed 24 times a year), 550 lamps at 3.7 Francs (3s. 0.6d.)	1,965	74.6
Daily expenses, 365 days at 54.5 francs (2s. 7.3d.)	19,892	795.68
	25,757	1030.28

The total number of Carcel hours being 445,300, the total cost per Carcel hour—.0578 franc or .55d. The price charged by the Havana Gas Company is .0625 franc, or about .52d. per Carcel hour, this gas being of a very low quality, and badly purified. There is thus a marked economy in the use of the Incandescence lamps. It is worth noting that the cost of this installation was practically 200 francs, or 8*l.* per lamp. The enormous wages paid to engineers and firemen, the high price of coal, and the charge of 10 per cent. as interest on capital, are all features of interest in the foregoing estimate.

The following particulars of an English installation will form a very interesting comparison with the foregoing. In a letter to the *Times* Mr. Alexander E. Cooper gives some details of a plant laid down at his residence, Berenbrook Hall, three miles from Colchester. The extent of the installation was 200 Swan lamps of 18 candle power, and the cost was as follows:

	£	s.	d.
Four dynamo machines	495	0	
Engine, boiler, and belting	190	0	
Engine foundations, &c.	25	0	
Engine foundations, &c.	25	0	
,, and dynamo house	120	0	
200 Swan lamps	195	0	0
Sockets, cables, switches, &c. ...	70	0	
Erection, laying wires, &c.	90	0	
Chandeliers, brackets, &c.	283	18	
Cutting and making good walls, floors, &c.	60	0	
	1670	8	

This total is equivalent to nearly 7*l.* 8*s.* per lamp. The estimated cost for establishing gas at the same place was:

	£	s.	
Machinery, building, and erection ...	750	0	
Gas main to house	75	0	
Laying pipes in house	200	0	
Cutting and making good	50	0	
Chandeliers, brackets, &c.	258	0	
	1333	16	

It may be fairly assumed that the total cost, including unforeseen expenses, would have been about the same as for the electric light plant. Mr. Cooper gives the annual working expenses as follows, presuming that the lamps are worked 1150 hours in the year:

	£	s.	
Coal at 20*s.* per ton	34	10	
Engine driver, 30*s.* per week,... ...	78	0	
Lubricating oil, &c.	18	0	
Depreciation 10 per cent. on engine and boiler	19	0	
,, ,, on dynamos	71	0	
,, ,, on conductors	4	0	
Total	232	15	

To the above ought to be added 5 per cent. interest on the capital invested—7*l.* 10*s.*—bringing the total annual outlay to 240*l.* 5*s.* This, with 1150 hours in the year for each lamp, or 230,000 lamp-hours in all, brings the cost per lamp and per hour to .25*d.* Mr. Cooper estimates that to obtain the same light with gas at Berenbrook Hall would cost 400*l.*, which would be equivalent to a price of about 1*s.* per 1000, allowing that 6 ft. of gas per hour will yield one candle power, and 5 per cent. for depreciation. This appears high, but Mr. Cooper apparently speaks from no actual experience of consuming gas on his premises. At all events the price is in excess of that quoted by the manufacturers of such plant, what is guaranteed by the manufacturers of such plant,

Engineering, July 22, 1882.

ELECTRIC LIGHTING NOTES.

Last Friday an extraordinary meeting of the Swan United Electric Light Company was held to receive the approval of the shareholders of the Bill now before Parliament. It was thought that some difficulty might arise as to whether the united company could adopt the provisional orders which had been obtained by the two companies, and the object of the Bill was to prevent this. The chairman stated that all the business was now transferred to the Edison and Swan Company, and he believed they were selling their lamps fairly well, and making a profit.

Some very interesting electric lighting experiments are about to be made at Hastings, in relation to obtaining the best mode of lighting the fish streets. They will be conducted by Mr. Preece, and the trials are intended to determine the relative efficiency of arc and incandescence lighting, the proper distribution of the lamps, and the most economical and effective manner of diffusing the light. The engine and dynamos are in position. The experiments are independent of any system or interests, and are looked forward to with much scientific and public interest.

An important installation was inaugurated last Monday at the Bank of England, the directors of which instructed the executive of this work to the Electrical Power Storage Company, Limited, the manufacturers of the Crompton and Kapp dynamo accumulator. The installation has been fitted up without interfering with the work of the employés. Progress has necessarily been slow in consequence of the limited periods during which workmen could be employed. It was intended to take the motive power from the existing steam engine and boiler, and to work with Wood over forty accumulators, but it was subsequently found to be more convenient and perfectly safe to employ a small portable engine and boiler for the purpose. The Secretary's office of the Victoria type constructed by the Anglo-American Brush Electric Light Corporation. Its carbon resistance is 120 volts, and it is capable of giving a current of 60 ampères. The dynamo charges an accumulator of 55 Faure-Sellon Volckmar cells, which in turn feed 150 incandescent lamps like those now distributed throughout the private drawing office, the hall office, and the counter. The lamps have a rating of 20 candle-power. The installation is fitted through out with Ashmead's safety cut-out, which is employed so as to automatically break the circuit when a certain heat current is reached. The light and motive power are at present employed. The fittings have been manufactured by Messrs. Hart, Falk, and Company, the Storage Company, limited, and introduced through gear specified in such a manner as to permit the use of the dynamo for charging the accumulators without cutting out the one interfering with the other. The whole of the installation has been carried out under the personal supervision of Mr. F. Thornton, the works manager of the company.

A very complete and successful installation of the electric light has been carried out on the Brazilian Imperial railway between Pedro and Queluz. Messrs. Mawson, which has just left the Clyde, the builders being Messrs. James and George Thomson. It includes 20 Swan incandescence lamps, each of 16 candle-power, which are distributed throughout the passenger carriages, the state rooms, officers' cabins, and in the luggage, the engine room, and the tunnel, &c. The power is obtained from a Thomson-Houston dynamo machine which is driven by a Stevenson dynamo machine which is driven by a Stevenson dynamo machine which is driven by a Stevenson

power of about 4000 candles each, and designed for working a shift of nine hours, including the night and the morning. Placed at a distance of fully 100 yards apart, the lamps are raised to a height of about 50 ft. from the level of the rails, and the poles from which they are suspended are 70 ft. high. The current for the two lamps is obtained from a Crompton-Bürgin dynamo, of the C type. It is considered most likely that the directors will very soon give orders for the central station at Glasgow being adapted throughout to the electric system of illumination, for hitherto the lighting by gas has been very inefficiently performed.

The magnificent but somewhat unfortunate screw steamer Austral, belonging to the Orient Line, and which lay sunk at the bottom of Sydney Harbour during a period of some three months, has just been entirely refitted by her builders, Messrs. John Elder and Co., Glasgow. As on the first occasion, the electric lighting arrangements were entrusted to Messrs. Siemens Brothers, and carried out for them by Mr. J. S. Raworth, of Manchester. No provision has been made for lighting with oil lamps, entire reliance being placed on the Siemens system of electric lighting. The dynamo machines are two in number, both of the Siemens alternating type and each capable of maintaining 200 Swan incandescence lamps of 20 candle-power. These machines are driven by two of Gwynne's vertical engines of 10 horse-power each, and capable of working up to 23 horse-power indicated, which is transmitted by an endless cotton rope in the manner first introduced by Mr. Raworth, and since extensively adopted by many other leading firms in the electric lighting industry. Both engines are fitted with Pickering's governors. The electric lighting extends to the whole of the ship. Every passenger cabin has its electric lamp; even the second-class and steerage portions of the steamer have not been overlooked in this respect; and the arrangements are such that the light may be turned on or off at pleasure by the passengers themselves. The installation has been laid down according to the general practice of Messrs. Siemens Brothers, which is now well known on many of the large ocean steamers. All the lights are under control from fixed stations, and are turned off at a certain hour, with the exception of a number which are left in action all night in the passages and saloons. The night main leads also supply the captain's, officers', and engineers' rooms, the chart room, engine room, stokeholes, tunnel, refrigerator, and electric rooms, &c. Four powerful arc lamps, each of 2000 candle-power, are fitted up over the deck of the ship, so that they may be used when she is in port at night coaling or taking in or discharging cargo.

ELECTRIC LIGHTING FOR STREETS.

To the Editor of Engineering.

Sir,—I thought my letter on the above subject in your issue of the 25th ult., was sufficiently clear to elicit, if it deserved any notice at all, objections of a less ambiguous character than those of "Arc and Incandescent," and the "Secretary of the Hammond Company," in your issues of the 1st and 8th inst. respectively.

I cited facts resulting from my observations of the working of the five systems selected for the practical experiments of "electric lighting for streets" in London, which it is of course open to any one to verify, criticise, or contradict.

The former of your correspondents gives us the experience of a particular arc system—the *rara avis*, no doubt, working somewhere; name of system and place not given. The latter tells us of an instance of fifty arc and forty-eight incandescent lights scattered over a surface of seven miles and working with perfect reliability at Brighton. As I am not aware of such an instance of electric lighting stretched over seven miles of *streets* being in operation anywhere, Brighton included, *surface* probably means the lengths of circuits.

I am perfectly aware that in cases where the electric light is distributed to various consumers (not too distant from one another) a railway station or warehouse, for instance, the porters or assistants are expected, after a little experience, to give the temporary help required by "recalcitrant" lamps. The number of practical assistants in these cases may, consequently, not be very great, their services being required only for the more serious and persistent *attacks*, but this is *not* electric lighting for streets; although, even in street lighting the passengers have occasionally obligingly performed the necessary service. It is well known that in the attempt to light Prince's-street, Edinburgh, with Brush regulators, the best friends of the system were the street Arabs who, independently of the men posted for the purpose, having become initiated to the mystery made it their sport to jump upon the lamps and give the friendly *jerk* whenever a lamp was seen to go "a swooning." My observations had been, as a matter of convenience, concentrated more particularly on the line of lighting from the south end of Southwark Bridge to the foot of Queen Victoria-street, and I can assure "Arc and Incandescent" that to see the men running from lamp to lamp with a heavy ladder on the shoulders during the winter nights did not convey to one's mind that they were having a jolly time of it.

On the whole, there is nothing in your correspondent's letter to make me alter my conviction that for the reasons I have given in my former letter, arc lamps of the regulator order are as unfit now as ever they were to keep a line of streets lighted with the necessary amount of reliability without an expenditure for outdoor watching, out of all proportion to the otherwise moderate expense of producing and maintaining the light at the works; and that, always as regards electric lighting for streets on a large scale, the Jablochkoff system being free from this encumbrance, has alone proved to be practically suitable.

Yours faithfully,

Alternate Current.

49, Elsham-road, London, February 19, 1884.

authorities that the law should be so framed that such a defect might be cured, where it arose in the claims. But Mr. Chamberlain, having, of course, the poor inventor's interest at heart, did not adopt this suggestion. On the other hand, however, care has been taken to provide in the law that every ground on which a patent might, at the commencement of the Act, be repealed by *scire facias*, shall be available by way of defence to an action of infringement, and shall also be a ground of revocation. These are points out of which the President of the Board of Trade apparently did not try to make capital in his misleading speech at Birmingham. Nor is he reported to have explained to his audience, that whereas the Act states that the application for a patent must be accompanied by either *a* provisional or complete specification; the rules, framed by his department under the Act, cast upon the applicant the trouble and expense of preparing *in duplicate* the provisional specification, the complete specification, and all drawings. Another detail pertaining to his much vaunted "simplification of procedure" likewise appears to have escaped his memory. The inventor, for whom all things have been made so easy, is required to furnish, in addition to his two complete specifications and two corresponding sets of drawings, a drawing illustrative of the feature or features of novelty constituting his invention. This drawing must be prepared in a prescribed manner; it must not cover a space exceeding 16 square inches; and there must accompany it a concise explanatory statement on foolscap paper, legibly written or printed. In short, the poor inventor who wishes to have, for 4*l.*, "the protection which the State has awarded to his ingenuity," will find a splendid field for the exercise of that quality (not to mention the virtue, patience) in attempting to comply with the requirements of the simplified procedure for which he owes such a lasting debt of gratitude to the President of the Board of Trade. Seeing how much the applicant for a patent has to do, and how long it must, at best, take him to do it; it becomes evident what little value Mr. Chamberlain places upon an inventor's time, when he tells him he can get a valid patent for 4*l.*

Surely, after this, inventors ought to feel themselves highly flattered, besides being truly thankful. Engineering 1884. Feb

THE BRUSH COMPANY.

The report just issued by the reorganised Board of the Brush Company may be summarised in the words of the military command "as you were." The history of the company during the last two years is fresh in the minds of our readers; after a splendid course of advertising, the directors sold the patent rights in the form of local licenses to nebulous syndicates, who, after floating subsidiary companies faded away, and having been seen by very few,

fairly well in incandescence work, and thus with a very moderate paid-up capital, and the finest manufacturing plant of any company in the same business, there is every probability that they will again take a good position and share with their competitors whatever profit there is to be made. Unfortunately the disappointment and loss of hard-earned savings of hundreds of small investors who put their faith in the name of Brush, cannot be relieved by a process of book-keeping.

THE WEATHER OF JANUARY, 1884.

The weather of January in the British Isles has been very mild, and its latter part very tempestuous. At extreme positions to which the Isle of Man is central, the main atmospheric pressure and temperature were as folllows:

Positions.	Mean Pressure.	Difference from Normal.	Mean Temperature.	Difference from Normal.
	in.	in.	deg.	deg.
North ..	29.53	below 0.08	41	above 2
South ..	30.10	above .20	48	" 5
West ..	29.87	" .09	40	" 3
East ..	29.93	" .07	43	" 4
Central ..	29.93	" .10	46	" 5

The Committee of Investigation appointed to examine into the affairs of Messrs. Mudie's Library Company have issued a circular to the shareholders stating that an agreement has been made between them and the Board to provide for the liquidation of the company by three members of the committee acting in conjunction with Mr. Borrer and Mr. Tottenham. A claim will have to be made on all any rate upon the promoters for a very large amount, and the committee feel that, in order to enable them to negotiate with the promoters for a settlement of the claim, should the opportunity arise, it is necessary that should be invested in the liquidators a power to compromise. It may be found necessary to provide for the working out of the provisional orders by means of sub-companies.

An extraordinary meeting of the Jubbulcholl Electric Light and Power Company was held on Friday last to consider three resolutions relating to the winding up the company, (2) to appointing Mr. W. A. Spain as liquidator, and (3) conferring on the liquidator a general authority to transfer the undertaking to a new company when incorporated. The chairman said petition after petition had been lodged against them by creditors when they could not pay, owing to the shareholders not answering to the calls. The new company was to have had 120,000 in capital in 1l. shares, 40,000 ordinary, and 80,000 6 per cent. preference shares. The first issue was to consist of 40,000 shares, to be issued at par for 30,000l., and the remainder would be sold in fully paid-up shares, and the remainder in debentures and cash. The liabilities were passed.

On Wednesday last the third ordinary general meeting of the Anglo-American Brush Electric Light Corporation, Limited, was held at the Cannon-street Hotel. A special resolution was passed for the purpose of reducing both the paid-up and nominal capital by 5*l.* per share, or from 800,000*l.* to 400,000*l.* There has at present 16,720*l.* shares with 10*l.* paid thereon, 20,000 with 8*l.* paid on them, and 20,560 unallotted, leaving 43,280 shares with 5*l.* paid. It is to be reduced from 10*l.* to 5*l.* The effect of this will be to diminish the paid-up capital by 283,560*l.*, which amount has been lost or is unrepresented by available assets. The report goes into the cause of this loss at length. There is a sum of 31,052*l.* which was typical at the last balance-sheet as being due from Mr. Lane-Fox, but which has been much reduced by a composition. It will be remembered that in 1882 Mr. Lane-Fox undertook to repurchase from the Corporation for a sum of 50,000*l.*, his distribution patents, believing that the company owed him much more than that amount. The company, however, took a different view of their indebtedness, and subject to the existing sum of 50,000*l.* being reduced by decrees and purchases, Mr. Lane-Fox took back the patents. He further undertook to pay the Corporation 20 per cent. of any profits he might make up to the 31st December, 1884, and from the next the Corporation agreed to transfer to Mr. Lane-Fox 14,000*l.*, in shares in the Electrical Power Company, and to make in the same proportion 14,000*l.* of which they have a first claim on all his electrical patents. The value of the shares in the new company is taxed to 25,000*l.* It originally stood at 179,686*l.*, in December, 1882, 152,056*l.* was written off, and now a further decrease is to be made. The property and plant stood at 37,823*l.*, of which 9,000*l.* is written off. A sum of 31,052*l.* is written off as "liquidation of patents," and is the result of the liquidation and part relinquishment of sundry claims; the item also includes 7,000*l.* amount written off in respect of bad debts. There is an item of 10,658*l.* "written off book value of patents," representing the difference between the value of the stock as per survey, and the value according to the books, which is considered the basis for winding up. It is proposed to still further reduce the value of the shares by 5*l.* each, that is by 47,280*l.* The sum of 10,286*l.* has been set aside "as provision against the shares held by us," and (2) whether any further loss may occur in the value of the shares that may hereafter occur in the value of the shares will not affect the amount reserved available for winding up the result of the manufacturing operations." The report and the Corporation, under the new arrangement, is shown by the following statement (omitting shillings and pence):—

Dr.	£	£	Cr.	£
Capital		1,120,562	Patents	25,000
Less calls unpaid		1,225	Bond and bullfrogs	25,000
		1,119,337	Stock	47,190
Creditors		148,977	Debtors	10,000
Provision against claims		10,286	Cash	12,045
Advice			Patents	9,232
		39,266	Balance	99,000
			Deficiency	1,018
		255,305		255,305

Out half the directorate retired after the last meeting and their places were filled by Lord Thurlow, Mr. H. C. Gibbs, and Mr. Edward Woods. The recommended board appointed successors to the late general manager, secretary, and engineer, and then reorganised the system of book-keeping. They found a whole host of difficulties with the subsidiary companies, and were threatened with actions on all sides, but after long negotiations they succeeded in effecting amicable agreements in all cases. They made alterations in the clauses of those licenses which bound the holders to use French and Lane-Fox apparatus only, and they secured for themselves the right to supply apparatus in the territories of the sub-companies on paying the latter a royalty. They have gone into the incandescence light, and have brought the Schuckert dynamos and the Lane-Fox lamp to a high degree of perfection for the purpose, and now they intend to resume their old position, and instead of being exclusively manufacturers they are going again into the market, and are prepared to supply private consumers. The Scottish and Irish companies have been wound up and their affairs likewise have received the approval of the separation upon surrender of the shares held by it.

The directors contend that the money loss is no indication of the future prospects of the company, and that even with the present amount of business there is a prospect of dividends.

IMPERIAL STANDARD WIRE GAUGE.

On page 218 of our last volume we gave a copy of the resolutions of the new legal standard wire gauge, issued by the Board of Trade, and below we publish a Table drawn up by the Iron and Steel Wire Manufacturers' Association, showing the lengths, weights, and breaking strains of iron wire under the new rules which come into force on the 1st of March next.

IMPERIAL STANDARD WIRE GAUGE.

Table of Sizes, Weights, Lengths, and Breaking Strains of Iron Wire, issued by the Iron and Steel Wire Manufacturers' Association.

Numbers of Wire Gauge.	Diameter.		Weight of		Breaking Strains.	
	Decimal Parts of an Inch.	Millimetres.	100 Yards.	Mile.	Tensile Standard Strength.	Actual.
	Ins.	Mm.	lbs.	lbs.	tons. lbs.	tons. lbs.
7/0	.500	12.70	204.08	1080	18 0	18 0
6/0	.464	11.79	175.78	930	15 10	15 10
5/0	.432	10.97	151.84	803	13 10	13 10
4/0	.400	10.16	130.61	691	11 10	11 10
3/0	.372	9.45	113.00	598	10 0	10 0
2/0	.348	8.84	99.13	525	8 15	8 15
1/0	.324	8.23	86.36	457	7 15	7 15
1	.300	7.62	74.69	395	6 15	6 15
2	.276	7.01	64.12	339	5 15	5 15
3	.252	6.40	54.64	289	5 0	5 0
4	.232	5.89	46.31	245	4 5	4 5
5	.212	5.38	38.88	206	3 15	3 15
6	.192	4.88	32.34	171	3 5	3 5
7	.176	4.47	27.14	144	2 15	2 15
8	.160	4.06	22.41	119	2 10	2 10
9	.144	3.66	18.16	96	2 0	2 0
10	.128	3.25	14.39	76	1 15	1 15
11	.116	2.95	11.85	63	1 10	1 10
12	.104	2.64	9.58	51	1 5	1 5
13	.092	2.34	7.59	40	1 0	1 0
14	.080	2.03	5.87	31	0 15	0 15
15	.072	1.83	4.75	25	0 15	0 15
16	.064	1.63	3.77	20	0 15	0 15
17	.056	1.42	2.88	15	0 15	0 15
18	.048	1.22	2.12	11	0 15	0 15
19	.040	1.02	1.47	8	0 15	0 15
20	.036	0.91	1.19	6	0 15	0 15
21	.032	0.81	0.94	5	0 15	0 15
22	.028	0.71	0.72	4	0 15	0 15
23	.024	0.61	0.53	3	0 15	0 15
24	.022	0.56	0.44	2	0 15	0 15
25	.020	0.51	0.37	2	0 15	0 15
26	.018	0.46	0.30	2	0 15	0 15
27	.016	0.41	0.24	1	0 15	0 15
28	.014	0.36	0.18	1	0 15	0 15
29	.012	0.30	0.13	1	0 15	0 15
30	.010	0.25	0.09	0	0 15	0 15
31	.009	0.23	0.07	0	0 15	0 15
32	.008	0.20	0.06	0	0 15	0 15
33	.007	0.18	0.04	0	0 15	0 15
34	.006	0.15	0.03	0	0 15	0 15
35	.005	0.13	0.02	0	0 15	0 15
36	.004	0.10	0.01	0	0 15	0 15

January 10, 1884.

METROPOLITAN SEWAGE DISCHARGE.

The first report of the Royal Commission on Metropolitan Sewage Discharge has been issued. It consists of 74 pages, and is signed by the Commissioners. The terms of the subjects laid before it. These are (1) the best means of preventing the sewage discharged into the Thames by the Metropolitan Board of Works, and (2) whether any still effects result from the present discharge, and if so what are remedies for such effects.

"1. That the works of the Metropolitan Board for the main drainage of the north side of London be completed on the lines of Barking Creek and Crossness have been carried out, and that the sewage matter be dealt with at present mainly in the same manner.

"2. That the storm overflows allow the occasional discharge into the river within the metropolis of considerable quantities of solid fecal matter accumulated in some of the sewers; but this has not caused, under present circumstances, serious damage or offence.

"3. That the storm overflows between the northern outfall sewer and Barking Creek, Crossness, and not, as was originally intended, through the pumped pipe intercepting relief sewers from the discharge.

"4. That the discharge of the sewage is in no case prevented during this whole year without any attempt to realise it, or otherwise by separating the solids as otherwise is at variance with the original intention and with the understanding in Parliament when the Act of 1854 was passed.

"5. That the discharge from the main outfalls becomes very widely distributed by the motion of the water both upand down the river, being traced in dry seasons through the metropolis and almost as high as Teddington; and that it oscillates for a long period before getting finally out to sea.

"6. That the effluent of the sewage by the land and sea water, aided by the agitation produced by the various motions in the river, effects a partial purification of the sewage by oxidation; and that this purification is carried further by the action of the sea-water on the sewage solids.

"7. That the sewage which becomes distributed to the land and to the lower portions of the river thus gradually acquires offensive properties. The limits above and below the outfall of the sewage within which these properties exist with the ordinary tidal conditions, but it may be stated that in general above Greenwich and below Gravesend the river does not afford ground for serious complaint.

"8. That between these limits the effects of the sewage discharge are more or less apparent at all times.

"9. That in dry seasons the dilution of the sewage is less, and the offensive effects are more marked.

"10. That it does not appear that the effects of the sewage discharge has had any seriously prejudicial effect on the general healthiness of the neighbouring districts, but that there is evidence of certain evil effects of a minor kind on the health of persons employed on the river, and that these may reasonably be anxiety on the subject for the future.

"11. That in hot and dry weather there is serious nuisance and inconvenience, extending over considerable distances both below and above the outfalls, from the foul state of the water consequent on the sewage discharge. That such is very offensive and the water is at times turbid.

"12. That foul mud, partly composed of sewage matter, accumulates at Crossness and elsewhere, and adheres to nets, anchors, and other objects used in the river.

"13. That coal-dredged near the outfalls, which used to be obtained in a pure state, is now found to be so much contaminated with sewage matter as to be unfit for consuming the bridges to go further away.

"14. That the sewage discharge is not at times in a state in which such an important highway to a great capital as the Thames should be kept.

"15. That in consequence of the sewage discharge fish have disappeared from the Thames above Crossness for 15 miles below and for a considerable distance above them.

"16. That there is some evidence that wells in the neighbourhood of the Thames are affected by the water in the river, and that the quality of the water of some has fallen due to the sewage, but it may be felt on that point.

"17. That there is no evidence of any injury to the navigation of the river by deposit from the sewage discharge, but that this discharge adds largely to the quantity of solids in suspension in the water, and so helps to cause deposit.

"18. That the evils and dangers are likely to increase with the future population in the districts drained.

"19. That it is desirable that there should be another "storm overflow" for the purpose of completing or preventing the evils and dangers resulting from the present discharge.

"20. That before we proceed to this further breach of existing rules and regulations we should have a complete scheme of the proposed new outfall, which should be submitted for the consideration of Parliament."

MANCHESTER STEAM USERS' ASSOCIATION.

At the monthly meeting of the Engineering Committee of the Manchester Steam Users' Association, held at the offices, 56, Mosley-street, Manchester, on Monday and Tuesday, January 28, Mr. Alderman Scholefield in the chair, Mr. Bailey, C.E., Bamford, C.E., Fletcher, and Mitchell, C.E., attending, from which we learn that the Board of Trade inquiry into the explosion of the steam vessel in the working of the Manchester Ship Canal, in March, 1882, which explosion resulted in the loss of 12 lives, has been completed and the Board of Trade experts state that the causes of the explosion have investigated and reported on 45 explosions, since the 25 persons were killed and 34 others injured. The report attributes the explosions to the following causes:—1, explosions, 3; 2, overheating of plates, 3; 3, defective safety valves, 5; 4, defective boilers, 4; 5, weak or defective rivets, 3; 6, shortage of water, 3; 7, overheating through shortage of water, 1; 8, defective safety valves being inoperative, 4; 9, killing 1 person, 1; 10, defective boiler seams, 2; 11, defective furnaces, 2; 12, killing 2 persons, 2; 13, explosions, 3; 14, explosions, 3; 15, explosions, 3; 16, explosions, 3; 17, explosions, 3; 18, explosions, 3; 19, explosions, 3; 20, explosions, 3; 21, explosions, 3; 22, explosions, 3; 23, explosions, 3; 24, explosions, 3; 25, explosions, 3;

handling in Paris

That the electric lighting has distributed over the city of Leeds, with which the Municipality have contracted for the supply of current, is the

lighted by the electric light. More than 100 forms with reflecting shades are employed, and the effect is very good. The installation has been carried out by Messrs. Holmes and Company, of Liverpool.

Notes.

A meeting of the Institution of Mechanical Engineers will be held on Friday evening, the 7th inst., when a paper on "Steam Engine Governors," by Professor Unwin, will be read and discussed.

The Wellington Club ball-room, Liverpool, is now lighted by the electric light. There are 100 Swan lamps, with reflecting shades, and the effect is very good. The installation has been carried out by Messrs. Holmes and Company, of Liverpool.

Next Monday evening, the 10th inst., at the Royal Institution, Albemarle-street, Piccadilly, Professor Dewar will commence a course of three lectures on "Recent Researches in Spectrum Analysis." The course will be illustrated by a lime-light engine furnished by Messrs. F. Darlot and Co., of Paris, and by experiments.

The Institution of Civil Engineers will meet on the 1st inst., when was read a paper on the "Electric Lighting of Glasgow," by Professor Jenkin, of the University of Glasgow, and Mr. Mavor, of the Glasgow Corporation Water Works. The author is Professor of Engineering in the University of Glasgow, and the installation was carried out by the Municipal Authorities of that city. There were eight arc lights and 25 incandescent lamps in use during the trials, which were made on the 20th and 21st of November, 1883.

which effective and electric lights are set up here, and as which lights may be easily seen from the Thames, and which, it is certainly that the area shall be well lighted, and that there would be considerable difficulty in drawing the line between the two systems. The Board of Trade would have to consider whether they would not be bound to carry out the letter of the law, and to compel the Municipal Authorities to light the whole area, or an adjustable line, which would be very difficult to draw. The Board of Trade would also have to consider these difficulties are evaded by the Municipal Authorities placing the lights on the north side of the river, and not on the south side, as at present. The matter of future electric lighting will be considered by the Board of Trade shortly.

HORIZONTAL ROBING MACHINE.

The accompanying illustration represents a horizontal robing machine, specially designed by the makers, Messrs. Krupp, of Essen, for the manufacture of steel tyres. The machine is shown in the act of forging a tyre, which is placed on the mandrel, and is being operated upon by the hammer. The mandrel is carried by a traversing carriage, which is moved backwards and forwards by means of a screw, as the tyre is being forged, so that the hammer may operate upon every part of the tyre. The mandrel is also capable of being rotated by means of a worm and worm wheel, which are driven by a steam engine, as shown in the illustration. The machine is capable of forging tyres of any diameter up to 6 ft. 6 in. and 2 ft. 6 in. wide.

(To be continued.)

plying current to 1200 lamps, and driven by Porter-Allen or Armington-Sims engines, and Babcock-Wilcox boilers. In August, 1883, the Edison Company made a contract with the communal administration for the lighting of the Theatre de la Scala, and immediately afterwards they commenced work in the interior of the theatre, and also at the station, where they erected two new dynamos and a fifth boiler. This was all completed towards the end of November last, when the theatre was lighted for the preparatory rehearsal days, and on December 21 the electric lighting was formally inaugurated.

The conductors are laid under the footpaths of the principal streets of the central portion of the town, in the neighbourhood of the Place du Dôme, and measure nearly 4 miles miles in total length. They extend to a distance of 1645 ft. in a straight line from the central station. The system supplies current not only to the Theatre de la Scala, but to also the Manzoni Theatre, and to a great number of private consumers, among whom there are three cafés, and many cafés, restaurants, and shops, particularly in the Place du Dôme and Galerie Victor Emmanuel. The number of lamps fed from the station is about 3200, and by the end of this month will have increased to more than 4000, as the wires are being rapidly extended to subscribers who have already contracted to take current. During the present summer it is intended to extend the system to other streets, increasing the number of dynamos to ten, sufficient to feed 10,000 lamps.

The contracts for furnishing light to consumers stipulate for various prices according to the consumption, upon the base of a constant sum for each lamp erected, to cover the interest and amortisation of the first cost, and as much per hour for the working expenses. Upon that plan large consumers have the electric light at a price about equal to, or rather less than, the price of gas, which costs at Milan 6s. 3d. to 8s. 4d. per 1000 ft., while small consumers, who burn their lights a less number of hours, pay ten to twenty per cent. more than for gas.

The Theatre de la Scala is the largest which has, as yet, been lighted by incandescence lamps. Under ordinary circumstances it is illuminated by 2500 lamps, of which 1000 are on the stage, which is the largest in the world, 410 in the auditorium and 500 in the vestibules, corridors, foyers, and boxes, and the rest in the offices, chauffeurs'-hall, staircase, cloak-room, pitching room, &c. The intensity of the light on the stage is 1200 lamps of 16-candle power. The installation, of which sight are for the nine floats, three for the battens, which number thirty-two, two for the foot-lights, and three for the great chandelier. These groups of lamps are controlled by twenty contact pieces corresponding to an equal number of degrees of illumination, from sixteen candles down to two. There are also four pendant regulators for the movable lighting apparatus, which can be placed at any part of the stage. These comprise six projectors, having in all ninety lamps, and twelve festoons of ten lamps each, designed to be laid on the boards to light the decorations from below. In every case the current is carried by conductors of stranded copper covered with India-rubber, and these are laid between the scenery, just as the ordinary flexible gas tubes are. All the lamp carriers are provided with red and blue glasses, in addition to transparent glasses for scenic effects. There are four main conductors carrying the theatre, which is at a mean distance of 1500 ft. from the station, and these conductors supply separately the stage, the auditorium, the vestibules, and foyers, and the extra scenic effects.

Besides the lamps already enumerated others are being erected for galas and *bal masqués*. They include 45 groups of five each in the auditorium, and 600 lamps on the stage. All the material of this immense installation has been constructed at the company's works at Milan, and in private manufactories, under the direction of Jacobi, Haskins, Gerard, Clerc, and Al. Guerini, and was sufficiently complete a few months before the rehearsals of the opera and ballet were ordered on December 21. At that date the new illuminant was viewed by the public, and received with the warmest acclamation.

Besides the central station, the Edison Company has numerous isolated ones in Italy, among which may be mentioned one of 1000 lamps at a cotton mill at Vendrì, with 500 lamps; one of 500 lamps at the Crespi spinning mill, and 300 lamps at the Nisalm weaving factory, besides others.

NOTES FROM THE UNITED STATES.

From Philadelphia, Feb. 22, 1884.

The American iron trade has not gained as much ground during the past week as the indications a short time ago seemed to promise. Inside selling prices to-day are 20 dols. for No. 1 foundry, ordinary, to 21.50 dols. for special makes; 18.50 dols. for ordinary No. 2 to 19.50 dols. for best. Of large sells in small lots at 17.50 dols., or makes at 19 dols.; very little sells above 19 few lots have brought 19.50 dols. The very investment of foundry and forge is for a slight increase in current requirements, about sufficient manifested by some about, although occasional inducements a the height of concession of about 25 Production is now at its lowest limits, as declined; a few weeks more of these or bring the iron trade to its turning point; demand is undoubtedly looked for by the watching the market the most closely higher prices will not be asked, quotations ably be even more firmly held than at occasional fermentation is likely to set in, provocation in effect by other furnaces Southern irons are selling at 16.50 dols., native, Charcoal liquor, 23 dols. to 50 bar, of fair makes, 32 dols. to 35 dols., and rial has sold at a little less. Common iron request at country mills, at about 1.75 cts., 1.85 to 2 cents; small lots from Merchant steel is in better requests, and are selling, and prices are very low; c active, and any upward tendency is out tion. Construction iron for car work, work, bridge work, and for ship and boat nearing its small lots at low prices. Cons nective that manufacturers are induced to concessions in order to attract as much sible. The rumour that steel rails would 28.50 dols. to 30 dols. is without foundation, a inside price for large lots at present, 30 dols., and in western mills 1 dol. to 2

ELECTRIC GOVERNORS.

To the Editors of Engineering.

Sir,—Surely Mr. Richardson deserves the credit of having invented all possible methods of "governing electricity," but only on the assumption that he be justified in saying that "Mr. Wilson's an infringement of his patent."

In the Provisional Specification, No. 5, A. D. 1, Andrew Jackson, from whom I have received a very letter on the subject, describes the idea appropriated followed up and published in his first specification.

But surely the idea of "governing the electricity" must have occurred to many, and if of an electro-magnet or solenoid directly to the engine would probably be the first method to itself.

But the difficulty lies in the practical application. The idea of a Chinese giant (or a dwarf) with an enormous wheel-barrow, and a child to control him is the first picture which presented itself when I myself, but he could hardly be that that combination was "essentially a principle" as the accountant more practical engineer, with a boy to drive, although I admit the saving the advantage of being more direct in Both solenoids and electro-magnets controlled by current lighting are not powerful enough to throttle valves, still less to actuate the cranks they must of necessity be placed on bridges main conductors, and must entail a loss of electrical the amount of which depends on the resistance and the electromotive force employed, as the resistance is constant, as it were, of series, it is consequently at some greater the actual work if it could be done directly economy in the production of the current.

Apart from the question of cost, a large saving made to work a small throttle valve direct, be a very large one, for the power available, valve pull on its cord, but only such a force to provide the maximum difference in electric pressure.

In the week any collision form of reversible solenoid direct is practically impossible, at *a fairly easy* if the solenoid's duty is merely a with some greater power. The solenoid is my governor, and I have only myself to blame that the friction of the plates was not overcome and the pull of the throttle valve changed.

The total amount of total pull to frictional resistance as 10 to 1, and the frictional power absorbed was rather less than half that of the electrical power developed.

But the friction of a throttle valve is nothing, working conditions, at any rate where shutting-down high-pressure steam are used, must be measured pounds, not in fractions of an ounce, and the total pull between frictional and electrical resistance is 1 retained. In fact, Mr. Richardson's governor must powerful, and should be more sensitive, than the ordinary governors with which it has to compete, and with electrical governors ought certainly to supersede.

Engineering, Feb. 24, 1884.

ELECTRIC LIGHTING NOTES.

THE Maxim-Weston Electric Company, Limited, have just completed an electric lighting installation for the new British Iron Company, Limited, who are, we believe, the first ironmasters in South Staffordshire to introduce the electric light. The light is installed in the mills and forges of their Congreaves Works at Cradley, near Birmingham, the current being supplied by a Weston dynamo to eleven Weston arc lamps and an estimated lighting power of 1600 candles each. The dynamo is driven by one of Messrs. Tangye's vertical engines of 16 nominal horse-power, having a 10 in. cylinder, and revolving at a speed of almost 150 revolutions per minute. The current is transmitted from a flywheel 48 in. in diameter, by means of a 7 in. leather belt, to a short length of shafting, carrying a wrought-iron pulley on which transmits the power to the dynamo by means of a 5 in. belt. The dynamo makes 1050 revolutions per minute when supplying the eleven lamps with a current having an electro-motive force of 280 volts, and an intensity of 19 amperes. With the arrangements made by the New British Company for the maintenance of, and attention to, the lamps, the light is expected to cost, at any rate, not more than 4*d.* per unit, and to give much better results—minimising waste, increasing production, and generally giving an improvement in the finished iron departments where it is located.

The s.s. Valetta, recently built by Messrs. Caird and Co., of Greenock, has been fitted throughout with the electric light by the Edison and Swan Company. The dynamos are two Edison L. machines, which have been altered to run at a slower speed—rather over 500 revolutions per minute—and sustain a somewhat larger number of lights than the normal number, by the strengthening of the magnetic field and certain other modifications. They are each capable of sustaining 200 incandescence lamps of 16 candle-power actual; it is only for a short time during the evening—when all the lights are burning, amounting to about 300, as reported at once—that it is necessary to run both machines at the same time. They are driven by a pair of vertical engines running at 270 revolutions per minute, made by Messrs. J. and H. Dewrance, of Hammersmith, and geared by means of an unoiled cotton rope, which runs three round pulleys provided with ten LJ grooves, the last turn being guided back to the proper groove by a pair of small guide pulleys. This arrangement was first introduced by Messrs. Siemens Brothers; it works very successfully, and is free from liability to break down, besides throwing very little strain on the engines. The dynamos are placed on sliding rails, and by means of screws can be moved forward to compensate for the stretching of the rope. The saloon is fitted with two rows of handsome gilded two-light pendants hung over the tables. The state rooms are lighted from lanterns let into the bulkhead, which also throw a light into the alley-ways, and are made to carry a candle as well as an incandescence lamp, the engine-room, stokehold, and the various officers' quarters, and forecastle, &c., are all supplied with substantial fittings, and are well lighted throughout. The wiring is, as usual in all installations made by the Edison and Swan Company on board ship, run in wood mouldings securely separating the leads one from the other, all main and branch circuits being fitted with fusible plugs. Where necessary, individual lamps are controlled by switches on the sockets, and a substantial switch board is placed in the dynamo room, to which are led the six circuits into which the wiring is divided. These are so arranged that by changing the plugs any circuit may be connected up to either dynamo. During the stay of the Valetta in London previous to her departure for her first voyage to Australia, the light was frequently exhibited to the visitors whom the Peninsular and Oriental Company invited on board. The entire absence of perceptible noise from the machinery was noticed as a very important feature of the installation, one of the most recent and best examples of the application of the electric light to steamships.

As might have been expected, the bold and trenchant policy of the Anglo-American Brush Corporation is being followed by other electric lighting companies, which, drifting fast on to the rocks of bankruptcy, can only hope to avert destruction by throwing overboard all superfluous cargo, and here and there a Jonah whose presence is likely to sink the ship. By doing this some of the associations may weather the storm, and hope yet to make a fair coast and prosperous voyage, but we must look to see the loss of many a good ship ridden on the rocks aforesaid, which, at least they will serve as a warning and land-mark to future adventurers. It is the Gulcher Company that has been adopting a policy of vigorous retrenchment. This company was established on the 1st of May, 1882, with a capital of 200,000*l.* in 40,000 shares of 5*l.* each, Mr. Gulcher and Mr. Grath had sold these patents to Mr. S. A. Hamilton for 20,000*l.*, of which 10,000*l.* was in cash and 20,000*l.* in shares. Besides these patents Mr. Crookes for incandescence lamps were bought for about 22,000*l.* in fully-paid shares. Mr. Hamilton sold to the Gulcher Company, his rights for 45,000*l.*, being 25,000*l.* in cash and 15,000 fully-paid shares. It is, first, the foregoing statements are shown on the face of the Registrar of Joint Stock Companies. However, from the company's report read at a meeting of the shareholders on Tuesday last, it appears that the actual capital consisted of :—

	£ s. d.
10,000 fully paid shares of 5*l.* each	= 50,000 0 0
30,000 shares on which 5*s.* 10*d.* has been called	= 29,906 10 0
Total capital	= 79,906 10 0

It is now proposed to cut down this capital to 50,754*l.* 10*s.* The condition of the company was such in September last, three special committees were appointed for investigation, for Financial, Patent, and Works. According to the reports of these committees, also was the condition of the company, and of course, the remedies to be applied. But the dark cloud had a silver, or at least a Britannia metal lining. Like the moon in the parable, the company had fallen among thieves—but into deep distress, and was lying helpless and all but insensible. But no harrier passed by, as Batterers, only good Samaritans, the very best of good Samaritans, these thieves came to the rescue, rescued up the company's wounds, and set it on its legs more than this they have forgiven large shares, and with a generous impulse too often inconsistent with commercial instinct. As time : The directors had actually received 70,000*l.*, of which 50,000*l.* were in fully paid-up shares, 20000*l.* in cash, and 18,000*l.* in shares on which 2*l.* 10*s.* per share had been (nominally we presume) paid up. The value of this large amount the promoters now proceed to the company including the 20000*l.* in cash, and ask for nothing in return save that the company undertakes to press them for the 5*l.* per share due on their partly paid-up shares aforesaid. But generosity has its limits, and the promoters had paid a call of 10*s.* per share or 6000*l.*, and further, as they had incurred the expenses of bringing out the company, they are now to receive fully paid-up shares amounting in nominal value to 7000*l.* Possibly some of the ungrateful stockholders might have preferred that the promoters should have been content with the remaining 3*l.* due on their shares, under the call for 30,000*l.* in cash would be useful, but this it would have been unreasonable. In the same spirit, the Messrs. Gulcher, Grath, and Crooker consent to waive their claims, or rather to allow the number of fully paid-up shares which they had received in part payment for their respective patents to be reduced, until they shall bear the same proportion to the general capital after the cutting away of the promoters' shares, as they did before that operation. This being done, the amount paid for the patents will be 40,000*l.* instead of 110,000*l.* The Finance Committee made a sad discovery in the course of their investigations. On October last a bill of sale for 11,000*l.* had been given, covered by the whole available assets of the company, for a fifth call, which was payable on the 29th of October, and all arrears of call were nominally to one creditor, and, but funds in hand were insufficient to pay that debt, while a sum of 10000*l.* placed to credit in Jones turned out to be a liability in October.

Further calls on the shareholders put over three difficulties, but did not remove a new one. The operations of the Gulcher Company were (must not) carried on in works at Battersea, leased by Messrs. Bunsome and Co., of Chelsea, for a rental of 1000*l.* a year, and by an agreement with Messrs. Bunsome, the latter firm were to receive a commission of between 4 and 5 per cent. on the whole turnover of the company during five years. Now when the "intolerable character of the burden of such a commission" was represented to Messrs. Bunsome and Co., the firm acted with a generosity which throws that of the promoters and patentees far into the shade. They at once abandoned their whole claim, and not only reduced the rent of their tenants to 400*l.*, and the only thing they asked in return was that the Stanley Works Company, Bunsome and Co.) should be lighted on the Gulcher system during one year. In other words, not content with making these concessions, their sole profits in the embarrassed company, they advertise for the most economical mode of lighting, and the excellence of their very admirable system. Then, too, Mr. Crookes, the electrician of the company, has given up, or rather postponed, for the present his salary of 625*l.* a year, until the company's new association can bear the charge. As for the third report, we need only say that the Works Committee appear to have introduced many of the fundamental requirements for the proper carrying on of business, which were absent before the time of the special capital consisted of :—

	£ s. d.
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30,000 shares on which 5*s.* 10*d.* has been called	= 29,906 10 0
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The London Daily Chronicle, Nov 6, 1882

PUBLIC COMPANIES.

BRUSH MIDLAND ELECTRIC LIGHT AND POWER.

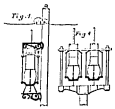
An extraordinary general meeting of this company was held yesterday, at the Caledonian Hotel, No. 3, St. Giles in the-field.

Mr. Cockburn (the chairman) said that the circumstances which led to the necessary consequences of several shareholders, whose holdings were of small amounts, having summoned a meeting of the company to recover the money paid on their shares on account that the statements in the prospectus as to the advantages which the company having the sole and exclusive right of the Lane-Fox patents would enjoy were not borne out by the documents before over by the company. With very little delay, a petition was written, a petition had been signed, and presented to the Chancery Court, and the result was that the provisional committee was not altogether so pleased. Certain small shareholders, representing 10 out of a body of over 200, and representing 10 shares, had taken advantage of what they considered the misstatement in the prospectus to bring serious pressure to bear on the future of their money. Some of the shareholders had been under the impression that a petition had been filed in Chancery to wind up the company, but this petition was quite of a friendly character, and it was only presented to protect the large shareholders against these small shareholders who were in a position to embarrass the undertaking. The misstatement upon which they founded their claim was that the prospectus stated the concession to be for the whole of the United Kingdom, whereas it had been ascertained that this was not absolutely the case, and that a company had not been injured in the event of obtaining or having the exclusive use of that lamp. They had therefore come to the conclusion that they could not carry on the business of the company profitably to obtain a all the Lane-Fox patents, and that they had been able to secure the rights for the whole of the United Kingdom, with the exception of Ireland. The word "exclusive" was used, but the error was quite a technical one, and of no practical importance to the company, as although the company had only been in existence a little more than six months, it had already been at work only for months, and had done a very good business, and had already got a large amount of outstanding accounts which would be coming in, and therefore he thought that the liquidators would be able to pay 20*s.* in the pound on the 5*l.* shares. Gentlemen who are fighting with very great success. Their district was mainly one of small towns, and of course the company was supplied with the small motor to provide the light much cheaper than they could have done if they would have to provide the motive power. They had not very well turned out Nottingham, where they had not very good premises, and where they had also to contend with the fact that the town gas had no less than five contracts. They had also to contend with Leicestershire, as at Chester, one as Stockport, and one at Nottingham. These companies were all in a flourishing condition. Of course, they had not been at work, as that the company was doing very well indeed, and that the very prospect of a very successful future for it. He moved—"That this meeting having heard the statement of the chairman as to the position of the company is of opinion that the business of the company can be carried on profitably, and that the proceedings of the shareholders who have demanded the return of their money, and therefore requests the directors to arrange with Mr. Wigram for the immediate withdrawal of his petition."

The resolution was seconded by Mr. Braithwaite, and carried with one dissentient.

The usual votes to the chairman and directors concluded the proceedings.

cooling 2.35 pence.* From experience obtained at other installations where they have more economical steam engines at work, Messrs. Crompton hope to reduce the



coal consumption on the Crompton arc light from 1.26 pence to .51 pence, which is the cost for coals for lights of equal size at King's Cross, and that for the Weston area from .54 pence to .26 pence.

TABLE I.—*The Electric Light at Norwich. Particulars of Horse Power absorbed.*

	H.P. at Horse Power as calculated from Indicator Cards.	Horse Power absorbed by Dynamo.	Horse Power absorbed by Shafting.	Horse Power absorbed by Lamps.	Arc Lights Crompton 2 Horse Power Lamps.	Arc Lights Weston 2 Horse Power Lamps.	Arc Lights Crompton 1 Horse Power Lamps.	Arc Lights Weston 1 Horse Power Lamps.	Arc Lights Crompton 1/2 Horse Power Lamps.	Arc Lights Weston 1/2 Horse Power Lamps.	Arc Lights Crompton Small Size Lamps.	Arc Lights Weston Small Size Lamps.	Incandescent Lights.
Engine unloaded	11.04	10.24	1.39										
Total, shafting and 11 dec. dynamos	11.81	10.24	1.39										
Arc lights in Prince of Wales'-road, brother to Market-place, Hall-plain, driving 7 Weston and Princes Street, Crompton, and 2 Crompton arc market lights	10.37	10.24	1.39	8.98				0.98					
Arc lights in Prince of Wales'-road, Princes Street, and 2 Crompton arc market lights	11.04	10.24	1.39	8.98		—		0.98		—			
Arc lights in Prince of Wales'-road, Princes Street, and 2 Crompton arc Market-place, 2 Weston arc Hall-plain, and 10 Swan incandescent lights	10.8	10.24	1.39	8.98	6.62	0.62	0.81	1.85	1.5				

TABLE II.—*The Electric Light at Norwich. Details of Working Expenses.*

	Horse Power used.	Coals per Hour.	Cost of Coals per Hour.	Coals per Horse Power per Hour.	Cost of Coals per Horse Power per Hour.	Cost of Water per Hour at 2s. 6d. per 100 gallons.	Cost of Oil, Waste, and Sundries per Hour.	Cost of Wages per Hour.	Total Cost per Hour.	Total Cost per Hour, in Pence.
	H.	lbs.	£ s. d.	lbs.	d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.
For each Crompton arc light	6.56	3.94	—	1.26	.51	.21	.52	.37	1.10	2.35
For each Weston arc light	1.79	1.34	—	.454	.183	.15	.157	.37	0.82	1.75
Total	15.8	10.8	1.17	0.75	0.306	1.36	1.2	0.42	1.4	0.716

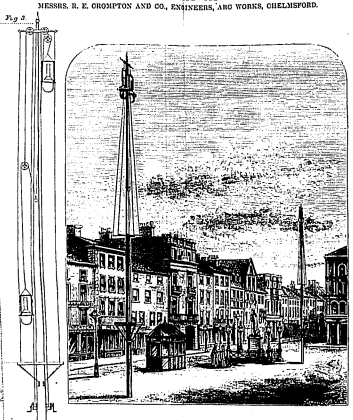
Under these conditions Messrs. Crompton think that the forty lights will not cost more than 5s. per hour, or at the rate of 1.26 pence per hour for the Crompton arcs, and 0.54 for the Weston arcs.

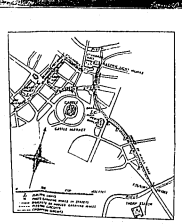
These Tables point out very conclusively that any considerable saving is to be looked for in these installations must be chiefly sought in the steam engine, and in the reduction of the coal bill. Some slight saving in improvement in the dynamo machines and lamps will have a but slight effect in reducing working costs. For instance,

* It is intended shortly to increase this Norwich installation to a total of 1,000 incandescence and thirty Weston arcs, and as the cost of superintendence and interest will remain nearly fixed, the working cost will be greatly lessened.

THE ELECTRIC LIGHT AT NORWICH.

MESSRS. R. E. CROMPTON AND CO., ENGINEERS, ARC WORKS, CHELMSFORD.





if a steam engine using but 2 lbs. per hour per natural horse power were put in, it would effect the reduction of 10 pence in the two items of 14.75 pence for coal and water. A reduction of carbon rods to one penny a foot would effect a saving of 2½d. on that item, the combined saving reducing the total cost from 40 pence to 25 pence. The wires are throughout No. 8 B.W.G. bare copper

wire carried overhead in a most substantial manner, on strong Stanton telegraph posts, and insulated in the usual way by earthenware insulators carried on oak cross pieces.

In Lesser-street, there are no poles, the wires being carried on east-iron brackets of ornamental design, bolted on to the fronts of the houses; some of the lamps in London-street are carried on the same brackets. The arc lamps are throughout arranged in pairs so that if any lamp fails to burn properly, or when its carbons are burned out the second lamp is automatically switched into circuit so that there is no interruption in the lighting.

The almost wasteful brilliance of the Haymarket, Market-place, Hall Plain, and Post-Office Plain has been of service in a somewhat unexpected manner. These open spaces in their former imperfectly lighted condition were the favourite resorts of the itinerant and homeless, and other disreputable characters. The police assert that since the introduction of the electric light it is a comparatively easy task to keep the pavements at the above points clear and orderly.

At before stated Messrs. Crompton now contemplate extensively adding to their plant, and supplement the public lighting by hiring out the current for incandescent lamps to all such consumers who care to use it within the area covered by their conducting wires.

The accompanying engravings show the general aspect of the works of the installation, and details of the light posts and the mode of suspension of the large Crompton lamp, as well as that adopted for the lower and smaller Weston regulators.

Engineering, April 7th 1882.

ELECTRIC LIGHTING NOTES.

THE Maxim-Weston Electric Company have contracted with the Science and Art Department to light the Bethnal Green Museum. They are furnishing the electric light at the Silbury Dock Works to enable the work to be prosecuted continuously day and night.

The library and dining-room of the House of Commons is now lighted by the Edison Electric Light Company with 265 incandescence lamps; three more being used in the engine-room. The power is derived from one of Armington and Sims' steam engines of thirty horse-power, fixed near the ventilation works, and conveniently remote from the boiler of the works. A cable of 1,000 ft. in length runs from the engine-room to the library and dining-room, where branch wires go to the clusters of lamps. Each clusterlier is kept under perfect control by means of a switch within the cupboard, and any lamps can be turned off without affecting the rest. The lights are partially turned down at midnight. The contract for the lighting extends to the end of the present session of Parliament.

At the forthcoming electrical exhibition in Vienna there is to be a pavilion specially constructed according to the wishes of the Emperor of Austria, and designed to show the effect of the electric light on clothe and broideries. Different systems will be exhibited. The Academy of Painting and Sculpture at Berlin has been lighted by 200 Edison lamps, and the dynamo is driven by a 30-horse-power engine of sixteen horse-power. At Budapesth, the capital of Hungary, the National Theatre is to be lighted by 1,000 Swan lamps. The Theatre of Rome, the Scala, has been lighted for several months by Edison lamps. The Municipality of Moscow has voted a sum of 30,000 roubles for the illuminations on the occasion of the Czar's coronation in May. The roof of the Kremlin, the ancient residence of the Czars, will be lighted with 69 electric lamps, each of 400-candle power.

The Gulcher Electric Light and Power Company, Limited, have been for some time settled in commodious premises in Battersea, adjacent to Messrs. A. Ransome and Co.'s foundry, and are actively proceeding the manufacture of their dynamo and arc lamps, and the Crookes incandescence lamp, of which they have acquired the patents. As our readers will remember, the Gulcher generator has an armature of disc form, and like a Pacinotti ring, and rotating through four U-shaped pole-pieces, alternately presenting north and south poles. The machine may now be made in six sizes, of which the smallest, No. 1, is capable of feeding four arc lamps of 450 actual candle-power, or two lamps of 1000 candle-power, or one of 2000 candle-power, or 20 incandescence lamps of 20 candle-power each. The largest machine, No. 6, with feet 128, or 64, or 32 arc lamps of 450, 1000, or 2000 candle-power respectively, or 640 incandescence lamps of 20 candle-power each. The characteristic feature of the Gulcher system is that all the lamps, whether arc or incandescence, are burnt upon parallel circuits, hence the two may be fed from one machine without any special arrangement, so long as both are designed for the same electro-motive force. Another great facility is with some difference of potentiality and rapidity derived from the extreme simplicity of regulation of action of the lamp, which is illustrated on page 411 of vol. xxxiii., and involves no extra apparatus whatever. All the lamps are of the same pattern, the difference between the large and the small ones consisting in the winding of the magnet, the diameter of the carbons, and the length and diameter of the arc. As the intensity of the current existing in the arc for each lamp depends upon its resistance, it is necessary that each should be carefully adjusted, and accordingly Mr. Gulcher has fitted up a very complete testing room in the works, in which every lamp is submitted to several hours' continuous trial, while at the same time the current passing through it, the difference of potential at the terminals, and the form of the arc are carefully noted. Although all the lamps are identical in principle, and in relative main characteristics, yet there is considerable variation in their external form. In addition to the table lamp shown in the illustration referred to above, the company manufactures a hanging lamp, a bracket lamp, and a sleep lamp, in which the arc is hidden in an inverted open-mouthed cone of opal glass, and the light is

(thrown on a white reflector above, and so distributed. The incandescence lamp of Professor Crookes is at present but little known to the public, but the great reputation of its author cannot fail to procure for it a favourable reception. Its manufacture is carried on, in a separate part of the works, where special apparatus has been erected, and every arrangement been made for producing the lamps in large quantities and at a cheap rate. Glass-blowing machines have been introduced, and an improved form of Sprengel pump, by which as labour is utilised as far as possible. The filaments are made from threads wound upon spun fragments of boxwood in cupro-ammonium until the cylinder attains the desired size; they are then withdrawn from the ammoniacal solution and carbonised to a black colour from the presence or contact to reddish, this they are soaked in weak acid, after which they are ready for carbonisation. This is effected in the usual way, the filaments are then inserted in the globes, and their resistance regulated by the passage of a current through them, while in an atmosphere of chloride of carbon. There is a large Crookes' installation, including 600 Crookes' lamps, at the Crystal Palace Exhibition.

Engineering, March 2, 1882.

ELECTRIC LIGHTING NOTES.

THE works of Messrs. Martin, Sons, and Co., of Lindley, near Huddersfield, have been lighted by the electric light by Mr. Wilson Hartnell, of Leeds. The installation includes three Crompton-Rimgin dynamo machines, nine Crompton-Crosley arc lamps, and twenty-nine Swan lamps. Eight of the arc lamps are fed with a current of fourteen ampères each, and one placed in the dye-house for matching colours, with twenty-eight ampères. The entire installation is very successful.

The Electric Lighting Committee of the Leeds Corporation have unanimously accepted the tender of Messrs. Paterson and Cooper, of the St. Paul's Telegraph Works, London, for the lighting by electricity of the library portion of the new municipal buildings which are to be opened in Easter week. The contractors undertake to carry out the work for 1500*l.* The dynamo machines will be driven by two of Messrs. Crossley Brothers' twelve horse-power Otto gas engines which, however, as the engines have already been purchased by the Committee, and the work in connexion with the electric lights is to be completed within two months from the acceptance of the tender.

It has been decided that the Jablochkoff Electric Light and Power Company shall be wound up voluntarily with a view to reconstruction, under the supervision of the Court. This will be a matter of surprise to many, who knowing that the company started with a good system, and has not spent much in perfecting it by experience or in advertising itself, imagined that it might at least not lost much of its capital, even if it has not made any profits. The extension of the Jablochkoff system on the Continent, coupled with its extreme simplicity, appeared to promise for it a more successful career there than its promoters have succeeded in securing for it, and it is difficult to comprehend why it is that its operations have been so limited. The company was established in the latter part of 1882, with a capital of 300,000*l.* in 60,000 shares of 5*l.* each. The electric light fever was then at its height, and 240,000 shares only were subscribed for by the public, representing, however, a cash capital of 1,200,000*l.* Twenty thousand fully paid up shares were issued as the price of the patents, and the same number remained unissued. The directors agreed to be sent that the chief feature of novelty consist in give 60,000*l.* in cash to the promoters. The wisdom of the absence of a reflector and the use of a holophote, this course is extremely questionable, and the policy of giving such enormous sums for patents, however valuable, when the vendors are willing to sell for scrip, is always questionable, and in this case the balance sheet submitted to the meeting showed other facts which cast still more serious doubts upon the good policy of the management. It is a pity that a company which has an established reputation, a system which has many excellent features, a capital which, though not large, is sufficient, and whose assets exceed its liabilities, should have to resort to winding-up for the purpose of reconstruction, although the process is no doubt a convenient one in some respects. We have always had a high opinion of the Jablochkoff system, and trust that it may soon again be in the front under more favourable conditions.

On the evening of last Friday a party of gentlemen from the Admiralty, the War Office, and several foreign governments, met at the works of Mr. Peter Brotherhood in Lambeth to witness the trial of a new search light, constructed by Messrs. Siemens Brothers for Mr. Gordon Bennett's yacht Namouna. The beam was projected across the Thames on to the clock tower of the Houses of Parliament, and elicited the unanimous admiration of the spectators by the extraordinary penetration of its powerful rays. The optical arrangement is a long focus holophote of the third order, consisting of a central lens and four concentric rings, the whole being about 22in. in diameter. In the front of this there is mounted, in a hinged frame, a sheet of plate glass to protect the lenses, which become warm from the heat of the arc, from splashes of sea water and spray. The lamp is fed by a current of 100 ampères, and is regulated by hand. The upper carbon is set behind the lower one, so that the crater is turned towards the lenses, and nearly all the light directed towards them, and to still further increase this effect the lamp is inclined at such an angle that the glowing surface of the carbon is approximately vertical, and parallel to the general plane of the holophote. When alternate currents are employed, and the carbons consequently consume symmetrically, the lamp is placed, of course, in the usual position. The motions of the carbons are regulated by a handwheel by which either or both of them can be moved, while their appearance can be observed through several coloured glass windows in the casing. To insure that the luminous centre shall be maintained in the optical focus of the instrument an image of the carbons is projected on to a screen by means of a lens and a mirror, and thus it can be seen at a glance if the consumption of either carbon is greater than that for which the gearing is arranged. The whole apparatus is mounted upon trunnions carried in two arms united to a vertical axis capable of rotation, and thus the light can be turned in any direction whatever. The arms are hollow, and serve as passages for the leading wires from the lamp; these are connected to permanent sliding contacts on the central axis, moving over corresponding contacts on the base. There is a graduated circle upon the base, and a semicircular quadrant upon the casing containing the lamp, and by their aid the light can be directed on any spot whose position has been found during the daytime by means of a theodolite or similar instrument. This arrangement is more particularly intended for service on land. Special care have been taken to prevent the objectionable heating which has characterised nearly all search light apparatus hitherto made. The casing is made of ample size, and has double sides, ground and between which a vigorous ventilation is maintained by air inlets and outlets, below and above. Over the mirror is erected an escape pipe, protected by a hood, for the air and the heated gases which rise directly into it, and no efficient is the arrangement that no part of the exterior of the apparatus becomes more than pleasantly warm to the hand. There is also an apparatus for transmitting signals by the Morse code, which has the advantage of allowing signals to be sent with the whole beam of light, either concentrated or dispersed by means of an additional lens—a result which has not been hitherto obtained. There is ample ventilation of the lantern. The current is produced by a Siemens dynamo of the type D, connected direct to a Brotherhood three-cylinder engine by an elastic coupling, and running at 400 revolutions per minute. Thus it will of novelty consist in the absence of a reflector and the use of a holophote, by this means a very narrow and concentrated beam is produced, while the long focal length of the lenses permits of the arc being kept at a safe distance from them. This latter is a most important point, as hitherto the glasses have often suffered from the heat and flame emitted by the arc, and to the general arrangement, there is little to be said, except that it displays that minute attention to details and points of practical importance which more often than not make the difference between success and failure than do those which create greater scientific interest. The bridge of a steamship is a very different place from a laboratory, or even from an engineer's shop, a fact which electricians have often forgotten in the past.

THE EDISON SYSTEM OF ELECTRIC LIGHTING.

(*For Description, see Page* 305.)

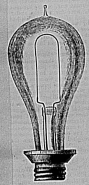


FIG. 1.

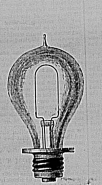


FIG. 2.

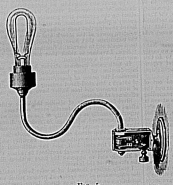


FIG. 5.

FIG. 10.

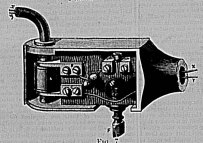


FIG. 7.

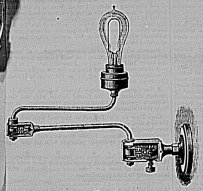


FIG. 6.

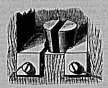


FIG. 8.

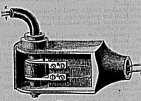


FIG. 9.

FIG. 11.

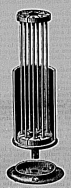


FIG. 12.

FIG. 13.

is about fourteen miles long, and connects the Neath and Brecon, near Danyrarth, with the line of the North Western Railway at Llangammarch, thus forming a slightly more direct route than any existing between the North and Swansea and Neath. By the same Committee has been decided the contest for the traffic between Merthyr and Quaker's Yard, which was the object of the Bills promoted by the Great Western, the Rhymney, and the Taff Vale Railway Companies; early in the day the first-named company retired in favour of the second, full powers over it having been secured, and now the Committee have granted the line of the Rhymney Company, with full powers, &c., over to the Taff Vale Company, thus fulfilling our surmise of last week.

Sir Robert Lindsay's Committee has also passed the preambles of the Bill of the Great Western Railway Company, by which they seek to connect the Rhondda Valley at its southern end with Cardiff by means of their Ely Valley line in one direction, and with Swansea by means of their Llynvi and Ogmore line in the other. This connecting line is about four miles long, and is a nearly direct line from the Porth station of the Taff Vale Railway to Herdon Forchan junction on the Ely Valley line.

Mr. Paget's Committee have evidently had similar views with regard to the Alnwick and Cove. bill; Bill of the North-Eastern, and that of the Central Northumberland Railway, for they have passed the former in its entirety, and the southern portion of the latter from Newcastle to Scott's Gap, and at the same time suggested the expediency of the construction by the North-Eastern Company of the line between Rothbury and Woolperton, the rejected link of the rival scheme; if the evidence of their witnesses is to be relied on it is obvious that the North-Eastern Company have without doubt by far the best of the fight, as they have obtained their desire, and at the same time broken up an opposition line of communication.

The Kilsyth and Falkirk Railway Bill has been passed by Mr. Paget's Committee, and they are now occupied with rival schemes of the Great North

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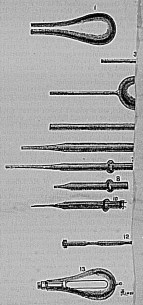

FIG.

and while preventing a much more elegant appear ance, they are not so liable to crack under the influence of unequal heating, and there is a smaller loss of light through refraction and internal reflection.

A considerable portion of the work of manufacturing the lamps is, we understand, performed by machinery, by which greater uniformity is insured, but the chief of operations by which the rough materials are converted into a finished incandescence lamp, is identical in its sequence and character with that of hand-made lamps, and will be understood from Fig. 3. The bulbs or disks are delivered from the glass works in the form shown at No. 1. The first process is to heat the closed end and draw out a hollow cone, shown in No. 2. To this little cone is then fused a short fine tube, by which the envelope is afterwards to be attached to the exhausting apparatus. The bulb then presents the appearance shown at 3. The next process is to prepare the glass stem, by which the

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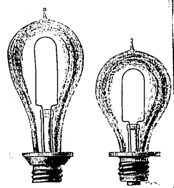

FIG. 1. FIG. 2.

4. That, as to the comparative liability of an ironclad and an unarmoured ship to be sunk by projectiles, there is much less difference than is generally supposed.

5. That for the cost of one ironclad we could have three unarmoured ships of far higher speed and carrying collectively three armaments, each equal to that of the armoured vessel; and he then describes a combat between three unarmoured cruisers and one ironclad, considered to be fairly matched, because representing the same pecuniary value; and assumes the victory would lay with the three unarmoured ships; and, without entering into the technical questions concerning "fleet fighting" concludes that the result would be the same if the number engaged on each side were proportionately multiplied.

6. He argues that we require a far more numerous Navy than we possess, or can afford to possess, unless we vastly reduce our expenditure on individual ships; and to do this we must dispense with armour, and that the chief expenditure of the country should be upon fast unarmoured ships, with armour-piercing guns.

7. He condemns the use of cruisers improvised out of ready-made merchant steamers, and forcibly points out the importance of the police service of cruisers, by reminding us of the enormous property we have at all times at sea in our ships, and that, in addition to their loss, we have also to guard against the interception of food supplies, and that the more our population increases and our agriculture declines, the more terribly effective for reducing us to submission would be the stoppage of those supplies.

I agree entirely in this last suggestion. I have never advocated a reliance on improvised ready-made steamers, and though under great pressure, they would be better than nothing. I hold that special and suitable cruisers, and to the extent expected to be required, are what we ought to rely on for such services as they are suitable. Neither can the importance of their mission be too strongly insisted on, knowing, as we do, that we never have more than four months' food in the country, and the terrible straits we must be reduced to if, from any cause, a stoppage of our imported supplies was to take place.

Before dealing with the important issues I would, in passing, observe that many of the arguments in Sir William Armstrong's paper used to establish the greater value of unarmoured ships over ironclads, really apply equally to both classes, and consequently lose all force when used in support of one only.

Again, after admitting the advantages of steel-faced armour, it is argued that a vessel covered with it, if pierced by a shot, will receive as much or more damage than an unarmoured ship similarly pierced, whereas, from their extreme tenacity, fragments from steel-faced plates, as a rule, never break off, and the damage to the inside of the ironclad would be almost restricted to the passage into it of the penetrating shot.

This might not be the case when the penetrating power of the shot was very greatly in excess of the strength of ship and armour plate to resist it; the injury then would probably extend over a larger area than in a weaker ship, as one can imagine that the strong frames and girders behind the armour might be displaced; but even then I doubt if the damage inside the vessel would be equal to that resulting to an unarmoured ship from a shell bursting in a thin plate.

No credit is taken for the great advantage the ironclad would have from her greater size, giving a steadier platform in moderate or rough weather, and insuring much greater accuracy of aim.

Nor for protection for engines, boilers, and steering apparatus, which can be obtained by armour, while it is not practicable at the present time to place the machinery in fast and full-powered vessels sufficiently below water to protect them from an enemy's shot, nor would it be possible in such cases to give complete protection by coal.

While the fact is lost sight of that an armoured vessel can only be attacked by very heavy guns and would be assailed by very few shot, while an unarmoured vessel,

is about fourteen miles long, and connects the Neath and Brecon, near Devynook, with the North-Western Railway at Llangammarch, thus forming a slightly more direct route than any existing between the North and Swansea and Neath. By the same Committee has been decided the contest for the traffic between Merthyr and Quaker's Yard, which was the object of the Bills promoted by the Great-Western, the Rhymney, and the Taff Vale Railway Companies; early in the day the first-named company retired in favour of the second, full powers over it having been secured, and now the Committee have granted the line of the Rhymney Company, with full powers, &c., over to the Taff Vale Company, thus fulfilling our surmise of last week.

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The Kilsyth and Falkirk Railway Bill has been passed by Mr. Paget's Committee, and they are now occupied with the rival schemes of the Great North of Scotland and Highland Railways to supply accommodation in the extreme north of Banffshire.

The Highland Railway Company's line starts from near that company's station at Keith, and proceeding in a northerly direction strikes the coast at Buckie, at about twelve miles on its course, it then turns east, following the somewhat rugged coast line for about four miles to its termination, about three quarters of a mile from Cullen. It is laid out to suit closely the configuration of the ground, and consequently sharpish curves and stiff gradients of 1 in 60 are made use of, and an inexpensive, and a thoroughly suitable line is obtained.

The course of the line (Banff, Buckie, and Elgin Coast), of the rival company is nearly east and west. Starting from Portsoy it traverses the town of Cullen between the fifth and sixth miles, thence it follows the same course as the Highland Company's line already described, to Buckie, whence it is carried to Elgin, in its course crossing the Spey near its mouth, and where the bed is nearly one-third of a mile wide. For the greater portion of its length the works are comparatively light, but near Cullen they are rather heavy, there being two banks of over 80 ft. in height; it has, however, been suggested that a viaduct might be substituted for one of these which crosses ornamental grounds, but of course this means extra cost not included in the estimate.

In a similar way, the suggested substitution of lengthened bridges for the two small openings, intended to be placed over the Spey, would add greatly to the cost of the undertaking; to these points the opposition has been chiefly addressed, in addition to which the supporters of the Highland Railway allege that their line, little over sixteen miles in length, supplied all the accommodation needed in this district at a far less cost than that of the rival company which is half as long again, and upon which works are necessary, the cost of which must be excessive, and at the same time cannot well be estimated, besides which the carrying of a railway across Cullen unnecessarily interferes with private property. This Committee, however, anxious to make things pleasant so far as the Commons are concerned, have passed both Bills, leaving to the Lords the unpleasant task of deciding if either, both, or neither are to be finally sanctioned.

MEAT REFRIGERATION.

SOME six months ago Messrs. J. and E. Hall, of Dartford, supplied to the Victoria Docks Company one of their medium sized dry air refrigerating machines, for the purpose of maintaining a low temperature in a series of chambers for the storage of sheep carcases sent to this country from Australia. The experiment was a very successful one, and an order was given for a large size machine capable of producing three times the quantity of cold air produced by the first machine. This large refrigerator has recently been fitted up at the Victoria Docks, and is now in daily successful operation. There are in all eleven chambers capable of holding 8000 sheep carcases, which are only temporarily stored in these chambers till the owners remove them to their several market-places. The chambers are arranged in the vaults below the dock buildings; the vaults have a double lining of wood, the spaces being filled with dry wood shavings, and similar partitions and doors divide the vaults up into chambers. Into these chambers the cold air enters through a wooden trunk about two square feet area placed along the bottom on one side of the vaults, and provided with sliding doors to admit the cold air. The latter is produced by the dry air refrigerators of Messrs. J. and E. Hall, the large new machine being capable of supplying 30,000 cubic feet of air per hour cooled to a temperature of about 90 deg. Fahr. below zero. This machine is entirely self-contained on a cast-iron bedplate, all parts being placed as compactly as possible, to take up the least possible space, a point of great importance when used on board of ships. The compression cylinder, which is 20½ in. in diameter and 2 ft. 6 in. stroke, is placed on top of the high base casting, in a line with the steam cylinder, which is 15 in. in diameter, and has a stroke of 30 in. The two piston rods are joined to one crosshead, which is guided by a parallel motion lever, which latter works in a vertical plane. The connecting rod passes under the steam cylinder to a crank and flywheel shaft placed behind the steam cylinder and at a lower level; from this same lever is worked the air pump of the injection condenser, which latter is placed on the ground level below the crankshaft.

The compression cylinder is water jacketted, the liner consists of a gun-metal bush, and in this cylinder the air, which is taken in through a pipe just outside the vault, is compressed to about 55 lb. From here it passes through two coolers, consisting of cast-iron cylinders placed below, and with their axes parallel to the compression cylinders. These coolers are similar to surface condensers, having a number of small brass tubes in them, through which the cooling water passes, while the air circulates around outside. In these coolers the temperature of the air is reduced to from 50 deg. to 55 deg. Fahr., and a considerable amount of moisture carried by the air is here separated and drawn out of the cooler at intervals. It now passes to the valve chamber of the double-acting expansion cylinder, which latter is placed also parallel to the compression and steam cylinders and at a level with the crankshaft, to which its connecting rod is coupled; the cranks being set at such an angle as to give the greatest assistance to the steam cylinder.

The valves are ordinary slide distributing and cut-off valves, worked from the crankshaft, the expansion cylinder, fitted with piston and plunger, is 16 in. in diameter and 30 in. stroke. The pressure of the air is here in two expansions reduced down to nearly atmospheric pressure, and after passing through the snow box, to finally deposit its moisture, leaves the machine to enter into the air trunk. In the snow box the temperature of the air falls to over 90 deg. below zero Fahr., and has a pressure only slightly in excess of that of the atmosphere to give an impulse to its travel in the trunks. The large machine, which, as we have already remarked, is very compact and measures but 7 ft. 6 in. over sides, performs its work very economically, the steam cylinder being jacketted and a condenser being moreover employed. We hope shortly to be able to place before our readers drawings and particulars of a smaller type machine, intended for use on board ships, and of which type several have been supplied to the Orient line, and one will be shown at the forthcoming Naval Exhibition embodying several novel features.

THE EDISON SYSTEM OF ELECTRIC ILLUMINATION.

HAVING described the very interesting installation of the Edison electric lighting system on the Holborn Viaduct,* and the splendidly carried out arrangements for demonstrating the capabilities of the system at the Crystal Palace*—the credit of which we erroneously gave to the Edison Electric Light Company, instead of to the representatives of the Edison system in this country, Mr. E. H. Johnson and his able assistants by whom the installation was designed and carried out before the existence of the New Edison Electric Light Company—we propose now to refer more especially to the details of the Edison system, from which our readers will be better enabled to appreciate the remarkably complete manner in which every detail has been worked out, as well as the thoroughly practical nature of the system as an application of science to commercial engineering.

We have, in the articles referred to, illustrated and described the construction of the Edison generators, which, while capable of being constructed of almost any size, are at present known in two forms, viz., the large, or thousand-light machine, which we illustrated a fortnight ago (see page 227 *ante*), with horizontal field magnets and its own separate engine, fixed to the bedplate, and the smaller machine with vertical magnets, capable of illuminating 75 lights (see page 252 *ante*). There is also a modification of this smaller machine, capable of illuminating 120 half-lights, but not intended for the full or sixteen candle lamps.

The incandescence lamps of Mr. Edison consist, like the Swan, Maxim, and Lane-Fox lamps, of a fine filament of carbon within an exhausted envelope of glass, and rendered brilliantly incandescent by the passage through it of a current of electricity of sufficient strength. This very general description applies to all the incandescence lamps at present in the market, but each possesses characteristic features which distinguish it from its competitors; and the Edison lamp has many points both in form, construction, and material which are of great interest, and which are not shared by other systems.

The form of Mr. Edison's lamp will be understood by a reference to Figs. 1 and 2 (page 302), Fig. 1 being an illustration of the larger, or sixteen-candle lamp, the resistance of which when in action is about 140 ohms, while Fig. 2 represents the eight-candle or half-lamp, whose resistance is about half that of the larger one. The fittings by which Mr. Edison places his lamps in circuit with the conductors leading from the generators, are very simple and ingenious, and are well shown in two forms in the figures. In Fig. 1 the two ends of the carbon filament are connected respectively, by means of platinum wires, to a screw and a cone, each stamped in thin brass, held at the proper distance apart and insulated from one another by a filling of plaster-of-paris, which surrounds the neck of the envelope and forms a firm and rigid attachment. The socket into which this fitting screws, and which is in permanent connexion with the conducting mains, consists of a cone of thin brass, below which is a hollow screw, both being embedded in a cylindrical mass of plaster-of-paris, and forming a matrix, or counterpart of the fitting on the lamp. The action of screwing a lamp into its socket is to draw the cone on the lamp firmly into its seat, and at the same time to press the threads of the screw against the corresponding threads of its helical socket, thus insuring very perfect metallic contact between the terminals of the lamp and the conducting mains. This form, excellent as it is, has certain disadvantages, one of which is that the mechanical action of the contrivance, when being screwed up tight, is to put a tensile strain on the plaster filling, and therefore has a tendency to break the connexion by pulling the screw and the cone apart. To meet this objection Mr. Edison has since introduced the form of fitting shown in Fig. 2, in which the upper cone is removed, and a flat disc, or sole-plate, shown at the bottom of the figure, is substituted for it. When a lamp of this form is screwed into its socket, the sole-plate is pressed against a corresponding plate at the bottom of the socket, and the strain on the plaster being one of compression, there is no tendency for it to be pulled apart. Mr. Edison has still further improved the material of his fittings by constructing them of thin copper instead of brass. The newest lamps which have just arrived from New York are supplied with these copper fittings, and the pear-shaped glass envelope is replaced by a very elegant form consisting of a cylinder with hemispherical ends. By this arrangement, which we shall illustrate in our next notice, the sides of the envelope are at a more uniform distance from the incandescent filament,

* See ENGINEERING, page 220 *ante*.

* See ENGINEERING page 252 *ante*.

THE EDISON SYSTEM OF ELECTRIC LIGHTING.

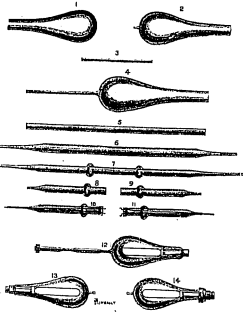

FIG. 3.

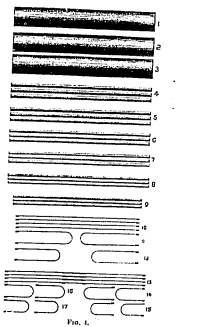

FIG. 4.

and while presenting a much more elegant appearance, they are not so liable to crack under the influence of unequal heating, and there is a smaller loss of light through refraction and internal reflection.

A considerable portion of the work of manufacturing the lamps is, we understand, performed by machinery, by which greater uniformity is insured; but the chain of operations by which the rough materials are converted into a finished incandescence lamp, is identical in its sequence and character with that of hand-made lamps, and will be understood from Fig. 3. The bulbs or flasks are delivered from the glass works in the form shown at No. 1. The first process is to heat the closed end and draw out a hollow cone, shown in No. 2. To this little cone is then fused a short fine tube, by which the envelope is afterwards to be exhausted and attached to the exhausting apparatus. The bulb then presents the appearance shown at 4. The next process is to prepare the glass stem, by which the lamp is hermetically sealed and within which the platinum conductors are fixed that are to join it to the connecting fitting. A piece of tube, No. 5, is taken, and its two ends are drawn or tapered off, as shown in No. 6. It is then thickened up in two places (see No. 7), between which it is divided into two separate tubes, shown at 8 and 9, two platinum conducting wires are then passed through the tube (see No. 10), care being taken that they do not touch one another. The large end is then heated nearly to its point of fusion, and is then squeezed flat so as to cause the platinum wires to be closely imbedded within its substance. The little crushed piece, shown in No. 11, are then soldered to the ends of the wires, and to these are attached, by an electric deposit of pure copper, the ends of the carbon loop to be presently described. The glass stem with the carbon filament attached, is then introduced into the neck of the bulb, to the point of which its thickened portion is attached by fusion, so as to form with it one piece of glass. The three down and is then trimmed off square, as shown in No. 13, which also illustrates the drawing down of the pieces of the exhausting tube, so as to form two capillary constrictions. This tube having been attached by a mercury joint to a Sprengel pump, the bulb is exhausted, and when the required exhaustion is complete, the contraction nearest the pump is sealed off, leaving a short length of tube attached to the bulb by a capillary neck, but exhausted to the same degree of internal residual pressure. A second sealing off at this neck renders the hermetical closing of the lamp complete, the object of the double sealing being to guard against any leaking at the two ends (see No. 13), so that two filaments may be constructed out of the same bamboo strip. The threads so far prepared are then laid in moulds consisting of nickel plates in which grooves are cut of the forms shown at 11, 15, 15, 16, or 17; a flat nickel plate is then fixed over them, so as to enclose them and prevent the admission of air during the process of carbonisation, which is effected in raising the moulds with their contents to a high temperature by placing them in a muffle and heating them to incandescence. When the moulds are opened the filaments are in a condition to be electro-plated to their platinum supports and introduced into the lamp-bulbs, but yet another process is required to confer upon them their perfectly homogeneous and elastic character, as well as their refractory nature at high degrees of incandescence, which are necessary characteristics in an incandescence lamp. This further process is applied when the lamp is attached to the pump and while exhaustion is going on, and consists in alternately heating and cooling the filament in the Sprengel vacuum by passing currents of electricity through it of increasing strength until high degrees of incandescence are reached and between each increase of current allowing it to cool down, exhaustion going on all the time. By this process, which we have fully described two years and a half ago in an article upon "The Physical Alteration of Metals,"* not only are the occluded gases eliminated, but as the fibre is subjected to a far more severe test than it can ever be subjected to in working, none but the "fittest" survive, and a healthy generation of lamps is insured.

We now come to refer to the different methods adopted by Mr. Edison for mounting the lamps and applying them to commercial or to domestic use, and those of our readers who desire to see the many

* See ENGINEERING, vol. xxxiii., page 337.

surfaced to one another, so as partly to project throughout the whole of its length; this projecting portion is then cut away with the exception of a little piece at each end, so as to leave a fine thread of bamboo fibre having enlarged portions at either end as shown in the figure at No. 16, or if the intended filaments are for the half-lamps an enlarged portion is left in the middle as well as at the two ends (see No. 15), so that two filaments may be constructed out of the same bamboo strip. The threads so far prepared are then laid in moulds

Engineering, January 25th 1884.

ELECTRIC LIGHTING NOTES.

The ordinary general meeting of the Anglo-American Brush Electric Light Corporation, Limited, was held on the 21st inst. last under the presidency of Sir H. W. Peek, M.P. The chairman referred to the accounts which had been briefly alluded to in the circulars forwarded in reply to them one by one. Beginning with the second item, he did not think explanations would be necessary, for salaries, of which £5,392 was paid, was not a large amount. The latter, he admitted, was a large amount, but it was only what was authorised by the articles of association to be given them as a proportion of the dividends of 100 per cent. lately paid to the shareholders. The miscellaneous charges of the workings into sudden darkness, or possibly in a fiery mine cause an explosions by a spark or stuff not being formed between two exposed portions of the conducting cables.

It is to be noted that Mr. Edison's representatives do not put forward his applications illustrated in Figs. 11, 12, and 13, as any part of the system, but solely as illustrations of applications to which it may lend itself, as well as to meet certain requirements which are constantly being asked for.

Having in this and the preceding notices described the lamps employed in the Edison system, as well as the dynamo-electric generators, by which the currents or apparatus bought by the sub-companies, we shall in our next article refer to the conducting cables and connections, as well as to some of the switches and other accessory apparatus employed in the Edison system.

Engineering, Jan. 25th 1884.

The International Electric Company held its general meeting on December 31. The report stated that contracts had been entered into for the supply of 13,501*l*., and that the revenue from the gross value of was 2641*l*., with an early prospect of an increase to 11,209*l*. The company has arranged with the whole of the Imperial Theatre House in Vienna, the streets of Temesvar, in Hungary, and to supply certain fittings for installation of light works in the palace of the King of Roumania. The street lighting is to be effected by Lane-Fox lamps and Brush dynamo machines, the lamps being arranged in multiple series and the series being carried overhead. The company has issued 26,685 shares, on which 3*l*. each has been paid, and has allotted 12,500 shares as partly or fully paid. They owe 3543*l*., and have 12,985*l*. in hand, 1256*l*. lodged as caution money, and 1774*l*. due to them. Their patents have cost 27,000*l*. in cash, and 48,000*l*. in shares, and their stock is valued (included erection) at 34,320*l*. The general expenditure during the previous eighteen months amounts to 20,616*l*., of which the principal items are brokerage 1,000*l*., issue of shares, 981*l*.; directors' fees, 2000*l*.; salaries, 8000*l*.; rent and taxes, 1075*l*.; travelling expenses, 1696*l*.; wages (exclusive of contract), 1001*l*.

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Published in the United States, by Mr. John Fowler, N. Scot. C.E.

NOTICE.

The Proprietors of "Engineering" beg to state that Mr. H. G. Reeve Thompson, who until recently acted as an Advertising Canvasser for this journal, no longer their authority to solicit new advertisements on their behalf, but that Mr. Howard Ellis is their sole authorised agent for the provinces.

The Proprietors also beg to state that they have entirely withdrawn their support from the French periodical known as "L'Ingénieur," with which they have now no connexion whatever.

ENGINEERING.

FRIDAY, JANUARY 28, 1883.

ELECTRIC LIGHTING IN MILLS.

The cost of electric lighting will be lessened, we are told, when it is undertaken on a commercial scale. This no doubt is true, for the installations hitherto erected have partaken to a large extent of an experimental character, and have necessitated expenses of supervision and management that have been out of all proportion to the light produced. But there exists at present one field for electric lighting in which it would possess very positive advantages that can be conceived as pertaining to the largest development that may be expected, and this is the lighting of mills. In the case of a factory the expenses of the electric light can be reduced to the lowest possible point, for the generator would presumably be driven by an engine that had been most carefully designed to insure economy, and the only working expense that need be charged against the installation would be fuel. No millowner in reckoning up his gas account includes a share of rent for the standing room of the meter, or for the space occupied by the pipes, and millowner would look for a dynamo machine, which is certainly not larger than a gas meter of equivalent lighting power. Again, while incandescence lighting the amount of supervision required, once the apparatus is properly erected, is almost imperceptible, certainly nothing more than the engineer could easily bestow in the intervals when his attention was not required by his engine. Such being the case the cost of electric lighting under the circumstances we are assuming, would be made up of four items only, namely, interest, depreciation, fuel, and renewals.

Having thus settled the character of the charges we will now consider their amount, and for this purpose will assume an installation of 200 16-c.p. lights, suitable for a mill or manufactory of a fair average size. The first cost of the plant complete and ready for work would be, at present manufacturers' prices, 9000*l*., and upon this there would be an annual charge of

	£	s.	d.
Interest at 5 per cent. per annum ...	450	0	0
Depreciation at 5 per cent. ...	450	0	0
Repairs to machines and belts ...	7	10	0
	907	10	0

Now the cost of a meter and gas pipes for 200 lights would be 120*l*., upon which interest and depreciation amount to 12*l*. per annum.

Seeing that the cost of electric lighting is made up as largely of fixed expenses, while that of gas lighting consists mainly of current expenses, it is evident that the latter must have the advantage when the periods of lighting are short. According to the Factory Act, women and children must only be employed between the hours of 6 A.M. and 6.30 P.M., or between 6.30 A.M. and 6 P.M., consequently in a mill employing women to any great extent, the period during which light is required is only about 300 hours per annum. For this period the expenses would be

	£	s.	d.
Fixed expenses (as above) ...	907	10	0
Renewals—200 lamps—each lasting 2000 hours at 5s. each = 500 = 25 ...	12	10	
Coal—6000 horse-power hours at 3½*d.* (per horse-power hour—at 6 lbs. a ton ...	3	12	
	86	7	

Cost per lamp per annum 8*s.* 7*d.*

The cost of gas for the period during the same time would be:

	£	s.	d.
200 burners, at 5 ft. each, with gas at 3*s.* 6*d.* per thousand	375	0	
Fixed expenses	15	0	
	60	0	

Cost per burner per annum 6*s.*

It thus appears that, under the most favourable conditions, a mill running fifty-six hours a week cannot be lighted by incandescence lights for the same cost as gas. But there are many exceptions to the fifty-six hours' rule, such for example as in lace mills and bleach works, which run night and day, using artificial light 6000 hours per annum. In these conditions the total annual cost for the electric light would be 231*l.*, or 1.16*l.* per light per annum. For the same time the cost of gas lighting would be 600*l.*, or 2.25*l.* per light per annum, that is, rather more than double that of electricity.

Putting the matter another way, the cost of an incandescence light per hour under the assumed conditions, varies from 0.34*d.* to 0.026*d.*, and of a gaslight from 0.24*d.* to 0.18*d.* By a simple calculation it will be found that the two systems equate at an annual working period of 670 hours, when the expense per hour and per lamp, both for gas and electricity, is 0.212*d.*, from which it follows, if our figures be correct, and we do not think that they are too favourable, that under no circumstances likely to be met with in practice can an electric incandescence lamp, burning less than 670 hours per year, be maintained under the price of gas, when the latter sells for 3*s.* per thousand feet.

The charges of such an electric light installation in this country can only be arrived at by calculation, but there are in America already sufficient actual data in existence to show what can be accomplished in practice. In a recent meeting of the New England Cotton Manufacturers' Association a paper was read by Mr. C. J. H. Woodbury on "Electric Lighting in Mills." From this it appears that up to last May there were seven of the establishments under the control of the Mutual Mill Insurance Companies provided with electric light, which, in some cases, had been at work sufficiently long for a fair comparative estimate to be made between it and gas in the matter of expense. The price of gas in America is always high, and varies considerably at different places. The majority of mills are lighted with gas made by the destructive distillation of petroleum. At it of 80-candle power, but is generally reduced to 40-candle power by mixing air with it, and is burned through "sun burners" (luminal) burners, which consume one and a quarter feet per hour. The annual cost of coal gas per burner is 7*l.* 10*s.* to one dollar. One large corporation, with exceptional privileges, makes its coal gas at an annual cost of 60 cents a burner. Another corporation inland makes its coal gas at 1.25 dols. per thousand feet, or at an annual cost of 1.75 dols. per burner, each burner consuming 1432 cubic feet (or two large mills in the same city, sun discharging similar goods, the more modern one makes its gas at an annual cost of 70 cents per burner, while the older one buys coal gas at 2.65 dols. per thousand feet. In all the instances intend upon about 6 per cent. forms an item in cost. A mill running 60 hours a week, using goods and running 60 hours a week, generally uses 2,000 to 3,000 burners, a mill that runs 110 hours a week requires light for 4000 to 4500 burners a year. A mill making goods used a large number of lights, and uses them an additional hundred hours a year.

The cost of new lights in several steam mills running 400 hours per year, is 6*l.* 5*s.* per burner, of which 1*l.* 10*s.* is for cashiers, and 5 cents for attendance, and 4 cents for engineering. When such runs all night the hourly cost is diminished. The number of new lights that must be lighted to light the loom on 700 to 1400 square feet of floor, ten and one-half feet in 1000 to 2000 square feet. A cash room 8ft. × 100ft., containing 64 cards, has been lighted by 6 gas jets or lamps. As a basis of comparison for cost, there is subtract the case of a weaving room where twenty-four gas lights replaced 252 6-ft. burners, consuming together 1752 ft. of gas per hour. These gas light therefore entailed the consumption of 73 ft. of gas per hour. A careful estimate shows that each new lamp cost 64 cents per hour, which corresponds to gas at 89 (58.9*d.*) cents per thousand. A similar estimate in another mill gives the cost of lighting by gas at 2188 dols., and by electricity at 1125 dols., the latter amount corresponding to gas at 90 cents (3*s.* 9*d.*) per thousand. In both these establishments the lights were used about 450 hours per year.

One of the Merrick Thread Mills has been fitted with Edison incandescence lights. This mill runs all night in the busy part work for fifty-one weeks in the year, using artificial light 2820 hours per annum. It was formerly filled with 70 burners, using city gas costing each 2.13 dols. per month (25.56 dols. per annum), or 2*l.* 2*s.* 6*d.* in all. These lights were replaced by 95 Edison B (eight candle-power) lamps. The cost of 2,000 hours five hour lamps had broken, and when the installation had been running 1278 hours eleven had broken. Allowing the lamps an average life equal to six months' use, the cost of lighting is made up as follows:

	dols.
190 lamps at 1 dol.	190.0
Interest and depreciation	153.50
Six horse-power at 10 dols.	60.00
Annual cost Edison light	403.50
Monthly	33.62
Monthly gas cost	797.00

This gives the annual cost per light of eight

Electrical Review
Feb. 12, 1883.

THE ELECTRIC LIGHT IN PARIS.—Some very successful experiments on the electric lighting of the *foyer* of the Opera House by the aid of Faure accumulators and Swan lamps took place last week at Paris. It is the idea to light the whole house by means of from 600 to 700 lamps of this system. The lamps were first shown to the public on Friday, September 29th. They have been placed in several parts of the building, but most prominently in the *foyer*, the extremely elaborate decorations of which have been entirely spoiled by the ruthless effects of gas. To light the *foyer* with gas 10 chandeliers, with 48 lights on each, were used, equivalent to about 4,800 candle-power. Two of these chandeliers have been fitted with 48 Swan lamps each; these were run up to about 40 candle-power, making a total of 3,840 candles for the two chandeliers, almost exactly equal to the eight chandeliers with gas. The effect upon the neighbourhood of the electric light was exceedingly marked, and the representatives of the Opera House, who witnessed the trial, expressed themselves extremely pleased with the result. We may add all the main cables were covered with lead, and every lamp was protected with lead or cut-outs, to avoid any possible chance of fire. The electric illumination of the shop of M. Sandoz, the well-known jeweller of the Palais Royal, has been discontinued, and doubtless will not be taken up again, at least under the same circumstances. This illumination was made with the aid of accumulators charged at the works and carried, insulated, to the lamps. These unfavourable and uneconomical conditions are, we think, the cause of the discontinuation of this lighting. The Grand Café and the Théâtre des Variétés, continue their electrical illumination with the same success.

Electric Review
Feb. 12, 1883.

ELECTRIC LIGHTING.

That electricity can be practically applied on a commercial basis for the production of light is a statement which will probably not be disputed in the face of the hundreds of electric lamps, both "arc" and "incandescent," that at present illuminate the streets of most of our large towns. The large sums recently subscribed towards the flotation of Electric Light Companies indicates how thoroughly public interest has been aroused in this newly-discovered adaptation of an hitherto uncontrollable element. It also in many instances indicates how little is known by the investing public of the laws which govern its production and management. The question, therefore, whether any of the systems now in use deserve to be regarded as superior to the old methods of artificial illumination is one which daily becomes of more and more importance. It is perhaps unnecessary to explain the difference between "arc" and "incandescent" lamps, but for the benefit of those who may not know it is sufficient to say that the "arc" light is produced by the momentary contact and withdrawal of the carbon pencils or "electrodes" during the passage of an electric current of high intensity. That given out by the "incandescent" lamp is caused by the passage of a current of low tension through an infusible conducting filament placed in a glass bulb from which the air has been exhausted under high pressure. Whatever advantages the arc lamp may possess for the lighting of large spaces, and they are under any circumstances doubtful, it is clear that this kind of light is totally unsuitable for purely domestic purposes. We are all familiar with the cold, blue, blinking lights, suspended in opaque glass globes to soften in some degree their blinding rays—a concentrated ball of light, casting shadows of the deepest intensity wherever the smallest projection occurs, giving a cavernous appearance to the eyes, and projecting the shadow of the noses down on to the chins of those who pass near them. This ultra brilliance concentrated in one spot is not quite the kind of light that accords with our idea of perfect lighting. Moreover, the necessity of screening or lessening the power of the light is manifestly uneconomical. There is also another and more serious objection to this mode of lighting—the many, and in some cases fatal, accidents which have occurred from inadvertent or accidental contact with the wires conveying the currents, a danger which is always more or less present owing to the great intensity of the current required for this class of light, but which does not exist in the conductors of incandescent lamps. It is therefore to one of the many systems of incandescent lighting that we must look to find those essential requirements that must exist in any substitute for gas or oil in our streets and houses—namely, safety, constancy, individual control, and economy. With the highest appreciation of the efforts of our own countrymen in this direction, yet the wonderful advance made in America so far exceeds anything yet undertaken in this country, that it is there we at once turn to find a solution to the question. The lighting up of a large area in New York, at present comprising some hundred or so of dwelling-houses, from a central station, has been the greatest and most practical test to which electric lighting has yet been put, and it is interesting to know what are the main features of a system which has secured the support of a large section of a city whose inhabitants are not likely to give such support from any merely sentimental admiration for its inventor, Edison, great though their admiration doubtless is. The "plant" was started and the district lighted up for the first time on September 4th, since when the station has been running night and day without stopping, and so far no serious obstacle has been met with. The [illegible] is generated by six dynamos, each serving twelve hundred lamps. The distributing mains, which are laid in the ground and tapped for branches in much the same manner as gas mains, consist of rods of copper surrounded with an insulating compound and enclosed in iron tubes. Of these there are at present over 79,000 feet laid in the district, and although they have been underground on an average nine months and have been in constant use since September, the leakage on the entire network only amounts to about 48 millionths of 1 per cent., or about ·00427 of one horse-power per minute. From the street mains the branch supplies are taken to the houses. Each house is furnished with a meter, by which the amount of electric current consumed by the occupier is measured. The meter is constructed on the principle of electro-metallurgy. The current passes through a solution of sulphate of zinc having zinc "electrodes," and in its passage decomposes the zinc of the one plate and deposits it on the other; and as one unit of electricity deposits an equivalent of zinc, by simply weighing the plates the exact amount of current can be ascertained.

The wires inside the houses are either quite concealed behind the plastering or carried under small wooden casings, or in inferior parts are simply carried along the face of the walls and secured with cleats. But in no case is there the smallest danger to life or property, the low electric pressure or tension of the current is such that only the smallest possible shock can be felt even on handling the naked wires, which, under all circumstances, are covered with a perfect insulating material. Absolute immunity from danger by fire is secured by an ingenious device of the inventor of the system, which consists in inserting at every branch and in every main a small block containing a piece of thin lead wire which fuses at a very low temperature, and at once stops the flow of the current. This prevents any dangerous heating of the wires, and extinguishes only the lamp or lamps on its own circuit, without in any way affecting the others, and also possesses the advantage of being repaired by simply screwing in another of the small wooden plugs, which may be done in a few seconds by the most inexperienced. The lamps are of the well-known pear-shaped pattern, and give a soft steady light, controllable in the same way as an ordinary gas-light by means of a small tap, but possessing advantages over the gas-light which have only to be experienced to be appreciated. No danger of explosion here through taps turned off sufficiently to extinguish the light, and then turned partially on again. The tap is turned, and there at once is the light, without the aid of matches or lighted paper, and as often as it is turned on or off, so it burns or is extinguished, and, burning as it does in a vacuum, the moment the glass is broken it is extinguished by contact with the air. The current is also used by means of small motors for driving machines, such as lathes and sewing-machines. Not in New York alone is the system in operation, though there the scheme of working from a central station has been most extensively applied; but there are no less than 123 Edison "isolated plants," aggregating 21,993 lamps, in various parts of the country. Here, then, we have a system in practical operation which seems to possess all the attributes we require from a new lighting agent, and at the same time is free from many of the dangers and discomforts of the present means, amongst the least of which are impure atmosphere and destruction of pictures, decorations, and furniture by poisonous and smoky fumes. It was a significant circumstance that while the Shoreditch Vestry were discussing the question of lighting by electricity their deliberations were disturbed by an alarming explosion of gas in an adjoining apartment. And the terrible explosion in the neighbourhood, which brought such destruction to life and property, is still fresh in our memories.

New Brunswick Weekly [illegible]
Nov 16, 1882

Edison on His Light.

The Edison Electric Light Co., which has secured the right to light the buildings of New York city with electricity, subject to the option of the owners or occupants of the buildings, has been for months laying wires throughout the district bounded by Spruce, Nassau and Wall streets and the East River. The city has been divided into thirty districts, and the one just mentioned is the first to be developed and is intended to demonstrate the practical workings of Mr. Edison's district system. The station is in Pearl street, near Fulton, and there are already six immense dynamo machines, each run by a 200 horse-power engine, completed and ready for operation. Each dynamo is capable of furnishing sufficient electricity to run 1,400 lights, and as, when the whole district is completed, there will be over 14,000 lights to furnish, it will be necessary to have six more similar machines to operate the entire district.

The six dynamos already completed and set up were ready for use four or five weeks ago, but when they came to be tested defects were found to exist in the machinery which were at once recognized as serious and which it has taken Mr. Edison all that time to overcome. Each engine and dynamo are on the bed plate and form one machine. The idea was to turn all the electricity generated by the six machines into one set of mains. When the experiment was tried, however, the result was not what had been expected. The difficulty, as explained to a *World* reporter by Mr. Edison, may be summed up as follows:

"I found on trying the experiment," said Mr. Edison, "that the trouble was that when the electric current from two dynamos was united it was impossible to make them work smoothly, for the reason that if one engine ran faster than another the fast engine would take all the load off the slow one, and the slow engine would be run merely as an electro-motor. The result of the first experiment was such as to astonish the engineers and every one who witnessed it, and came near proving serious. When the current from the second dynamo was turned on, first one engine, then the other would go like lightning, and first one and then the other was converted into a motor. One of the engineers, witnessing the effect, shut off steam, and still his engine was running just as rapidly as before. He came running towards me as white as a sheet, exclaiming: 'My God, Mr. Edison, what is the matter? I have shut off the steam, and yet my engine is running at lightning speed and I can't stop it!' In addition to the 200 horse-power engines running at a high rate of speed, there are also attached to each a four-ton bobbin, which in effect increased the power equal to about 1,000 horse. The next thing that happened was the meeting in a second of six or eight pounds of copper, which was thrown off in a sort of vapor, filling the room and nearly blinding every one present. Everybody groped their way to the windows, half frightened to death. If the whole six machines had been in operation at the time I don't know what would have happened. I suppose everybody would have jumped out of the windows. I tell you it was a pretty serious business, and I saw at once that I had a pretty difficult job before me to overcome it. But I saw what the trouble was and what would have to be done to remedy it."

THE EDISON [illegible] BOARD SHIP.

INTERESTING EXHIBITION AT GREENOCK.

On Saturday afternoon the magnificent new screw steamer Tarawera, built and engined by Messrs Denny, of Dumbarton, for the Union Steamship Company of New Zealand (Limited), was thrown open to the public at the Albert Harbour, Greenock. The steamer, which is the eleventh built by the Messrs Denny for the same company, and which has been fitted up with all the latest improvements and is luxuriously furnished throughout, is lighted up with the Edison Incandescent System of Electric Lighting, and is the first vessel in this country to which this system of lighting has been applied. The number of lamps in the vessel is 150, and the driving power is supplied by a Brotherhood 3-cylinder direct-acting engine, which on Saturday was going at the rate of 470 revolutions per minute. This engine drives the dynamo-electric machine direct. The dynamo is of the size known as the "L," or 150 light machine, but is really capable of supplying from 10 to 15 per cent over this nominal capacity. The nominal speed of this type of a machine is 850 revolutions per minute, but to suit the circumstances of the present case the electricians of the Edison Company have made certain modifications on it without injuring or deteriorating its supplying powers. The space occupied in the vessel by the generating machinery is 9 feet by 2 feet 6 inches. The lamps throughout the ship are of 16 candle power, and they are so arranged in the state rooms, &c., that the light in each lamp can be turned off or on at pleasure by means of a tap similar in principle to an ordinary gas cock. The simple turning on of this tap lights the lamp. The "wiring" throughout the ship is done with a thin copper wire, covered with four separate coatings of insulating material, and at every point where the wires branch off to supply lamps a safety fuse is inserted. This safety fuse contains a piece of lead wire, which fuses immediately upon the addition of any excess of current beyond what is nominally intended to be supplied. Complete immunity from fire is thus secured. The average "life" of these lamps is about 2000 hours' continuous burning. In the first factory fitted up with these lamps, of 131 put in only nine have so far broken, and the remainder are still burning, having lasted up to the time of writing for over 2400 hours. An exhibition of the working of this light was given on board the Tarawera on Saturday. The private view lasted from two till five o'clock, after which the vessel was thrown open to the public at a nominal charge, the proceeds to be handed over to the Greenock Infirmary. For the private view a large number of invitations were issued to gentlemen interested in shipbuilding and the electric light, and, notwithstanding the extremely wet weather that prevailed during the afternoon and evening, the vessel was thronged with ladies and gentlemen during the time the exhibition lasted. Among those present were Captain Watson, of the Cunard Line; Captain Liest; Mr Napier, shipbuilder; Messrs Denny, Dumbarton; Messrs Henderson, Glasgow; Messrs Scott, shipbuilders, Greenock; Mr H. Brown, director of the Caledonian Railway Company; Mr Bowers, City Chambers, Glasgow; Mr John Darling, superintendent of the Union Line; Mr Jas. T. Bottomley, F.R.S.E.; Mr Holmes, locomotive superintendent, North British Railway; Mr Bennett; Mr Hyslop, gas manager, Paisley; Commander Hereford and officers of H.M.S. Warrior; Mr Brock, Dumbarton; Mr Alexander, of the Guion Line; Mr F. W. Allan, of the West Indian Mail Company; the Provost and Magistrates of Greenock and neighbouring towns; Ex-Provost Sommerville, Port-Glasgow; Mr J. Aitken; Mr William Murdoch, engineer, Glasgow; Mr Biles, naval architect; Mr Johnstone, Dumbarton; Principal Jamieson, Glasgow; Mr Peck, naval architect; Mr Johnstone, engineer, Glasgow; Mr Stewart, gas manager, Greenock; Captain Williamson, of the Ivanhoe, &c. The arrangements for Saturday's exhibition were conducted by Mr C. T. Grant, of 100 Hope Street, Glasgow, the agent for the Edison Electric Lighting Company, and the [illegible] under the charge of Mr [illegible] electrician for the company in Scotland. The exhibition of the light was an entire success, and general satisfaction was expressed on all hands, not only with the incandescent system of lighting, but with the whole appearance of the steamer. The shaft tunnelway of the Tarawera is lighted up with two of the lamps, and this application of the light seemed to give immense satisfaction to the many engineers and shipbuilders who visited this part of the steamer. Captain Williamson, of the river steamer Ivanhoe, was so well pleased with the light that he declared his intention of having his vessel fitted up with it for next season's moonlight excursions. The Tarawera is also fitted up with oil lamps, which will be ready for use in case of any breakdown in the electric lighting.

The Glasgow News, Saturday, Dec. 9, 1882.

DEPARTURE OF THE S.S. TARAWERA.

A large company assembled on Prince's Pier, Greenock, on Thursday, to witness the embarkation on board the s.s. Tarawera of friends bound for the antipodes, and as the steam tender, with the passengers on board, left the pier the crowd gave them a hearty farewell greeting. The morning was stormy, but the weather improved as the day advanced, and the passengers were enabled to board the vessel with ease. Here they found that ample provision had been made for their comfort by the officers of the company. The Tarawera, a handsome vessel of 2,050 tons burthen, recently launched from the yard of Messrs. William Denny and Brothers, Dumbarton, for the Union Steamship Company of New Zealand, is the twelfth vessel built for the company by these builders, and the sixth of the same class. The vessel is intended for trading in the Australian Colonies, and is admirably adapted to meet the requirements of the trade. While our southern cousins may not "desire to shine in the high æsthetic line" they evidently have an eye for the beautiful, and the style of decoration pursued by the builders will enable the most enthusiastic æsthete who may chance to voyage in the vessel to live up to exquisitely designed and painted panels. The social hall immediately under the poop is a most comfortable apartment. At one end is placed a piano by Chappel & Co., while the other is occupied by a fine American organ by Clough & Warren. A compact library, furnished by Bryce & Co., Glasgow, will also enable the voyagers to while away the time with pleasure and profit. The main saloon is a commodious apartment, lighted from the roof by handsome stained-glass windows, on which are representations of birds and flowers. It is pannelled with mirrors and polished sycamore wood, on which chaste designs have been skilfully painted. Between the panels are pillars of white satinwood, the effect of the whole being most pleasing. The seats here and in the dining-saloon beneath are of polished American walnut, covered with Utrecht velvet, the coverings and fittings being removable, so that it will be possible to thoroughly ventilate the apartments and prevent any experience of the stuffiness usually associated with fittings of this description. The ladies' state-rooms and the berths of the passengers have been very completely furnished, there being in each a lavatory constructed on the most approved sanitary principles. The beds are fitted up with Archibald Stewart & Co.'s spring mattresses, and under the pillow of each bed is placed a life-belt, directions for its use in case of emergency being given on an enamelled plate affixed to the wall of the apartment. At the stern there is a commodious card-room, chastely painted in shades of blue, the seats being covered with buffalo leather, and on the poop a comfortable smoking-room, paved with encaustic tiles and pannelled in rouge royale, with pillars of white marble, bordered with hand-painted wood, in imitation of faience work, the ceiling being painted white and relieved with gold. Throughout these apartments there is a complete service of pneumatic bells. A portion of the ship has been set apart as a children's mess, where their creature comforts will be duly attended to, and for their amusement a magic-lantern has been provided by a Glasgow gentleman interested in the vessel. The apartments for the ship's officers are placed amidship on the main deck, and the accommodation for the crew and second cabin passengers is forward. The second cabin is a roomy, well-ventilated apartment, and there is also a separate cabin for the use of lady passengers. As already announced the vessel has been fitted up by the Edison Electric Light Company with their incandescent system of lighting. On the invitation of Mr. Charles Grant, Hope Street, Glasgow, agent of the company, a large number of scientific gentlemen, among whom were Professor Sir William Thomson, Sir William Drake, and others inspected the system at Greenock on Saturday. On that day the light was tried at a revolution of 475, which, however, did not give the desired brilliancy, but on Thursday when another test was made at 523 a beautiful light was obtained. The aim of the company has been to produce a sufficient light without any waste, and their efforts in this direction have now been successful, the light afforded by the system on Thursday meeting with the highest praise from the passengers and several scientific gentlemen and others interested in shipbuilding, who were on board. The entire space occupied by the machinery required to generate the light is 9 feet by 3, and 7 feet high. The electric engine was under the charge of Mr. Bradbury, of Brotherhood & Co. Among the company on board were Messrs. Peter and John Denny, Mr. William Brock, Captain Stewart, Mr. Darling, Superintendent of the Union Company of New Zealand, Mr. M'Allister, inspecting engineer, Mr. Charles T. Grant, Mr. Bottomley, Glasgow University, &c., The vessel was to have been despatched on Thursday afternoon, but was detained owing to the non-arrival of several passengers from England, who were unable to reach Greenock in consequence of the block on the railways. On their arrival yesterday, the vessel set out for Melbourne, under the skilful guidance of Captain Sinclair, and an efficient crew. The following is a list of the passengers:—

First Cabin.—Australia—Mr. and Mrs. C. Favre, Mrs. and Miss Wilson, Mr. J. J. Lowden, Mr. R. Higham, Dr. R., Mrs. and Misses Ida and Muriel Locking, Miss Annie Tweedie, Melbourne; Mr. and Mrs. C. G. N. Lockhart, Mr. J. H. Stewart, Mrs. Joseph and Miss Isa Orr, Mr. John F. Shankland, Sydney; Mr. R. G. Balderston, Brisbane; Captain and Mrs. Charles L. Oliver, Hobart Town. New Zealand—Mr. and Mrs. G. and Master W. Lamble, Miss Marion King, Mr. G. M. MacLean, Mr. J. N. Stewart, Mr. F. M'Adam, Mrs. and Master A. Hutchison, Dunedin; Miss Agnes Fyfe, Mr. R. Greenhalgh, Mr. and Mrs. F. and Master Yateman, Lyttelton, Mrs. Emily, Misses Laura M., Annie H., Millicent H., and Edith M. Fry, Wellington, Mr. Herbert Deaville and Miss Ina Christie, Auckland, Mr. C. M. Henning, Akaroa. Second Cabin.—Australia—Rev. M. and Mrs., Misses Eliz., Edith, Florence, and Master A. Morris, Mr. William Spain, Mr. Michael O'Brien, Mrs. Margaret and Misses Ellen and Louisa Wood, Messrs. Charles, W. A., Albert, and Harry Wood, Mrs. and Miss Martha M'Kechnie, and Rev. Andrew Ryan, Melbourne; Mr. Robert M'Carlie and Mr. Hugh Curtis, Sydney; Mr. Tom R. Newton, Brisbane; Mr. John M'Whirter, Adelaide; Mr. John Barnes, Hobart Town. New Zealand—Miss Eliz. M'Laren, Messrs. John and Thomas Logan, John Duncan, Messrs. Alexander and David Mann, Mr. A. G. Fern, Mr. John M'Naught, Misses Jessie and Mary Scott, Mr. and Mrs. Joseph B. and Master George F. Little, Dunedin; Mrs. and Misses H. M. and S. A. Ryair, Miss Harriett Phillips, Mrs. D. M'Donald, Mr. David Findlay, Lyttelton; Mr. William and Miss Maud Bird, Mr. John Symonds, Mr. Evered Poole, Mr. H. A. Finlay, Wellington; Mr. Fred. Chapman, Mrs. H. Bell, Mr. Herbert Smith, Mr. Thomas Wilson, Auckland.

Detroit Post & Tribune Dec. 12, 1882.

THE NEW LIGHT.

A Description of Edison's Latest and Best Illuminator.

The Many Excellences Claimed for It—Its Cheapness.

The Central Supply System and the Isolated Generating Apparatus.

A warfare exists on both sides of the Atlantic waged by the gas companies on the one hand to prevent the general introduction of the electric light and by the various electric lighting companies on the other to induce the present consumers of gas who use the latter to any great extent, to become their patrons. The arguments used by the competing illuminating companies are both novel and ingenious, and in many cases very convincing to the average reader. That the various electric light companies are making rapid inroads upon the business of the gas companies cannot be gainsaid, while the gas producers are very loth to admit or acknowledge such to be the fact. The two illuminating agencies have within the past few years been brought face to face, and the verdict rendered has almost unanimously been in favor of

ELECTRIC LIGHTING.

For years philosophers and electricians have delved into the mysteries of chemistry to find some process whereby they could produce a practical electric light that would become universal in its use, and not merely confined to the laboratory for experimental purposes. For a long time the spark was confined to a lamp for producing the electric light upon stated occasions, but it way always attended with such great expense in providing the delicate clock work machinery whereby the carbon pencils were operated that the light failed to be utilized as a common illuminator. Periodically articles would find their way into the scientific publications in France, England and America announcing the electric light perfected, only to find that when the over zealous projectors put their lamps to actual test and had their ideas tried in the fiery crucible of science, they were no nearer than their co-laborers who had preceded them. It was not until during the past decade that anything new transpired that tended to enlist the confidence of either the capitalist or the scientific world. All seemed to grapple at the wrong end of the problem. Foremost among the savants who have solved or nearly solved the problem, are Edison, Sawyer, Mann, Brush, Fuller, Wallace, Maxim, Swan, Lane, Fox, Van Depoele and a few others of less note. With the exception of Edison none have a complete system for making and producing the light, it is claimed, the others relying upon other scientists to furnish supplementary parts.

THE EDISON AND BRUSH ELECTRIC LIGHTS

seem to obtain the most favor, although they are entirely without semblance in construction. The former is of the incandescent type and burns in a vacuum, while the latter belongs to what is known as the arc or carbon pencil light, burning in the open air. Each have their respective friends and advocates. It is not the purpose of this article to speak to the detriment of the Brush light or any other, but on the contrary to show the beauty, the economy, the simplicity and the utility that will be derived when the Edison incandescent electric light is introduced and practically tested in the city of Detroit. Mr. Edison is well known. When he abandoned the arc system of electric lighting he gave his whole thought to the problem of subdividing the electric current in a way which would enable him to [illegible] separate lights as he desired without being compelled to duplicate the generating apparatus. The matter of incandescence also engaged Mr. Edison's attention. His first step was to employ the platinum wire, the only metal known that would be infusible in the intense heat that it would be subjected to. This proving unsuccessful it was discarded to give place to what Mr. Edison considered the long-sought for agent. The material was carbon, which, if not allowed to burn, would prove infusible in the highest heat developed. This was obtained by submitting a suitable texture of cardboard to the intense heat of a furnace constructed for that particular purpose and from which he obtained sheets of carbonized paper. These were cut into strips which were fashioned into loops very much resembling a horseshoe. This filament of carbon was placed in a vacuum glass globe and brought up to a candescence representing 16 wax candles. Great as this success was it did not satisfy the exacting requirements of Mr. Edison. He was lost to the scientific world for several months. During this time he was confined within the realms of his mysterious laboratory at Menlo Park in search of something more practical and durable than his carbonized paper horseshoe, which he considered insufficient to withstand the mechanical shocks to which it would be subjected or support candescence for any great length of time. He discovered that if the fiber of the bamboo is carbonized he could obtain filamen's therefrom that would meet his requirements. These fibers when placed in position in the vacuum globe very much resemble a loop of black horse hair.

IS THE EDISON LIGHT PRACTICAL?

This question can at once be answered in the affirmative. To substantiate the correctness of this prompt answer all that is required is to refer to patrons of the Edison incandescent light who have substituted it for gas, oil and various other burning fluids. Perhaps one of the best places, if not the best, to test the durability and practicability of the various kinds of electric light is in a mammoth metropolitan daily newspaper, where about 10 hours of work is done after dark. It is in such an establishment that the very best light is procured. In the New York Herald office Mr. Bennett has a plant of two Edison K dynamos, each with a capacity of 250 lamps, or 500 lamps in all. These lamps are used 363 nights in the year. The total number of lamps in the Herald building is 632. The average number of lamps burned all at once is 383, except Saturday night, when the number is increased to 460. The largest average number of lamps are used between midnight and 2 A. M., when the paper is being "made up" ready for the press. Careful and accurate comparison accounts have been kept at that office between the expense of electric and gas lighting, and the saving is $5,000 per year.

THE RELATIVE

cost of producing and operating gas and electric plants in large cities has been very carefully estimated both in England and America as well as in France. The most reliable figures at hand are given below. The figures for the gas account were derived from plants having a capacity to manufacture 1,000,000 feet per day, while the cost of the electric light was compared to every 1,000 feet of gas consumed:

Plant Account.	Per 1,000 Feet. Gas.	Edison Light.
Interest	12.	12.
Depreciation of producing works	10.	6.
Depreciation of mains	2.5	1.1
	24.5	19.1
Manufacturing expenses—		
Labor	12.	0.
Coal	22.5	20.
	34.5	20.
Working expenses—		
Distribution	2.5	2.5
Totals	61.5	50.6
In favor of the electric light.	50.6	
	10.9	

Another carefully prepared table shows that if $6,000 worth of gas is consumed at the rate of four hours per day, the electric light for the same length of time will cost $1,510, which gives the Edison light a credit of $4,500 in its favor.

Two hundred and fifty gas jets, consuming ten feet each per hour will cost $3,500, which at $2 per 1,000 feet will cost $5 each, or $1,500 for the 300 days. The total estimated cost of the Edison light for the same period is as follows:

Total cost of gas for 300 days, at one hour per day	$1,500
Total cost of Edison light for 300 days, at one hour per day	685
Balance in favor of Edison light	$815

Supposing $4,000 to be invested in an isolated electric plant the investor will, perhaps, mentally ask what will be the hourly cost of operating the light, for a 250 light machine of 16-candle power! Here is the correct answer:

For a 35 horse power engine, three pounds of coal per horse power, per hour, at $5 per ton	27
Lamps per hour	[illegible]
Interest at 7 per cent. (on $4,000), per hour	[illegible]
Engineer, at $2 50 per day, per hour	25
Oil, etc.	[illegible]
Total cost per hour for 250 lights	$1 00

IS IT A SAFE LIGHT?

This question has been answered by the board of underwriters of the city of New York who have given the Edison company full permission to carry their wires and machines wherever they may see fit. The insurance men have given this light the most careful attention and submitted the conducting wires and dynamos to the most rigid inspection, and in some instances, it is believed, in the interest of the gas companies, but have so far failed to elicit a single fact that would act as a barrier to its successful introduction. Unlike the Brush current, which would insure death if one touched a naked wire, the current of the Edison lamp is so low that the globe of the lamp is scarcely warm to the hand, and safety is guaranteed in its workings. But to provide against any possible danger the light and dynamo are provided with a safety apparatus, which instantaneously arrests the current in the event of a breakage of any of the wires or conductors. The fires which had occurred from accidents by the arc or Brush system for a long time prejudiced the insurance people against any and all kinds of electric lights, but during the present year the tests and examinations made of the Edison system have been such as to allay fear.

THE EDISON LIGHT FROM A SANITARY POINT OF VIEW.

Various objections have been made to various methods of lighting wards of hospitals, closely and poorly ventilated houses and workshops. The purity and coolness of the incandescent light as now made, meets and casts aside all these objections. The sewer commission of London, England, in adopting the Edison light, did it on its merit and reliability. In their report of the lighting of the Holborn viaduct they say that the Edison light, which now displaces the gas, gives double the light of the latter. No electric lamp is more than 60 feet distant, and there is scarcely any part of the viaduct which is better lighted than another. There are no strong or sharp shadows to deceive the eye or footstep; no flickering, and no material variation in illuminating power, so far as can be observed ordinarily.

Many cases of short-sightedness, weak eyes and headache have been attributed to the heat that is radiated from the flame of lamp chimney and gas jet, and reflected from the shade and the surface of the paper. Ordinary gas burners and oil lamps give out a considerable heat by the energetic combustion of the hydro-carbons and hence their injury to the eyes and head. In this respect the electric incandescent light is not objectionable. While the incandescent light can be made as intense as desired, there is little or no radiation of heat.

FOR GENERAL ILLUMINATING PURPOSES

it has no equal, both for indoor and outside purposes. It is soft, mellow and durable. This has been demonstrated beyond contradiction, both in London and New York city.

The Edison company have established companies for the purpose of establishing isolated plants or apparatus for furnishing light to separate buildings, independent of gas or other lighting companies. These patrons will be enabled to furnish their own electric light at cost and whenever it suits their convenience. Mr. John R. Markle, special agent for the Western Edison light company of Chicago, is in the city in the interests of the isolated plant company. The company which operates on this plan of placing isolated plants in no way clashes or interferes with the rights and privileges of the Detroit electric light company. The capital at the latter company's command and the high business standing of the gentlemen composing it are a sufficient guaranty that when the proper time arrives and the demand will warrant it the work of furnishing the light will only be the work of a few months.

The Republican, Garland, Dec 13. 1887.

LIGHTING A BREWERY.

Edison Electric Light Company's Dynamos Running with Electric Lamps—The Danger of Wires on Poles.

An opinion has been expressed that the day is not far distant when the different buildings of this city will, on the darkest nights, be illuminated to a brilliancy that will compare favorably with the light of midday. On Saturday one section of the Edison light installation was started in the buildings of the Phillip Best Brewing Company, and, in about two weeks, 700 Edison globes will be in operation. In malthouse, No. 1, there are 220 incandescent lights, and in the cellar and other buildings and Frederick Pabst's residence, there are to be 480 additional lights, 700 lamps, and 11 lamps of ten to twenty candle power. The dynamos and engine are located on the corner of Chestnut and Tenth streets, in the boiler and engine-room. The engine is one of Edison's latest vertical, runs at a speed of 350 revolutions a minute, and develops seventy-horse power. The cylinder of the engine is 8x9 inches. The dynamo machine is sufficient to furnish currents through the entire system. The revolutions of the armature are 1,200 per minute, and the total electro motive force of the machine is equivalent to 110 Volts. The underground conductors, of which 300 feet have been laid, were tested in the factory at New York at 100,000,000 Ohms, and, after being placed underground, were tested at 20,000 Ohms to and fro current. His most severe test that they could be subjected to. In the test, the loss of electricity was nothing. The current used in the underground tubes conveys the electricity from the machine to the different buildings and the total resistance, when all the lamps are in operation will not exceed 1 in those conductor tubes. Each light and each group of lights is controlled by safety cutouts, forming an electrical guard against fire or an overcharges of electricity.

Henry E. Meade, general agent for Wisconsin of the Edison Electric Light Company, when asked to explain the system, said: "Our system is about the largest station of 14,331 lights, distributed from the Produce Exchange district, where a 75,000 feet of conductors laid underground. They have been underground, on an average, for about two years, and tests show that the loss of current in the entire network is forty-eight millionths of 1 per cent, and, were we to light the entire city of New York with, say 400,000 lamps, and, taking the Produce Exchange District as a test, the loss of current from leakage would not be sufficient to run a single lamp, or, to be more explicit, 400 tenth of one-horse power. Then, you see, the loss of current by our underground system is almost unappreciable. We have installed in the United States exclusive of the New York station, and have in operation, about 75,000 Edison lamps, of which 10 per cent. are underground.

"How do you register the consumption?"

"We meter our current by the deposit of metals and arrives at one one-hundredth of 1 per cent. of the amount consumed. We guarantee the average life of our lamp at 600 hours constant burning. The lamps are sold at the nominal price of $1 each.

"Do you think there is danger from wires on poles for are electric lights?"

"Where wires are run on poles there is great danger of their coming in contact with telephone or fire alarm wires. Should an electric light wire, having a powerful electric motive force, be caused by a telephone or fire alarm wire its result would be terrible, and nothing is more likely that might come in contact with it would ignite. The insurance companies are right in saying wires should be underground and the City Council should compel all companies operating them to do so, as above there. This is perfectly practical, and the only reason why are because it would take a little time and trouble to perfect a system of underground conductors. In fact, the wires would throw high tension currents, but should they come in contact with a man?"

"That mean would vary under different conditions. A person become connected with the ground by means of a wire with a high tension—say 2000 Volts and ten Watters current in circulation—he would meet with severe injury, if not death. Should a person become connected across the poles and receive the charge, I should not care to take his place, as I have had several mild shocks and they were sufficient to test the nerves of the strongest man in a grocer store. Although the human body is a conductor of several thousand Ohms, nevertheless the current finds its way through the veins and tissues of the body and causes paralysis. There have been at least twenty men killed by wires from this arc system, but we have yet to hear of the first accident from the incandescent system."

"Why is the incandescent system safe?"

"Simply because the Edison incandescent system uses but 110 Volts of pressure and about 1 and 75-100 Watters of current. To be fatal to life a current must be over 2500 Volts. Therefore, you will perceive that the difference in the safety of the two lights. I do not consider the system of electric light that will secure the safety of those who use it and of the buildings through which it runs. Therefore I say, if companies wish to do business let them put their wires where they will be safe and they cannot be safely placed over ground."

London Times, Dec. 2. 1882.

THE ELECTRIC LIGHT.

The total number of Provisional Orders for which applications relating to the electric light will be made on the next part the applications will be made by corporations and other local authorities. Only two metric—those of St. Pancras and Richmond (Surrey)—appear to be coming electricity in the areas within their jurisdiction. The principal applicant among the joint-stock companies is the Metropolitan (Brush) Electric Light and Power Company will be supplied for, to produce, supply, and store electricity for lighting and other purposes, to break up public and private streets, &c., and to erect, lay down, and maintain wires and other apparatus and works. Powers are asked to enter into agreements with the local authorities, to demand and recover rents and charges, to make applications as to Bills, &c. The districts for which these powers are sought are Islington, St. Pancras, City, Clerkenwell, and St. Luke; Battersea, Fitzwilliam, and Lupton; Hornsey, Highgate, and Southgate; Hampstead, Willesden, Hendon, and Finchley; Marylebone, Paddington, St. James's Westminster, and St. Anne, Soho; Kensington, St. Giles-in-the-Fields, St. George, Bloomsbury, and Holborn; Lambeth, Chelsea, St. Martin-in-the-Fields, and Westminster district; the Strand district, St. George, Hanover-square; Camberwell and Penge; West Ham, East Ham, and Wanstead; St. Olave, Bermondsey and Rotherhithe; Fulham, Hackney, Battersea-green, and Shoreditch; Chiswick, Acton, and Ealing; Islington, St. George the Martyr, and St. Saviour's, Southwark; Wandsworth and Wimbledon; and Greenwich and Lewisham. The Pilsen Electric Light Company (Limited) intend to apply for a Provisional Order for similar powers "in perpetuity or for such period as may be prescribed" to the City of London and the Districts thereof, St. Andrew, Holborn-above-Bars, St. George the Martyr, St. Sepulchre, Saffron-hill, Hatton-garden, Ely-rents, and Ely-place, and the Liberty of Glasshouse-yard: St. Anne, Soho; St. Paul, Covent-garden, St. John the Baptist, Savoy; St. Mary-le-Strand, St. Clement Danes, and the Liberty of the Rolls; St. Giles-in-the-Fields, St. James's, Westminster, St. Martin-in-the-Fields, and a portion specified of St. Margaret, Westminster; Clerkenwell, Lincoln's-inn, the Temple, Westminster Abbey, and the Victoria Embankment. The Swan United Electric Lighting Company (Limited) will apply for authority in four Provisional Orders "to produce, store, supply, and sell electricity, electric currents, and other like agency for public and private purposes" in certain portions of the Strand district, the Hanover-square district, the South Kensington district, and of the Brompton (London) district. The Pilsen-Joel and General Electric Light Company (Limited) intimate that they will ask for three Provisional Orders for certain streets in the Holborn and Strand districts, Marylebone, Paddington, and the City of London —Old Broad-street, part of New Broad-street, Liverpool-street, part of Throgmorton-street, Lombard-street, part of Gracechurch-street, Cornhill, and Leadenhall-street; Tottenham-court-road, &c. The Provisional Orders will be applied for as regards a specified portion of Chelsea and of the parish of St. John, Hampstead, by Syrencl, Thompson, and Ince (Limited). The Incandescent Electric Lighting Company (Limited) notify their intention to apply for a Provisional Order for powers to produce, supply, and sell electricity for Birmingham, Walsall, Smethwick, Smallfield, and Reading. The Union Electric Light and Power Company (Limited) will ask for eight Provisional Orders "to produce, supply, and store electricity for lighting and other purposes, to break up streets, to erect, lay down, and maintain wires, &c., and to enter into agreements with the local authorities" for Bermondsey, Greenhithe, Dartford, Wandsworth-cum-Earn, Malvern, Hyverstone, Aldershaw Burstall, Hartshill, Nuneaton, Atherstone, Polesworth, Dordon, Tamworth, Ashby-de-la-Zouch, Ashby, Packington, Coleorton, Whitwick, Earl Shilton, Barlestone, Stoke Golding, Dadlington, Sutton Cheney, and Shenton. Orders will be made by the south-eastern (Brush) Electric Light and Power Company, and by the Provincial (Brush) Electric Light and Power Company, the latter of whom will apply, in addition, for a Provisional Order to supply Sudbury. Authority will be asked for "to produce and supply electricity for lighting and other purposes, to break up streets, to erect, lay down, and maintain wires, &c., and to enter into agreements with the local authorities" for Cleobury-Mortimer, Ditton Priors, Neenton, Burwarton, Aston Eyre, Monkhopton, Upton Cressett, Much Wenlock, Bridgnorth, Quatt, Alveley, Claverley, Worfield, Ackleton, Albrighton, Donington, Tettenhall-Wood, Tettenhall, Codsall, Bilbrook, Pattingham, Patshull, Perton, Wrottesley, Featherstone, Shareshill, Brewood, Boscobel, Coven, Huntington, Cannock, Hednesford, Rugeley, Brereton, Armitage, Handsacre, Colwich, Longdon, Hamstall Ridware, Blithfield, Abbots Bromley, Admaston, Rugeley, Penkridge, Stretton, Acton Trussell, Bednall, Teddesley Hay, Cheslyn Hay, Great Wyrley, Churchbridge, Walsall Wood, Aldridge, Walsall, Pelsall, Brownhills, Norton-Canes, Shutford, Bodicote, Hardwick, Bloxham, Adderbury, Milton, Deddington, Hempton, Barford St. Michael, Barford St. John, Steeple Aston, Middle Aston, Somerton, Ardley, Fritwell, Souldern, Upper Heyford, Rousham, Lower Heyford, Steeple Barton, Duns Tew, Middle Barton, Chesterton, Wendlebury, Bucknell, Boarstall, Brill, Chilton, Dorton, Worminghall, Ickford, Shabbington, Oakley, Long Crendon, Chearsley, Waddesdon, Quainton, Grendon Underwood, Edgcott, Marsh Gibbon, Poundon, Fringford, Hethe, Stratton Audley, Bicester, Launton, Ambrosden, Arncott, Piddington, Blackthorn, Merton, Islip, Bletchingdon, Kidlington, Yarnton, Cassington, Begbroke, Hampton Poyle, Kirtlington, Shipton-on-Cherwell, Enslow, Wootton, Glympton, Kiddington, Sandford St. Martin, Heythrop, Chadlington, Spelsbury, Ascott-under-Wychwood, Shipton-under-Wychwood, Milton-under-Wychwood, Fifield, Idbury, Langford, Kelmscott, Filkins, Broughton Poggs, Holwell, Asthall, Swinbrook, Burford, Widford, Taynton, Upton, Great Tew, Little Tew, Enstone

THE ELECTRIC LIGHT FOR WAR PURPOSES.

In continuation of our recent description of apparatus for the above purpose we now propose to describe in detail Colonel Mangin's aplanatic projector, external views of which were given on page 408 of the current volume.

The reflector consists of a concavo-convex spherical lens of crown glass, the convex side M O N being silvered, and the concave side M' O' N' being struck at a smaller radius. Colonel Mangin has established by calculation the relation which should exist between the radii of curvature of the two surfaces and the index of refraction of the substance of which the lens is made, so that the spherical aberration due to refraction shall exactly counteract the spherical aberration due to reflection.

Colonel Mangin also determined the relation to establish between the radii of curvature of the two surfaces in terms of the index of refraction of crown glass (taken as the substance), so that O, the centre of the inner surface, might also be the principal focus of the aplanatic reflector. Consequently, if a luminous point be placed at O the rays will traverse the inner surface almost normally, and no light will, therefore, be dispersed by reflection from the concave surface of the lens.

The only divergence produced by this lens, when properly focussed, is that which is due to the size of the luminous point as compared with its distance from the centre of the silvered surface. This divergence cannot be avoided.

In the case of an ordinary spherical reflector there is much scattered light, and the intensity of the light varies consistently in the various portions of the illuminated area.

Those are great defects in a search light for war purposes: not only because the penetrating power of the light is so greatly diminished, but because it is often of such immense importance to direct the light upon an enemy while keeping one's own forces in darkness. These defects are overcome in the Mangin projector, the cone of light from which is accurately well defined and the intensity of the light in the various portions of the illuminated circle is practically equal, diminishing only according to the distance combined with the state of the atmosphere and to the angle of divergence.

Figs. 1 and 2 show the lamp and projector in sectional elevation.

The hood A is closed at the back by the large aplanatic mirror B, protected by the metal cover b. In the centre of the mirror a small portion is unsilvered, so that it may be used as a sight hole, through which to watch the carbon points. The front of the cage is closed by a window c, holding vertical panes of glass, sometimes flat and sometimes, when it is desired to obtain horizontal divergence, these window panes are of a plano-cylindrical horizontal section, the plane surfaces being external.

The hood is provided with openings to act as ventilators, which are covered with copper shields a. It is also provided with two trunnions, one of which is fitted with a worm and wheel e, actuated by the rod e_1 and handwheel e_2, and clamped by the nut and handle e_3. The hood is likewise fitted with a tube a_1 (see Fig. 1) carrying a prism and object glass, for producing an image of the side view of the carbon points.

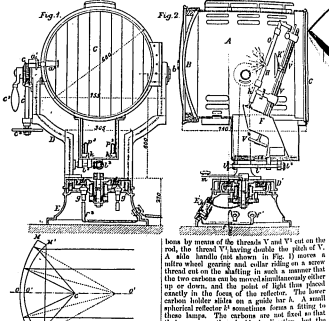
The supporting arms D are hollow, and the insulated copper leads p are carried up inside them. The arms are fixed to a table D^1, which rests on rollers that allow of horizontal revolution on the base-piece E of the apparatus.

Under the table D^1 is fixed a wooden annulus, to the bottom of which are attached two bronze rings, against which press the contact pieces f^3.

The leads from the dynamo are clamped to f^3. The positive current starts from f^3, whence it runs the following course: by copper strip f^2 through the insulating tube 2 to the ring d_1 to the arm D, to the side of hood to p^2, to the side of lamp (sliding contact) through lamp to p^3 to hood and other arm D and other ring d to p^1 and f^1 and back to the dynamo-electric machine.

Messrs. Sautter and Lemonnier, of Paris, are the sole manufacturers of this projector, and make four sizes:

One of 30 c.m. diam. and 160 mm. focal distance.
" 40 " " 240 "
" 66 " " 322 "
" 90 " " 710 "



The projectors are fitted with electric lamps which are regulated by hand, and are inclined at 20 angle of 20 deg. with the vertical, the top being the positive carbon. The lamp is ingeniously arranged so that the top carbon and its bracket can be racked backwards or forwards or sideways if required and then clamped. Also the handle l_1 moves the carbons by means of the threads V and V^1 cut on the rod, the thread V having double the pitch of V. A side handle (not shown in Fig. 1) moves a rather wheel gearing and collar riding on a screw thread cut on the shafting in such a manner that the two carbons can be moved simultaneously either up or down, and the point of light thus placed exactly in the focus of the reflector. The lower carbon holder slides on a guide bar b. A small spherical reflector l^2 sometimes forms a fitting to these lamps. The carbons are not fixed so that their axes exactly coincide in direction, but the upper or positive carbon is placed parallel to the lower carbon and slightly nearer to the lamp. In this manner, and on account of the inclination of the lamp, the centre of the positive carbon is caused to face towards the reflector (and in very large projection—over 80 per cent. of the light—is thus thrown in the desired direction. The electrical details of this lamp are substantially arranged last year as regards points of novelty. These lamps require the continuous electric current, and Messrs. Sautter and Lemonnier advocate the employment of the Gramme dynamo-electric machines driven direct on the same axis by three cylinder Brotherhood engines.

Most of the information in this paper has been taken from Messrs. Sautter and Lemonnier's pamphlet on this subject.

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Menlo Park Scrapbook, Cat. 1019

No. 111. "Electric Light"

This is the last of nine scrapbooks containing clippings about electric lighting. The book covers the years 1881-1885, but most of the material is for 1884 and 1885. The pages are unnumbered. Approximately 70 have been used.

be really independent of that of the elongation.

4. Every vibration of the wire is accompanied by a generally very well marked variation of the resistance. In the majority of cases there was a decrease of resistance when the vibration was excited, and it was greater with harmonic than with fundamental vibrations. It was observed when the vibration was small. This latter law, however, needs confirmation.

The author considers it may be concluded, from his observations, that the variations of the resistance through tension are to be attributed not so much to a removal of the molecules from one another, so to a rotation, and consequent change of their mutual directions.

CHARSLEY'S IMPROVED VELOCIMAN—THE NEW PATENT TRICYCLE.

IT will be remembered by many of those who take a great interest in the bicycle when it was first introduced, that the original, some twelve or more years ago, that is, was called the "Velocimanicalcal bicycle" at several colleges in Oxford, at the same time patented a tricycle worked by hand, called the "Velocimen." Many used it with great comfort and pleasure. There was one great inconvenience however: the driver had to sit with his legs below the crank-axle, throwing a great part of his weight on the steering-wheel. The inventor rode many thousands of miles on it, and by the course of his journeys he always found that he could obtain the greatest speed, both consistent with ease and comfort, when the cranks happened to be parallel. It will be understood from this that the crank-axle was divided in the middle, making each wheel, with its crank, independent of the other, while the driver grasped the two cranks throughout each revolution.

When he found this, his great aim was to secure the constant parallelism of the cranks; and this, of course, was immediately effected by letting one wheel run in a box. The box sought to raise the seat of the driver above the crank-axle, and this was accomplished by introducing levers, which is described by the inventor as just that of rowing a boat, where one or both feet may be employed by the driver to urge forward the work of the hands. These we have the power of using any one, two, three, or all of the limbs at the same time, indeed, 10 different ways of driving are always at the option of the driver while the limbs not in use may be rested. The great advantage which follows from this rowing motion is the perfect steadiness of the wheels. The feet, when employed, act exactly in unison with the hands, and thus an immense speed can be secured. The machine has not been finished many days—in fact, the patent is not yet published. Mr. Charsley has, however, by very accomplished some wonderful performances with it already, especially in the way of mounting stiff hills. It travels backwards or forwards, and describes circles in its own length.

Before making the tricycle, the inventor's mathematical knowledge enabled him so to arrange the parts that the mechanical advantage of the combinations of the lever and wheel and axle should be a maximum, in other words, that the expenditure of muscular energy should be the least possible. Now it is made, it exactly ensures every expectation which he had formed. He calculated on 60 revolutions a minute with these wheels, which secures 15 miles an hour, with a little extra pressure he can increase the speed to 80 revolutions, or 20 miles an hour. Practice is continually showing us that these wheels might be driven with greater ease. How this would increase the speed if necessary figures will easily show. Mr. Charsley's first trial-trip with the machine just out of the shop was 84 miles long. It lay through Warwick to Stratford-on-Avon. He timed himself wherever he caught sight of a milestone, and found a mile took, on an average, 3 minutes; "Facile" minutes. The first mile exactly 20 years of age shows how easily the machine travels.

THE "FACILE" SAFETY BICYCLE.

SINCE our notice of the "Facile" bicycle, (p. 776, Vol. XXXI.) it has been improved in several minor details and in one important feature. The general design remains the same, but the crank and its attachment to the handle bevels are of a lighter and better shape, and by means of a screw-thread and nuts on the connecting rod or link, a machine of any given size can be adapted for use by riders having different length of leg. This feature will, we think, tend to bring the machine into considerable favour in certain quarters, especially where there are two or three riders in a family. When we passed Messrs. Starley's works the largest machine made was 48in., while the smallest wheels as high as 44in. have been adopted. We are glad to see by recent trials of the "Facile," it is not unlikely the makers will enter the field as builders of racing machines. With the 52in. wheel an average-sized rider can touch the ground while straddling the saddle, and with a 45in. one foot or the other is within a few inches of the ground, so that there is no fear of falling. With a machine of the latter size, well-known riders have kept up the usual club-run speed with their fellow members mounted on "ordies," and when a hill had to be negotiated had a decided advantage over the big wheels and direct action. At first sight it is concluded that the extra friction of the levers and links must necessarily militate against speed as compared with the ordinary bicycle, but the work being brought more directly under the rider's body is found to be an advantage nearly, if not quite, counterbalancing the disadvantage of the extra friction. The fact that a 48in. machine has been driven on a track one mile in 3m. 28s. shows that there is speed in the "Facile" as well as safety. We need not, when to this is added the fact that hills may be mounted and ridden down with comparative ease, that the "Facile" has a decided advantage over a brake without touching its virtues, be seen that there is a large class to whom such a bicycle commends itself. We see it announced that the telegraph authorities of New South Wales are about to mount their messengers on velocipedes of the tricycle type, and they expect to save about £500 per annum in the cost of forage alone for Sydney; but we think it a mistake to adopt a machine which runs on two tracks, when one equally safe can be had that will run on one track. The "Facile" is at length becoming known throughout the country, and the better it is known, the better it is liked.

THE BECQUEREL LECTURE.

THE Faraday lecture was delivered by Prof. Helmholtz last week, by the theatre of the Royal Institution, before a brilliant audience. Prof. Roscoe, as president of the Chemical Society, introduced the lecturer. After a few words of introduction, the chairman handed Prof. Helmholtz the commemorative medal in palladium, and a duplicate in bronze, and the lecturer then proceeded with his discourse. The lecture consisted of a sketch of the way in which Faraday's discoveries had been connected directly or indirectly with questions touching the nature of electricity. The facts which he found were universally known. Nevertheless, the fundamental conceptions by which Faraday was led to these most-admired discoveries have not been received with much consideration. His principal aim was to oppose in his new conception the notion of electricity as a kind of hypothetical substance and force. This would really a progress in general scientific method, especially in purely science from the last remnant of metaphysics. Now that the mathematical interpretations of Faraday's conceptions regarding the nature of electric and magnetic force had been given by Clerk Maxwell, we see how great a degree of acuteness and penetration was really hidden in the words of Faraday, which were sometimes used in vague or obscure; and it was astonishing to the highest degree to see what a large number of general theorems, the fundamental ideas of which comprises the highest powers of mathematical analysis, he had found by a kind of intuition, with the help of mental experiment, without the help of a single mathematical formula. Almost the whole of Faraday's researches, although containing a great number of perfectly accurate and demonstrated questions, were directed to the solution of the fundamental problems of electricity. Principally, the one more regarding the nature of electricity, which he called the theory of Volta-force; the other, to the more exact knowledge of chemical force, or those which act from molecule to molecule, and the relation between these and the first. The great problem which Faraday called the theory of Volta-force was the existence of the working electricity or without any intervening medium. He took up the old and long-known of the motions of magnets under the influence of electric currents, and discovered "induced" currents, and later, in 1846, he discovered the phenomenon of diamagnetism, which gave indications of a "polar force," instead of all so-called permanent "matter" in magnetism. Further, with quite wonderful sagacity and intellectual precision, Faraday performed in his brain the work of a great mathematician without using a single mathematical formula. He was led to the idea that the whole space system of tensions and pressures caused by the dielectric and magnetic polarisation of space which surrounds electrified bodies, magnets or wires conducting electric currents, all the phenomena of electro-static, magnetic, electro-magnetic attraction, repulsion, and induction which take place in the neighbourhood occurring at all in these active electrified or charged. Professor Helmholtz then dwelt at length on Faraday's work in connection with electric and chemical force. Taking up the electro-chemical theory of dissolics, he carried out experiments which showed that the view was erroneous which supposed that the quantity of electricity collected in each atom was dependent on their mutual chemical affinity. The result of these researches was, that—if we accept the hypothesis that the elementary substances are composed of atoms, we cannot avoid ascribing that electricity also, positive as well as negative, is divided into definite elementary portions, which behave like atoms of electricity. As long as it remains in the body of the electrolyte liquid each atom remains united with the corresponding quantity of equivalents. At the surfaces of the electrodes decomposition can take place if there is sufficient electromotive power, and then the atoms give off their electric charges and become electrically neutral. Professor Helmholtz then passed on to a consideration of the forces which are called into close motions of considerable matter going on in an electrolyte. The author showed by calculation that chemical affinity and electricity are one and the same. In concluding, he said that it seemed to him best, to take as his portion of the review of Faraday's work, what treasures, from a chemist's view, still lay hidden in his work, though he did not know the precise formulation of the law of energy applied to the electrolytic act, nor of the laws which regulate the distribution of electricity in space, as well as in considerable isolated quantities of electric current or flowing conductors.

THE BRUSH SYSTEM OF ELECTRIC LIGHTING.

By CHARLES F. BRUSH, M.E.

The Dynamo-Electric Machine.

THE most prominent peculiarities of the Brush dynamo-electric machines are embodied in the armature, the arrangement of field magnets, and the commutator. The armature consists of a ring of soft cast iron, revolving in its own plane. This ring is composed of two or more parts, each encircling the shaft. After a few words of introduction, the chairman handed Prof. Helmholtz the commemorative medal in palladium, and a duplicate in bronze, and the lecturer then proceeded with his discourse. The lecture consisted of a sketch of the way in which Faraday's discoveries had been connected directly or indirectly with questions touching the nature of electricity. The facts which he found were universally known. Nevertheless, the fundamental conceptions by which Faraday was led to these most-admired discoveries have not been received with much consideration. His principal aim was to oppose in his new conception the notion of electricity as a kind of hypothetical substance and force. This would really a progress in general scientific method, especially in purely science from the last remnant of metaphysics. Now that the mathematical interpretations of Faraday's conceptions regarding the nature of electric and magnetic force had been given by Clerk Maxwell, we see how great a degree of acuteness and penetration was really hidden in the words of Faraday, which were sometimes used in vague or obscure; and it was astonishing to the highest degree to see what a large number of general theorems, the fundamental ideas of which comprises the highest powers of mathematical analysis, he had found by a kind of intuition, with the help of mental experiment, without the help of a single mathematical formula. Almost the whole of Faraday's researches, although containing a great number of perfectly accurate and demonstrated questions, were directed to the solution of the fundamental problems of electricity. Principally, the one more regarding the nature of electricity, which he called the theory of Volta-force; the other, to the more exact knowledge of chemical force, or those which act from molecule to molecule, and the relation between these and the first. The great problem which Faraday called the theory of Volta-force was the existence of the working electricity or without any intervening medium. He took up the old and long-known of the motions of magnets under the influence of electric currents, and discovered "induced" currents, and later, in 1846, he discovered the phenomenon of diamagnetism, which gave indications of a "polar force," instead of all so-called permanent "matter" in magnetism. Further, with quite wonderful sagacity and intellectual precision, Faraday performed in his brain the work of a great mathematician without using a single mathematical formula. He was led to the idea that the whole space system of tensions and pressures caused by the dielectric and magnetic polarisation of space which surrounds electrified bodies, magnets or wires conducting electric currents, all the phenomena of electro-static, magnetic, electro-magnetic attraction, repulsion, and induction which take place in the neighbourhood occurring at all in these active electrified or charged. Professor Helmholtz then dwelt at length on Faraday's work in connection with electric and chemical force. Taking up the electro-chemical theory of dissolics, he carried out experiments which showed that the view was erroneous which supposed that the quantity of electricity collected in each atom was dependent on their mutual chemical affinity. The result of these researches was, that—if we accept the hypothesis that the elementary substances are composed of atoms, we cannot avoid ascribing that electricity also, positive as well as negative, is divided into definite elementary portions, which behave like atoms of electricity. As long as it remains in the body of the electrolyte liquid each atom remains united with the corresponding quantity of equivalents. At the surfaces of the electrodes decomposition can take place if there is sufficient electromotive power, and then the atoms give off their electric charges and become electrically neutral. Professor Helmholtz then passed on to a consideration of the forces which are called into close motions of considerable matter going on in an electrolyte. The author showed by calculation that chemical affinity and electricity are one and the same. In concluding, he said that it seemed to him best, to take as his portion of the review of Faraday's work, what treasures, from a chemist's view, still lay hidden in his work, though he did not know the precise formulation of the law of energy applied to the electrolytic act, nor of the laws which regulate the distribution of electricity in space, as well as in considerable isolated quantities of electric current or flowing conductors.

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fifty revolutions per minute, in its normal magnetic field, the electro-motive force developed in the conductor is sufficient to maintain its normal volume of current through an external resistance, including the field magnets of the machine, of fully eighty times as much as a copper wire twenty times as great in diameter. No other form of dynamo-electric machine has ever been made to approximate with this. The current operates from sixteen to eighteen powerful electric lights arranged in a *single circuit*, going to each an arc of about two millimeters length. The resistance of these arcs averages about four and a half ohms each, as shown by many careful measurements of different lights during the past year. This makes a total resistance included in the magnetic field of 72 ohms, the resistance of which is, however, quite small, and will be given further on.)

The bobbins of wire on the armature of the Brush machine are not connected together in a single circuit, but each pair of diametrically opposite bobbins only are connected together, thus forming a set of the commutator bar formed of two only of the segments of the commutator cylinder and attached to diametrically opposite segments thereon, which segments are not connected with any other bobbins. Thus each pair of bobbins is entirely independent of any other pair. In this arrangement, which secures important advantages, the Brush machine again differs radically from the Gramme and all similar continuous-current machines.

The commutator consists of four separate rings of metal, each ring consisting of two nearly semi-circular segments, whose ends, on one side, are separated by a considerable space. This space is occupied by a piece of metal attached to an adjoining ring, and known as an "insulator." It is insulated by an air-space from each of the segments between which it is placed. The two insulators, of the segments being simply separated by a single air-space. The office of the "insulator" is to separate either of the brushes which collect the currents from the commutator, from both segments during a certain interval, and to unite in each revolution of the commutator. The insulators are placed at right angles to the axis of the armature which are connected with the pair of segments are not only out of the general line of cut, but are open-circuited themselves, so that no current can circulate in them. Each pair of bobbins on the armature is thus provided with a commutator ring, and the segments of this ring occupy the same angular position with regard to their respective bobbins as the brushes occupy with regard to those attached to the other pair of bobbins.

It will now be seen that only one pair of armature bobbins is cut of the general circuit at one time; and this is made to occur when the said bobbins are at and near the neutral points of the armature, and are not in a condition to contribute to the general current. Now, if it were not for the "insulators" mentioned, the idle bobbins would afford a easy passage for the current from the active bobbins, and, like dead-beat bobbins of the armature.

The Gramme form of commutator, which is employed for the production of continuous currents in all machines other than the Brush, involves serious disadvantages, which the Brush form of commutator is free. The practical difficulty arising from the use of the Gramme form of commutator is, wire, wears at and near the neutral points of the armature, constitute little or no useful effect: but the current from the other bobbins must pass through them in order to reach the brushes, thus experiencing a considerable and entirely useless resistance, and owing to the opposite directions of the currents in the bobbins on the two opposite sides of the neutral points, the current is arrested by passing through the idle bobbins, and strongly to produce "sensorial" shocks in the armature where the neutral points should be: thus interfering seriously with the proper distribution of the armature's magnetism. It may be argued that this latter disadvantage is obviated by allowing each of the brushes to exchange with two sections of the commutator, corresponding to bobbins on both sides of each neutral point: this is, no doubt, true to some extent, but another and perhaps worse evil is thus introduced: the bobbins corresponding to the commutator sections connected by each brush are short-circuited by these two contacts and brushes occur with each brush in each revolution, and the consequence is that, in different flags, we find but one-fourth of the whole current is received at one time.

Further, the use of the subdivision appears to be impracticable with the Gramme form of commutator, while it may always be employed on the Brush commutator with great advantage. Thus the durability of the commutator is much increasingly greater than that of the other. When necessary, the wearing segments of the commutator may be replaced by duplicate pieces in a very few minutes by any mechanic.

The Lamps.

There are of very great simplicity of construction: insuring ease of management, safety against informal derangement, and wearing out but slightly of working; the double magnet circuit conveying currents of opposite direction, by means of which any number of lamps may be ejected in a single circuit, without any change of strength in the main current, automatically open-circuiting any lamp offering an abnormally great resistance, owing to the final consumption of its carbons, or other cause, will, without any change of strength in the main current, automatically short-circuit the said lamp, and thus preserve the integrity of the general circuit; the small size of carbons, burning successively, without the intervention of any attendant, and thus insuring a steady light and economy; the maintenance of the light for any desirable length of time without requiring attention; lastly, the absence of any adjustment to be made by the attendant other than placing the carbons.

Three lamps consists mechanism or similar mechanism of any kind. The movement of the upper carbon is effected by a simple clockwork train, a description of which, as applied to this lamp, is carrying the carbons. When the lamp is in operation, one side of the clamp is lifted by magnetic action; this causes it to grasp and raise the rod, and thus separate the carbons. As the carbons burn away, the magnetic action diminishes, and the clamp rod and more gradually downward, maintaining only a proper separation of the carbons; lastly, the absence of any adjustment to be made by the supporting fixe from which it slides, any further downward move will at once release the rod and allow it to fall through the clamp, until the latter is again brought into action by the increased magnetism due to the shortened arc between the carbons. In continued operation, the normal condition of the clamp is to contact with the upper support, the action of the ascending magnet being sufficient to overcome the descending one. If, however, the rod accidentally slides in the clamp, it will instantly and automatically be raised again, as at first, and the carbons thus restored to their proper relation to each other.

Each magnet bobbin is first wound with a few layers of coarse wire, through which the main current passes, and then with a fine wire of high resistance. Over this coarse wire another wire is wound, the length of fine wire, having its ends connected with the terminals of the lamp, but in such a manner that the electric current shall pass through it in a direction opposite to that in the coarse wire coil. Thus the fine wire forms a secondary circuit of high resistance through the lamp, which should be independent of the arc between the carbons, and is in fact a shunt to the arc. Under the normal conditions of the current the latter is the case, but the fine-wire bells will constantly tend to neutralise the magnetism produced by the coarse wire or principal helix. The number of convolutions of the fine-wire bells and its resistance are so proportioned to the number of convolutions in the coarse wire helix, and the resistance together with that of the lamp, that, with the magnetising power of the fine-wire helix, the magnetising power of the former. Considering the small amount of current which passes through the fine-wire wire when joined one per cent. of the whole current, its magnetic power is very considerable, owing to the great number of convolutions.

Now, when a number of regulators provided with these double magnet coils are placed in a single circuit, great uniformity of action will be maintained, owing to the peculiar function of the secondary bells. Thus, when any lamp gains more than its normal arc, the resistance of its main circuit is increased; more current is consequently diverted through its secondary helix, and the retarding power of the latter is increased, causing the clamp to approach its normal position. If an arc becomes incident, its resistance is reduced, and more current is diverted through its correspondent secondary helix; consequently, the working magnetism in that lamp is lessened, and the carbons are drawn further apart. This it will be seen that, although the total strength of the current upon passing a large number of these lamps does not vary, the distribution of the current is automatically under the agency of varying conditions, precisely as though it were the only lamp in the circuit.

In practice, the resistance of the fine-wire bells or helices in each lamp is rather more than four hundred and fifty ohms; while the resistance of the coarse wire, various connections, carbons, and bells in each lamp used with the sixteen-light machine is about four and one-half ohms. Hence not more than one-fiftieth part of the current is diverted from the arc. The resistance of the coarse-wire bells, carbons (copper-coated), connections, &c., in each lamp is very small.

To determine this resistance, sixteen lamps were connected in series in the usual manner, about two hundred feet of No. 16 copper circuit wire being used. Full-length carbons were also placed in the lamps, and the upper carbons of each pair were adjusted by means of a screw at the top, so as to project to each carbon, the distance of the whole arc was then measured, and found to be 2·20 mm., showing a resistance for each lamp, with its carbons, of 0·11 ohm. This is 2·2 per cent. of the whole resistance of the lamp when in operation. To this low must be added the one per cent. due to that minute current diverted from the arc by the secondary helix, making a total of 3·2 per cent. of 225 ohms, the total resistance of the lamp, or 7·2 ohms, a very slight energy absorbed in each lamp appears in the arc between its carbons.

The shunting or short-circuiting device in each lamp consists of a small magnetic core, surrounded by a coarse and a fine-wire helix, similar to those of the working magnet. Its current passes through the coarse wire until the magnet which it surrounds is sufficiently energised to lift its armature, with the contact piece, which forms a part of the short circuit established through the lamp. The fine-wire helix of the shunt is in the circuit of the fine-wire galvanometer below referred to work. During the normal operation of the lamp, this fine-wire helix exercises a magnetising influence on the shunt magnet, but its attractive action is only to a certain degree of force, not sufficient to lift its armature. Should, however, the arc of the lamp increase in length, or from their failing properly to feed together, the arc between them becomes considerably lengthened, the fine-wire helix exercises a great resistance in the lamp, a greatly increased current will be shunted through the fine-wire helix, the iron core of the latter will raise its armature, and thus short-circuit the lamp, the carbons of which will, in consequence, approach each other.

Evidently, when the short circuit is closed as above, the current will continue to circulate in the wire helix, and the magnet would drop its armature if it were not for the fact that the armature not retained by some means other than the magnetism of the wire helix; but it will be remembered that the coarse-wire helix surrounding the shunt magnet is in the main circuit, and that the current passes in the contrary direction to that in the fine-wire helix. Hence, when the short circuit is established, which any lamp becomes extinguished, the coarse-wire helix always present when many lamps are burned in a single circuit. It is believed that it would be without any change in the strength of the general current, supposing a number of many lamps were put into the great merit. No effect is produced in the fine-wire galvanometer by the extinction of a lamp, as the latter is not in the circuit of the galvanometer. The regulation of the current through the lamp is effected by the separation of the carbons when the arc is established, and the approach of the carbons when the arc is extinguished. The action of the lamp consists in the attraction of a soft iron bar, which is drawn into the coarse wire helix, and the resistance of the carbons is thus increased. The carbons are held apart by the repulsion of the two magnets, which are placed in the circuit of the lamp, and the upper carbon is lifted by means of a clockwork train, actuated by a weight. The latter is wound up by means of a cord passing over a pulley on the axle of the train, and is connected with the upper carbon holder. The clockwork train is set in motion by the attraction of the

Pesti Napló. August 22, 1882.

— Edison-féle villamos világítás a fővárosi közkönyvtárban. A Gánz- és társa gyár mérnöket hóban fő tett próbát a villamos világítással a fővárosi táviróhivatal géptermében. Ezen két héti próbát a mult héten kedden befejezték. A nevezett gyár villamvilágítási osztályának vezetője által működtetett többféle lámpával tett kísérletet. A mint a Zipernowsky-féle lámpák a mult héten eltüntek a központi táviróhivatal most fönyes berendezéseit temdőbl, P. t. k.s Ferencz, a fővárosi telefon-vállalat igazgató tulajdonosa azonnal megkezdette a berendezési munkálatokat, a vgy a géptermében működő tiezti személyzet, mint az intézet vezérférfiai élénk érdeklődéssel néztek az első próba elé. Május 30-ára, szombata közen lesték a bereudezés egy részével; a mennyiben a fiert és női távíró-géptermében összesen 80 db. különféle kínézésű Edison-féle villamos lámpa már — a mint egyelőre nevezik — el volt helyezve, a gőzgép, melyet elektro-dinamikus gép, fel volt állítva. Estefelé 8 óra után pár perczczel a termek már meg voltak világítva. E próbára eljött Puskás Ferencz bányás is Párisból. Ezen kivül sok látogató volt. Míg a Zipernowsky-féle nagy ívlámpák világították mellett az egész terem szépségében lebeteri gyönyörködni a sok valóban fényes elvarázsoló, meglepő benyomást tettek a szemlélőre az első pillanatban : addig ezen czélszerűbp elosztott apró, kedves ívlámpák és kisebb nagyra könnyű kitatni ; hanem az egyes távirógépek közvetlen közelségében, ernyőről elátva, mintegy lefolyozott szerőnyeg, tűntek fel az emberi szemnek. Ha meggyőződtünk, az egyes gépeknek hiv szépen, kellemes világítás mellett, lehetett dolgozni, hahár két gépre volt egy lámpa alkalmazva a nagyobbakból. A személyzet legnagyobb része ezeket megelégedett az uj világítással s e rendszerben egyáltalában több remónyt kötnek ; mert hiszen az eddigi gyakorlati tapasztalatok szerint ezen izzó lámpák legalkalmasabbnak a távíró hivatal czéljaira. Itt nem azról van szó, hogy egy helyen nagy, vakitó fényt fejlesszenek, az ternmi a annak állandó személyzetét a nagy közönségnek mutogassuk, hanem hogy a rosszgásvilágitás, a nagy hőség és még rosszabb levegő helyett szép világító szervezeti hivatalnoki haron esszünye legyen. Es ez leginkább elérhetőnek látszik ezen. Érdemleges birálatot ugyan most még korán ezeknek mondani; mert a czél az a helyi körülmények, távírók helyes, czélszerű kiakasztásától sok függ ; de mi azt hiszszük, a mennyire az e téren tett tapasztalatokra támaszkodhatunk, hogy ebből állításunk és találvatnak nem fog csalni. Különben a világítási mindenről lesz alkalmunk meggyőződést szerezni s erről a közönségnek lehen értesíteni. A próbák ugyanis 2 hónapig fognak tartani ; a fentemlített helyiségeken kivül a Puskás és a közmunka- és közlekedésügyi minisztérium távíró-szakozatában közöttük kötött egyezmény szerint a posta-távíró palotában még a következők lesznek villamossággal megvilágítva : a távíróhivatalban földszint a távíratok : földszinti szolgáló terem, annak előcsarnoka, valamint az fpdlet koronaherczeg-uteza felől levő előlépcsője egészen a lámpák emeletig ; a főpostánál : földszinten a zsidra-uteczai részen levő valamennyi levélfeladási helyiség, az első emeleten az irányító terem s az a mellett levő helyiségek és végre a zsidra-uteczai sarkon levő előlépcső egészen a harmadik emeletig.

Edison és az elektrikus világitás.

Edison már sálunk sem' mithikus 'alak,' mint volt kezdetében, midőn hire jött számos rendkivüli találmányainak, mint a phonographnak, edison-lámpának, stb. Itt látjuk már kiküzdtnek szivól-szivre a mesés találmányokat.

A sznad egyik legtcrkésebb alakja körülbelül 36—37 éves, a középtermetnél magasabb, sőtben termetiel, hallatlan kitartással a munkában, mely tudományosságával a mathematika, vegytan, természettan terén és speczialista a villanyosság kezelésében, kombinálásában.

Kiterjedtsnek jellemzéseo elég lesz elmondani, hogy miképen szerkesztette ő híres elektrikus lámpáját. A beszerzőnk almájának megszerzése, Herkules tizenkét hőstette semmi'ahhz a tanulmányozáshoz, utazáshoz, kölcsönzéshez, a mit Edison elkövetett a végett, hogy végleg megállapítsa : mit alkalmazzon a lámpában a fény terjesztésére ?

1878-ban, mikor Edison neve már bejárta a világot, különösen a phonograf ró'vén, egyszer azt mondja neki egy barátja, Draper: Mi volna abból, ha te most a villamos világitás tanulmányozásra adnád magadat s — Igaz a ! — felelt Edison szárazozotan.Aztán bemeuve laboratoriumába, azonnal egész komolységgel elkezdi a studiumot, abban hagyva félben levő munkáit, találmányait. — Már neki meg volt a maga czélnje és a tervezetet nagyobb vonásokban elkészité. Ha a villamosság fényt produkál, meg kell találni az eszközt, hogy állandó világosságot is terjesszen, még pedig no csak a közterekeu, utczákon, nagyobb helyiségekben, hanem a házak belsejében is. Az czeme tehát az volt, hogy az olcsót, petroleumot és gázt helyettesitseni kell a villamosság által ; ezt már első tudjuk állitani : most hát az a feladat, hogy egy készülékot konstruáljunk, a mely a villamosságot a jelzett czélra alkalmassá tenni, olyat, a mely mintegy kanalizálja a villamosságot és azt elvezesse hárhevá, mint a czévek a gázt.

Ez nem volt könnyü feladat.

A használatban levő rendszerek, a melyek oly jóknak tüntek fel, illvalón rendszerek voltak. A melyeknél a szonet pótolgatni kellett, mint a petroleumnál a lámpa-belet, Edisonnak gyarlóknak látszottak. — Mért ne lehetne használni a platina drótot, mely a villamos fólyam által világossággá terjesztett ? Ez oly erős rugyogó fényt ád. Próbát tett a platinával és az is használhatónak mutatkozott, a villan-folyam alatt, de mihamar elolvadtak.

Ezután kisérletet tett másféle szilárd érczekkel is, melyeket ugyszólván elvarázsltásunknak mondtak ; a melyek többnyire a platinával együtt találtatnak, ilyenek: a ruthenium, palladium, rhodium, osmium, iridium stb. Ezek közül mindegyik megjelentésre ritka. A leggazdagabb laboratoriumokban csak apró adagocskákat lehet belőlök látni, olyatzo egy-egy tognatják meg őket ; ez rhodium, ez meg osmium stb. A mint Edison a valamennyit, a m végezte érezeket keresztül akarta próbálni, nagyon megakadt a rhodiumnál. Nem talált egy pozsemmiyik sem a chemiai anyagokkal kerekedő bolloknál. Itt tehát az Egyesült-Államok egy híres mineralogistájához, a kiről gyújtőmárgye van érvényben, a mélő nép szerelmére három évet, urasi, töltött nekem egy kis rhodiumot ; majd megszolgálom.«

»Rhodiumot ? — felelt a tudós, — nem volna gáthatnék, de fogadok rá, hogy az egész Egyesült-Államokban nem talál ön annyit az érczből annyit, hogy egy forsknzat czélnthesson belőle.«

— No hiszen majd meglátjuk — szólt Edison a levél olvastatása után.

Találtak már darabon platinát elegot ; ott rhodiumnak is kell lenni.

Utaszik el ön rögtön — szólt azután Edison egy segédjéhez, — vigyen magával munkásokat és mindent a mi szükséges, azután teromtsen nekem rhodiumot a föld alól.

A kikelőtét azonnal utra kel vagy 50—60 munkással, a kiket busás fizetéssel lát el, a találandó aranyat mind nekik ajándékozná a nuhány hét multva ; sőtazonnal vagy bat kilogramm rhodiumot és hazavissi Edisonnak.

Edisonnak a legelső gondja pedig'az volt, hogy legyakkott egy kilogrammnot a rhodiumból e elkildte a hires mineralogistának, hehtozyfejtsék, hogy még sem olyan nagy ritkaság az az ásvány.

Hanem lás6 ez a rhodium, so a platina, so az iridium, so más érez — fiazáru tóbb, mint meglep jő sikrrt experimentálásnak — nem vezette Edisont végleges megoldásra.

Ekkor azután megint csak visszatért próbálgatásával a szénre. Próbálta szenesiteni a papirost, a bristol cartont, a ruhát, mindenféle fa gallyát, a siten tudná mi mindent ! Segédeit alkalmazta ez ópus egy, mint a rhodium felkeresésére — ogész Amerikát, Ázsiába, különösen Chinába és Japánba, hogy bornmak onnan neki minden ismert és ismeretlen növényből mutatóbo, a hambusz, különösen annek rostjai létezoitak Edison előtt alkalmasaknak a kivánt czélra. Tárgyleg csakugyan a japáni bambusz rostjait használta azután a lámpáihoz.

A szenesitett rost hajlit alakjában van egy kis légmentes golyóban elhelyezve, a csak részli beszáritni és elektrop os folyamot, azonnal vakitó fényben jrik, a mely fényt azonban egy alkalmazott készülékkel mindenfülékpen mérsékelni lehet.

Most azután már Edison minutiosus kidolgozása folytán olyan tökéletességre van vive az elektromos lámpa, hogy lehet belőle csillárokat épen egy vendéglőtani, mint a hogy használhatja az otte dolgozó emberek, mindenütt ugyanoly erőteljes világosságot szolgáltat, ellyen a gáz fölött az, hogy az egészségre semmi káros behatással sincs, s még a gáz annál érzékenyebbtelen hőséget árasz, addig az elektromos fény egy csapnyi szem változatja a sárt fölött nem érez.

Az Edison-féle világító rendszer jelességeről különben mindenki meggyőződhet szerezhet magának a központi távíró hivatalban és Szilassy vendéglőjében. Valamint oté a hivatal kar, ugy itt a nagy vendégsereg csak dicsérettel emlékezik meg róla.

A hahéta mai világban azonban nincs az a jó, a mely ellenében más nem állana elő nnal, az ime jobb ! Ez: tesni a Gánz-féle társaság midőn kiáll a nyilvánosság terére A nemzeti zászlóhoz, nélkülözhetetlen világitási rendszerét világgal, és hogy a maga részére hódítsa a nagy közönséget, azt adja ki jelszóul, hogy ez »hazai találmány.«

Ha valaki, ez valóban azok, kik készséggel nyujtanák oda neki a babért, ha csakugyan egy rangha volna helyezhető az Edison-féle világitásnál vagy azt csak meg is közelitené. Fájdalom azonban nem tehetjük, mert a tompa világosság fogalmat a »fény« nevével nem illethetjük. Hozzá járul ehhez még az, hogy a mellett, hogy nem »jobb«, de nagy nem is »hazai találmány.« Nem egyéb az, mint külföldi utánzatból helytelenül összekombinált *fényforrás* fény szükül és meglehetősen forkand.

Nem a részrehajlás mondatja ki velünk az itéletet; hanem a meggyőződés, melyet hathatósan támaszt a közvélemény, mely azt mondja, ha eddigi világitási módunkat újabbal akarjuk pótolni, válasszunk a legjobbat, a legmegbizhatóbbat, és mely gyakorlati alkalmazhatóságának már nem szorul kiséletre, hanem egész tökéletességében ajánlkozik a használatra. Ilyen pedig Edison elektromos világitási rendszere. P.

NOVEMBER 26, 1882

THE SUNDAY HERALD

You manuscript of the Nijne Tavnire tale' ictan a step in advance of any' manuscript in the country, as evidenced sufficient for fighting purposes. Edison's light is the best light in the world exclusively. The Savoy in London was the first Theatre to be illuminated with the incandescent light, and the Paris Opera House is the second Theatre, also illuminated by the same adopted this system; but the Paris Opera House is not illuminated as well as the Savoy Theatre in London. However, the Paris Opera House is illuminated with the Edison system for its decorations, and the Edison light is the best in the world for decorations. In the Savoy we have about three chandeliers pendent from the dome, 360 lights in each chandelier, and 12 lights on the walls of the auditorium on each tier or tower floor and six in the balcony, 37 tiers in all. The stage is lighted by the Edison system, and the footlights are all electric lights. The chandeliers were manufactured in New York for the Edison Co. of Paris, but, on account of the war, were not sent over—they are now in the Edison Co.'s warehouse in Paris, and will be put up shortly. In the Opera House there will be about 1,200 lights. Mr. Edison himself has planted the dynamos in the cellar, but will personally superintend the plants.

SEPTEMBER 22, 1883.
NEW YORK HERALD.

ELECTRICAL WONDERS.

INTERESTING RESULTS OF THE VIENNA ELECTRIC EXHIBITION.

Among the many startling electrical scenes at the Vienna Electric Exhibition is Messrs. Lauterwasser and Bitter's new thermo-electric battery. The principle of these batteries is the direct transformation of heat into electricity without passing through the intermediary stage of work, as in the case of the employment of a dynamo. Great promises were held out here three or four years ago, on the construction of Clamond's so-called heated thermo-electric screw, that this most important problem was advancing toward a solution, but it never came; but nothing further was heard of it, and the clearest whatever has been made since is by the above.

Messrs. Lauterwasser and Bitter exhibit a thermo-electric battery, which presents the form of an ordinary screw, and can be used in such. It consists of thirty superposed concentric cylinders of German silver, the rings being fastened from one another by means of asbestos. The external cylinder of an either of two electrically opposite metals that the pointed nut being completed the inventor used the nut and its exact composition, which forms an air-tight cylinder, or ear heating this alloy an electric current is generated. The remaining cylinders are placed in the center, and, of considerable space between them, form the communicating rings, so that the heating of the alloy of one cylinder draws, and the communication by which the alloy is heated does not exceed 300 degrees to 600 degrees C. Both the inside ring and the outside cylinder are connected, the whole or the part of the current being passed. The current has an electric motive force of twenty volts, and twenty current resistance. The battery is attached for gilding, and has been used in an important point of the above, as the case in which, in that which is not of air, as that current power can be established by using a number of accumulators sufficient for Siemens lighting purposes, or to drive a small motor for doing electric work, without any extra expense.

Mr. Bitter's second machine was thermo-magnetic. There are three telephone rooms for central reproduction. In one of these the Berliner telephone, established by Mr. J. Bettner, of Hanover, reproduces the concert of a military band performing at Hengelmann's restaurant in the Prater. The receiver is an ordinary bell. The transmitter is the exhibitor's invention, is of very simple construction and admirably adapted for ordinary transmission of speech. The conversation can be carried on in the largest room of the house, and every note is repeated with great clearness. The microphonic transmitter has caused the "chaperon telephone," with the "sleeper of silence," the "polyphonic" telephone all the other telephonic stores at the Palace (see correspondence of yesterday), and there can be no doubt that this will be received by the fact that with the microphonic transmitter no sounding on the part of the listener is necessary, valid with the receiver to produce the subscriber can always considerably. Within the room in order to be heard; Siemens's transmitter consists of a small hard carbon point, placed between two conical screws; the carbon point which forms a small, specially hard carbon disk which is connected to a variable diaphragm, and the whole complete contact is made without friction. The transmitter is only fixed at the back of the receiver is the microphonic case, and on electing the small pointed screw the point is carbon which is opposite to the carbon disk, fixed to the membrane. The second point is fixed to the back of the receiver case, but the membrane, and, but also as a regulator, in case of the vibration of the membrane being too strong or not strong enough. The transmitter battery consists, as a rule, of two Leclanché element.

THE TRANSMISSION.

The reputation of the exhibition, please judged at the restaurant was clear and distinct whenever a part time was played, as was also when piano was performed its sounds became confused and indistinct. The fault lie in the arrangement of the transmitters at Siemens's; they were fastened to the entrance of the pavilion under which the band was playing. If they had been suspended

[illegible]

of the room, as was [illegible] done the [illegible] ition the effect would doubtless have been better. The two other telephone rooms are located by the Vienna Private Telegraph Company. A lady singing at Baden (about twelve miles from Vienna) was accompanied by a man playing the zither at Kornneuburg, about the same distance from Vienna, but on the opposite side of the Danube. The receiver itself was very successful, but the peculiar crackling noise of induction was only too audible and greatly interfered with the performance. In the third room was heard the finale of the first act of Verdi's "Aida," which was being performed at the Imperial Opera. The reproduction was perfect anyone, and the orchestra, the instrumental music and also the applause of the audience were reproduced with the greatest clearness. The Vienna Private Telegraph Company also transmitter almost identical with Berliner's, the only difference being that it has three parallel carbon contacts instead of one.

ELECTRIC RAILWAY CARS.

There is an apparatus, not quite new, called the Hallmark-Wilmhill locomotive lamp for illuminating railway trains. It would appear that the unavoidable vibration and frequent shocks to which a railway train is exposed would render the gas lamp wholly unfit for illuminating purposes. The lamp successfully overcomes this difficulty, and is used on the Kronprinz Rudolf Bahn, in Austria. It consists of two vertical tubes of different diameter and connected at the bottom; two pieces carrying the cotton serve in these tubes, which are filled with glycerine. At the bottom of one of the tubes is a small, hollow plug, connected with a lever, which terminates in an armature opposed to an electro-magnet. As soon as the current passes, the arm of the lever is attracted, the electro-magnet is instantly energized and attracts the lever. The piston closes the communication between the two tubes, causes a slight lowering of the liquid in one of the tubes, and consequently a withdrawal of the layer carbon, and the electric arc is formed. As soon for incandescence headlights, the lamp is attached to the front of the smoke box, and a small Schuckert dynamo placed in front of the bottom of the latter feeds the lamp. Such a lamp illuminates a space of about one-third of a mile and is very useful for lighting up a tunnel and for distinguishing signals.

Crewe, March 1884.

THE PROGRESS OF ELECTRIC LIGHTING.

A paper on this subject was read before the Society of Arts on March 5 by Mr. W. H. Preece, F.R.S., Mr. Fredefield, Abel, C.B., Crompton, and amongst others present were Mr. Hammond, Mr. Crompton, and a large number of gentlemen connected with electric lighting. Mr. Preece, in commencing his lecture, remarked that experiments had been made in some quarters to the effect that electric lighting was at present a failure. He proposed to show that this was incorrect, and that electric lighting was a most pronounced success. Electric company mongering and floating had, however, in many cases resulted in disastrous failure. Mr. Preece next pointed out that the effect of the Electric Lighting Act, introduced in 1882, the object of which was to prevent the formation of a monopoly such as that of water and gas, had been to add considerably to the obstacles in the way of progress, and stated that the act was all in the interests of one class, viz. the local authority. The lecturer next made a rapid survey of the extent to which electric light up to now enabled us to solve the problem of the economical supply of electricity. With regard to the claims of motive power in connection with the modern system for generating the electric current, water power, steam power, or gas engines had been employed. The latter he thought best, but were very imperfect in their workings. Recent improvements had been made in the manufacture of gas engines by increasing the quantity and quality of the iron, and by rearranging some parts of the machine, by which means it had been successful in doubling the output of one horse-power. Mr. Crompton had also produced a dynamo which would light up 250 lamps instead of 90, and Sir William Thomson had turned out a little machine capable of lighting 1,000 lamps by a mass of metal which one man could would not have sufficed for 100 lamps. With regard to alleged frequent breakdown of electric lighting, the lecturer had not examined one single case of a failure of an electric light that had not been traceable either to crass ignorance or to absurd attempts at economy. A sensation crusade was now being carried on against overhead wires. If properly constructed, these were highly desirable, and were especially adapted to electric lighting. In many instances they were, however, recklessly run up without method or system, and wanted. In the production of arc lamps two or three distinct makers had been obtained, and the working parts had been much simplified. For domestic illumination the glow lamp was eminently adapted. It was of no use to ignore the fact that there was a certain amount of danger in the introduction of the electric light into our homes; but careful rules and regulations had been drawn up for the guidance of those in charge of installations, and it was merely easy to employ sure but skilful and perfected contractors, and to leave the premises inspected periodically by the engineer to secure such guidance and safety as the electric light was capable of. Its harmless and devoid of danger. The accumulator was the next point that was the cause of numerous accidents by burns, fire, and explosion. The true solution of isolated house lighting, Mr. Preece thought, would be secured until we had obtained a reliable, effectual, and economical secondary battery. Plantè's original accumulator, as improved by Faure, Sellon, and Volckmar, had a progress towards this consideration steady progress, as exceedingly battery had the advantage that electricity could be stored up for use as wanted by day or night without the constant use of machinery. With regard to street lighting, the public, owing to the dazzling glare of the arc light, were not satisfied with the electric light of the same illuminating power as gas. A very interesting series of experiments was being conducted at Wimbledon to determine the best form of diffuser for use with the Siemens arc lamp. Herring referred to the electric light growing into favour with theatre managers, the lecturer remarked that the Marquis of Salisbury—himself an amateur electrician of no mean type—had established a system at his seat at Hatfield. Our New Law Courts were admirably lighted, and some of the judges had said that the electric light was the only good thing in the Palace of Justice. The electric light had been adopted in numerous hotels, public buildings, and railway stations; but its introduction was especially desirable in our homes, inasmuch as by its use there was no air vitiated, and a smaller amount of heat was produced than by gas, oil, or candle. Then the electric light was the purest and the most healthy. With regard to primary batteries, Mr. Preece remarked that these, owing to their cost, had not met with marked success. Railway trains on the Brighton and other lines were being admirably lighted by dynamos and secondary batteries. The energy of the moving train itself was capable of producing the current of electricity to illuminate every compartment with the light of day. It was difficult to ignore an epidemic as to the economy of electric lighting. In comparison with gas was not fair, as no central electric lighting station of sufficient magnitude at present existed, but the cost of supplying electricity now was far less than was the cost of supplying gas in the early days of its introduction. The public would have the electric light, however, not because it was cheap, but because it was safe, healthy, pure, soft, and natural; whilst gas was most insanitary and unhealthy. Questions of sanitation, ventilation, and decoration would determine the use of electricity, and not questions of price. At present it was a luxury for which we must pay; but such rapid progress was being made that it was evident the day was not far distant when we should cease to look on it as a luxury, but should demand it as a necessity.

In the discussion which followed, Mr. Crompton said that there was no reason for the impression abroad that electric lighting required more care than gas. As a manufacturer, his experience had been that the cost of production was steadily decreasing. What was wanted now was the practical breaking out of all that had been invented. Up to the present time had been there forward and systems had been neglected.

Mr. Gordon Salomons described an improved system of lighting by means of secondary batteries being carried out in Colchester, at present the only instance of a public system being carried out under the provisions of the Electric Lighting Act.

Mr. Hammond thought that the bar to quicker progress had been bad workmanship, and the determined opposition of gigantic capitalists connected with the gas interest.

Mr. Taylor Smith exhibited numerous portable incandescent lamps, which by means of a shoe and socket fixed in the wall could be removed from one position to another. Also candelabra capable of being raised or lowered as required, and other contrivances.

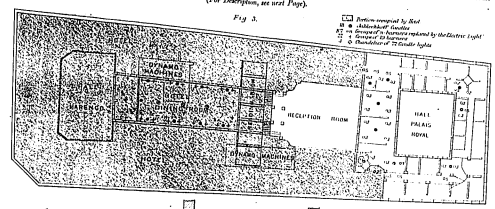
In moving a vote of thanks to the lecturer, Sir Frederick Abel expressed the hope that, as the use of gas rapidly extended in new directions not previously contemplated, we should see electricity gradually supplant it as an illuminating agent.

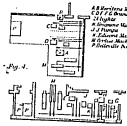
Mr. Preece made a few remarks in reply.

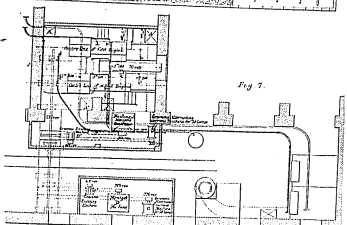
THE ELECTRIC LIGHT INSTALLATION OF THE MAGASINS DU LOUVRE.

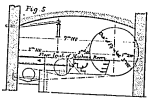
(For Description, see next Page).

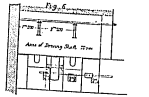
Fig. 3.

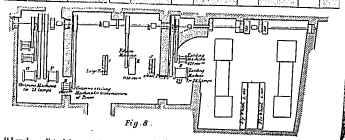












by having her nets cut, which saved her from a torpedo, that would otherwise have probably sunk her. Our men were as cool as if they were only going to have practice at a target. They did everything ready, and the result shows what can be done with three boats, five out of seven torpedoes discharged, taking effect, and either sinking or disabling a ship of the enemy.

"I have now given you a full account of the Battle of Port Said, and there is little more to tell you; I hear that the Ocean, which was knocked all to pieces by the heavy guns of the Inflexible, went down during the night of the 2nd. We are anxiously waiting for news of the Channel Squadron; if they fall in with the enemy they will capture or sink every ship, but I fear that we shall not be able to hear anything for some days.

"I enclose a list of the enemy's ships with all the information we have yet been able to obtain:

COMBINED FLEET AFTER THE BATTLE.

French Fleet.

Amiral Duperré: Sunk by torpedo from boat of Colbrook.
Devastation: Sunk; rammed.
Friedland: Sunk by torpedo; night attack.
Heroine: Serviceable.
Héros: Foundered during night of 2nd inst.; battered by heavy gales.
Redoutable: Serviceable.
Gilbert: Serviceable.
Suffren: Compartment filled by torpedo night attack.
Tolbert: Sunk by torpedo; night attack.
Surveillante: Sunk by torpedo, during battle.
Richlieu: Serviceable.
Ocksomoma: Sunk by torpedo; shortly after first charge.

Turkish Fleet.

Yeth-i-Bahrei: Compartment filled by torpedo; night attack.
Orchanieh: Sunk by torpedo from boat of Alexandra; early in battle.
Archer Shefket: Serviceable.
Assar-i-Tefik: Sunk by torpedo; shortly after first charge.
Intombeh: Serviceable.
Mendeelie Hedr: Sunk by torpedo; night attack.
Avini Illah: Serviceable.
Four corvettes: Serviceable.
Merveille: Sunk by ram.
Twenty-six torpedo boats: Seventeen destroyed.

Total Loss.

Ten ironclads sunk, one torpedo-ship, seventeen torpedo boats.

Existing Fleet.

Nine ironclads, four corvettes, nine torpedo boats."

This account, written by Lieutenant Forrest, will

THE NATIONAL ELECTRICAL CONVENTION.—The six days' work of the Electrical Exhibition has terminated very satisfactorily, considering the many disadvantages under which it has laboured. Of these, one of the most serious was the intense heat of the valley—a drawback which will doubtless be avoided in the case of any future appointments. It is to be regretted that on this occasion, in which the respective advantages of theory and of practice in the electrical field have been brought together for the first time, further encouragement affording no opportunity for discussion, there should have been any apparent disposition to depreciate the value of the theoretical researches of those who have revolutionized their knowledge. Even in connection with the dynamo machine, the telephone, the telegraph, and many others of such a feeling existed, the of all others was the occasion on which to harp it. It is difficult to realise that in the scientific investigation of electricity, where practical results are brought about by every attempts, it should be asserted that no person has a right to theoretical opinion on any of its theoretical problems "without a knowledge of its mathematics." Such a dictum would have suppressed the investigations of Faraday, and rendered it impossible even to power the researches of Clerk Maxwell. Science is work for all, and none of us are so wise but that we may gather some grain of knowledge from many to whom the higher mathematics are a sealed book. The indispensable value of purely scientific investigation is fully recognised by all, but it has not fallen to the lot of every one of those who are blessed with minds to conceive and hands to execute, to be supplied with elaborate apparatus and ample resources with which to demonstrate that a certain theory must be correct, and that a certain result must follow. Sir; this is a free country, and we live in the nineteenth century, and this particular period even the importance of the lesson which it teaches is generally recognised. One of the most significant results of the conference was the apparent disappearance of this feeling, as the arena of discussion gradually developed the fact that the experience of practical men was, after all, as interesting and instructive as that of the theoretical student. This was due, in a great measure, to the introduction of a considerable foreign element, which has been trained in a school where theoretical knowledge has been brought into closer relationship. The work which has been done auspiciously inaugurated should now be taken up by individuals and associations, in order that it may be perpetuated by the same enthusiasm which—*The Electrician and Electrical Engineer.*

June—Sept. 5, 1882.

ELECTRIC LIGHTING FOR RAILWAY TRAINS.—We hear so much of the progress of electric lighting in America, and are assured so often that in England we are, so to speak, in the dark in this matter, that we may be allowed to wonder how the terrible accidents reported from Greely, Colorado, should have been possible. A train, having one, taking sixty men of a circus company to the sleeping-trucks, caught fire. There were twenty barrels of gasoline on the car; these were set on fire, we are told, either by sparks from the engine or "by the torch used to light the room to bed." Nine of the sleeping men were burnt to death, and two others badly injured. Surely this could in event with attention be entirely prevented. Sleeping railway carriages, whether they be sleeping-cars or not, are lighted electricity, both in the United States and here at home.—*Leeds Mercury.*

June—Oct. 7, 1882.

THE ELECTRIC LIGHT ON BOARD HER "COLOSSUS."—A satisfactory trial is reported to have been made last week of the electric lighting apparatus on board the *Colossus* at Chatham. This is the most comprehensive installation which has yet been introduced on board an English ship of war, the whole vessel being lighted by electricity. In addition to the complete lighting of the ship herself, the dockyard by a connection with the installation includes the lighting of three powerful searchlights, as well as incandescent yard-arm lights. The system adopted is that of the Anglo-American Brush Company. The interior of the ship is lighted by 100 lights of 20 and 100 lights of 10 candle-power, the lamps being also manufactured by the Brush Company. The current is produced by three Victoria dynamos, coupled to Brotherhood engines. The test consisted in running the machinery for six hours continuously, with a full load of 180 amperes and an electro-motive force equal to 80 volts. The dynamos rotated at the rate of 400 revolutions a minute, with 40 lb. pressure of steam.

AN ELECTRIC LIGHTHOUSE IN BRAZIL.

An electric lighthouse has recently been erected on the island of Itaca, at the entrance of the Bay of Rio Janeiro. The lighthouse proper is 85 feet high, and is put upon a rock 230 feet in height, so that the focus of the light of the apparatus is fixed at an elevation of 315 feet above the sea. The electric current is produced by a continuous current Gramme machine, working at the rate of 700 revolutions, and feeding a light of 2,000 candle-power. The Gramme machine referred to is worked by a stationary surface-condensing steam engine; this arrangement being inevitable owing to the want of fresh water. All the fittings are double, so as to prevent interruptions by unforeseen accidents; and, to make assurance doubly sure, an oil lamp is always kept in readiness. The light is revolving, having two white discs and one red one, succeeding one another at fifteen minutes' interval, and the light is visible at a distance of about 35 statute miles.

June—Sept. 12, 1882.

THE ELECTRIC LIGHT ON BOARD SHIP.—The *Rapid* made a successful trial of her electric illumination on September 4. She has 101 32-candle-power lights, and 200 of 10 candle-power, as well as sixteen 50 candle-power searching lights. The whole is driven by one of Allen & Nelson-Hopkinson dynamos, driven by one of Joyce's "Invincible" compound engines. The engine was being driven to 465 revolutions a minute, whereas the maximum allowed by the contract, is 500.

ELECTRIC LIGHTING FOR RAILWAY TRAINS.

Powerful electric lights have become exceedingly important as regards the safety of life and property at sea, while vie with each other in the development of apparatus suited to their special needs.

Enormous increase in the power of single lights has been obtained during the past few years by the great improvements which have attended the introduction of electricity as an illuminating agent. This has benefitted the defence more than the attack, whether the operations be on land or sea; for, usually, the main functions of a powerful light are to guard against surprise, to give the defender a timely warning, and to enable those to aim at the advancing forces. The defence can, moreover, employ the most powerful lights, the machinery for which is sometimes more than suited to the mobility required by the attack. Nevertheless the use of a powerful light may frequently aid the attacking forces very materially. Thus, during the attack on Charleston during the War of Secession, the Southerners were prevented from repairing the breach in Fort Sumpter by night on account of a deadly glimpsed fire which was directed upon the breach by the aid of a limelight, which is so inferior to the light now obtainable by means of the electric arc.

Again, in an advance over obstacles it has been found that the attacking party will often receive great assistance from the electric lights of the defence. As before stated, however, the balance of advantage appears to be considerably on the side of the defenders.

In all descriptions of siege operations the employment of the electric light has become a matter of considerable importance, many operations which it has hitherto been customary to perform under the cover of darkness being no longer possible, and other operations, such as the bridging of rivers, which formerly could only be carried on during daylight, being now possible on the darkest night.

But the two important war services for which powerful electric lights have been provided, in this country, are:

1. As search lights for the vessels of our Royal Navy.

2. As search lights to act in unison with the artillery and submarine mining defences of our ports and harbours.

In the one case the machinery is carried on board our large men-of-war, and in the other case is erected inside our forts. In each of these positions the machinery can be placed practically out of reach of an enemy's shot and shell; but the protection of the projector, and of the men who manipulate it, can never be so satisfactorily provided for, and the subject has consequently received a good deal of attention, both in the Army and Navy. The subject has especially been worked up by our Royal Engineers, and has been attacked in two ways:

1. By attempts to place the projector and manipulators out of the direct line of an enemy, and to use a mirror for the final projection of the ray of light in his direction, such mirror being exposed to the fire, but being arranged so that it can be easily and quickly replaced.

2. By attempts to greatly decrease the cost of the projector, and to arrange the optical portions so that they can be expeditiously replaced if broken.

The projectors at first used both in this country and abroad were large metallic reflectors, either parabolic or hyperbolic, fixed on a lighter, smaller, and equally powerful arrangement was found in the Fresnel system of reflect a spherical holophote. It consists of a central lens, generally in three pieces, of a focal distance of 0.35 m., and which receives directly the light rays in a cone of about 60 deg. The catadioptric portion is composed of five or six annular rings so placed that the principal focus of each one coincides with that of the dioptric portion. There is also sometimes added a small spherical metallic mirror, placed behind the focus, so as to catch and throw forward again the rays from the back of the arc light. Owing to the short focal distance, it is very difficult to focus the light properly in these costly projectors, and the glass rings are frequently cracked by the flame and heat from the electric arc. For short ranges, however, they are efficient.

These projectors have given place to a most effective arrangement designed by Colonel Mangin, of the Corps du Génie (French army), and which consists of a reflecting iron ground on the inner side to a spherical surface of somewhat shorter radius than the outer spherical surface, the glass of the reflector being, therefore, thicker at the sides than at the centre. In fact, the projector is a spherical catoptric apparatus, the divergence of which is rectified dioptrically.

The perfection of the arrangement will best be shown by comparing Mangin projectors by Messrs. Stuttzer, Lemonnier, et Cie., the sole manufacturers.

TABLE SHOWING THE DIMENSIONS AND THE DIAMETERS OF THE LIGHTS OBTAINED AT DIFFERENT DISTANCES WITH VARIOUS MANGIN PROJECTORS.

Size of Projector, &c.	Distances of Light from Mirror.	Diver-gencies.	Diameters of Illuminated Circles in Metres at						
			1000 m.	2000 m.	3000 m.	4000 m.	5000 m.	6000 m.	7000 m.
	metres.	deg.							
Projector 0.30 m. diameter	0.160	2	30	60					
Light 6 mm.	0.170	3	180						
Gramme M									
Projector 0.40 m.	0.240	2½	45	90	135				
Light 10 mm.	0.250	3½	60	120	180				
Gramme A	0.300	4½	180	360	540				
Projector 0.60 m.	0.450	3	30	60	90	120	150		
Light 12 mm.	0.440	4	78	156	234	312			
Gramme D	0.450	6	118	236	354				
	0.600	11	180	360					
Projector 0.90 m.	0.700	2	35	70	45	60	75	90	105
Light 12 m.	0.710	3	45	90	135	180	225	270	315
Gramme D	0.700	4	45	90	135	180	225	270	
	0.750	5	60	120	180	240	300		
	0.800	7	115	230	345	460			

Fig. 1, on the following page, shows one of the 0.90 m. projectors complete, with the inclined hand lamp, screw in bottom of the head for focussing, sup-bolts on side for observing the carbon points—an image of the arc being thrown, by means of a small lens, upon a piece of ground glass. The hood is mounted on a stand wholly a motion in altitude and azimuth can be obtained, and the whole is carried on a spring wagon or they fitted with all the necessary tools.

By means of an inclined lamp nearly 90 per cent. of the total light can be thrown towards the mirror, a constant current being employed, and the mechanical details of the feed arranged accordingly.

Fig. 2 represents a smaller Mangin projector of 0.60 m. diameter, and which also figures in a few of the mechanical details. It is fitted with two hand bars, and can then be moved about by two men, the lattice-work stand being screwed to the ground when these projectors are used, and to place them so as to look over the parapets of our forts or the bulwarks of our ships is to invite their speedy destruction by an enemy's fire.

To meet this difficulty arrangements were made and tried at Chatham in accordance with suggestions made by Major Sale, R.E., C.M.G., in 1876-7 then Secretary R. E. Committee, to place the projector on a platform-carriage, and direct the beam of light on to a plane mirror placed a short distance of and above a parapet to the enemy's fire. The results were encouraging, but difficulties were encountered in the fixing and manipulation of the mirrors, the apparatus tried being so weak that the wind moved the mirror unduly.

In these designs the projector and the mirror or mirrors were placed nearly in the same horizontal plane, and there was a loss of light when the mirrors were approaching at extreme angles of training. Moreover, the range was limited, and unless large mirrors were used (in some situations not convenient, and which does not possible) no appreciable effect is had, the portion of the whole circle illuminated was limited. And in some situations the length of parapet required could not be spared.

In April, 1880, Lieutenant Mangin, R.E., proposed the following arrangement:

1. To work the ray of light to the zenith, either directly or by means of a mirror.

2. To deflect this ray by an upper mirror carried in a framework or funnel.

3. To carry the funnel or tube that supports the upper mirror, upon a ring, and this again upon another and another till it is finally stayed to the inner wall or walls of a fort. A slow motion screw, a worm, &c., would then move the funnel in azimuth at pleasure, and consequently the ray of light from the mirror.

4. To move the upper mirror by a slow motion screw actuated by a light grip wheel on the axis of such screw, which wheel can be turned by an endless cord from below, by a man who would take his orders through a speaking tube from an observer in the firing station. The only commands required would be "up, down, right, left, fast, slow."

Such a tube could be taken down at daybreak and put up again in the evening in a few seconds by a telescopic arrangement like that used in raising and lowering Thames steamboat funnels. It is difficult to work a light ray direct to the zenith, especially

with a "Mangin" projector, as the burst pieces of hot carbon fall on the glass of the projector at the thinnest part (the centre) and perforce crack it. The vertical ray can, however, be readily obtained by means of a lower mirror.

It should be noted that this arrangement provides for reflection at about 45 deg., a very small angular movement of the upper plane mirror producing a large vertical motion of the ray of light.

Fig. 3 (page 409) represents such an arrangement which consists of a wrought-iron tubular structure 20 ft. long and 30½ 3in. in diameter made of boiler

THE ELECTRIC LIGHT IN LONDON.

We are as yet very far from a general application of electricity for the lighting of the streets of London, although, so far as legislation was concerned, that boon appeared to be secured for the metropolis. We learn that the Board of Trade have decided to proceed at once to revoke no fewer than twenty-five of the provisional orders which were granted by them last year, and subsequently confirmed by the Parliament, for the electric lighting of London and its suburbs. Of this number, twenty-three are orders which were obtained by the Metropolitan Brush Electric Light Company, which has since gone into liquidation. These orders relate to the electric lighting of Barnes, Mortlake, Bermondsey, Chelsea, Chiswick, Clerkenwell, Finchley, Greenwich, Hackney, Holborn, Hornsey, Islington, Limehouse, Poplar, Rotherhithe, St. George's-in-the-East, St. George the Martyr, portions of the parish of St. Giles, the parishes of St. Luke's, St. Olave's, St. Saviour's, Southwark, Shoreditch, Whitechapel, and an order known as the Wandsworth order, which, however, relates to portions only of the parish of Clapham. Of the other two orders which will be revoked, one relates to the lighting of Kensington, and the other is an order granted to the Pilsen-Joel Electric Lighting Company, with powers to light those portions of the parish of St. Giles not granted to the Metropolitan Brush Company. So far as London is concerned, the result, therefore, of the numerous electric lighting orders which have been granted during the past two years is that only eight now remain in force, namely, the St. James's and St. Martin's orders, which, with the Hanover Square, Strand, and Victoria district orders, are now held by the Edison and Swan United Electric Lighting Company; the Hampstead order, granted to the Hampstead Electric Lighting Company; the St. Pancras order, granted to the twenty; the order for the lighting of Fulham, which was granted only last May to the West Middlesex Electric Lighting Company; and the order, also granted in May last, to the West London Electric Lighting Company, for lighting portions of the parishes of St. George's, Hanover Square, St. James's, Westminster, and St. Martin-in-the-Fields. Of these eight orders, the first five have already had their time extended within which to comply with the provisions of the orders, and unless these provisions are complied with before October 15 next, the powers will be lost unless a further extension of time is granted. With those facts before them, the metropolitan public, it appears to us, will come to the conclusion that electric lighting is still in its infancy, and that great improvements, combined with a reduction of the charges made for the electric light, are impending. Londoners, moreover, will be satisfied for the present with gas, not in the least concerned whether electric light companies are ruined or not.

ELECTRIC LIGHTING.

TO THE EDITOR OF THE "STATIST."

SIR,—In your last issue, in an article upon "Electric Lighting in America," you refer to the installation by this Company at Colchester. I shall feel obliged by your allowing me to point out that the system adopted at Colchester is so entirely different from that of the Edison Company, that it is misleading to draw any inference from the results of the installation in America as to the working of this Company's system. At Colchester the lighting is entirely from storage batteries, placed in five centres in different parts of the district, which are charged in series from a central station where the electricity is generated. The street works, in which cables have been laid for supply of 2,200 lamps of twenty-candle power, the steam power, dynamo-machines, accumulators, the fitting of the stations, and every appliance for complete working of 2,200 lamps, under the provisions of the licence from the Board of Trade, will not exceed £11,000. The annual working expenditure, including fuel, wages, rent, &c., and 10 per cent. depreciation, will not exceed £1,100, and a much larger business could be carried on with very little additional expense beyond cost of fuel, &c. If you compare these figures with your statement that the cost of Edison's station was over £200,000, and the working expenses £16,000 (you do not say if this includes depreciation), for the supply of 12,540 lamps, you will find that a similar plant upon our system, put down in this country, would have cost only £52,700, and the working expenses also proportionately less. This Company recently estimated for an installation of 5,500 lamps on the Colchester system, and the cost of steam-engines and boilers, dynamo-machines, secondary batteries, charging and distributing cables, and service wire, and all the electrical apparatus, amounted to £32,050; whereas the same installation upon the direct system was estimated at £51,000, the great difference being in cost of conductors. The lighting at Colchester is entirely from secondary batteries, which are charged during the day, and are never used in combination with the dynamo-machines. The system is fully described in the enclosed paper, read by our engineer on the occasion of the installation at Colchester being inaugurated on June 11th last. So far from the experiment at Colchester being a permanent loss to the Company, it will leave a large margin of profit as soon as the 2,200 lamps are installed for which the cables have been laid; but the installation is growing in having practically demonstrated the success of the first attempt to supply house-to-house lighting from storage batteries in central stations. The works have been visited by many British and foreign electrical engineers, with the gratifying result that the system has already been adopted for house-to-house lighting in an important Continental city, the first shipment of plant having been made by this Company last week.—I am, Sir, &c.,

GEO. OTTON,

Manager, South-Eastern ("Brush") Electric Light and Power Company (Limited and Restricted).

68A *Cowcross Street, London, November* 20th.

THE ELECTRIC LIGHT IN THE MAGASINS DU LOUVRE.

(Concluded from page 48.)

In our previous article we gave a description of the electric light installation as it actually exists at the Magasins du Louvre. We explained that this installation, very carefully arranged in a practical point of view, is directed with great care, and that a very detailed account is kept of the expenditure involved. The figures we shall now give, and which we owe to the kindness of M. ——, are therefore absolutely exact; they are deduced from a careful examination of the official accounts, and refer to the year 1882, during which the electric lighting of the Louvre was carried on without unusual complications, without any change or interruption.

As we stated in the previous article, the lighting of the Magasins is effected by five Gramme machines with independent exciters; each of these supply eight circuits of three Jablochkoff candles, or 120 in all. There are also two Merrison machines, each of five circuits, feeding thirty candles in all, or a total of 460; there are, besides, four other dynamos, each working an arc lamp, and one Edison machine, type 'A,' supplying sixty incandescence lamps.

The expenses relative to this installation have been separated from the general accounts, and include the following items:—These are as follows:

1. Those of first cost.
2. The annual interest on cost of the lamps.
3. The cost of maintenance and working.

In any ordinary installation the first costs are generally easy to arrive at; the second are usually calculated more or less approximately; the expenses of the third it is rarely that running and maintenance are carried on with sufficient accuracy: these, however, are the most important of all.

During 1882 the Jablochkoff candles in many of which it will be remembered during this year 4 candles were set at night, gave a total of 294,978 hours; the four arc-lamps furnished 1,736 hours, or a total of 296,714 hours; as they are each equivalent to five candles power, the total for an uninterrupted work is represented, their proportional port corresponds to 2962 × 5=14,710 hours. The sixty Edison lamps were recently placed, furnished during the months of November and December last, 2,000 hours of light, but each of them absorbed only 0.2 of the power taken by a candle, so that their proportion of power absorbed was 0.2 × 20,205=4241 hours. We have thus a total of 221,570 hours of light, of equal intensity. The foregoing is the basis from which the calculation of expenses, management, fuel, stores, &c., has been arrived at for each of the different systems.

The 201,578 hours of lighting supplied by the Jablochkoff candles, corresponds to a total of 130,246 candles consumed; hence the average duration of each candle was about 1.5 hours. The part of the expenditure works out, at the price at which the candles are supplied to the Magasins du Louvre, to, 121 francs (1.19) per hour; the cost of working and maintenance corresponds exactly with the same figure; as to the allowance for loss and depreciation of the candles, we have put an amortisation of all the capital invested in the installation—for candlers, steam power, material of all kinds, conductors, lamp brackets, &c.—it corresponds to a total of 0.145 francs (1.36d.).

The whole of the expenditure per candle amounts, 0.393 fr. (3.79d.) per hour, divided as follows:

	francs.
Candles	0.121
Motive power and maintenance	0.121
Sinking fund and interest	0.145
Total	0.393 (3.79d.)

The cost of the arc lamps is made up as follows:

	francs.
1. Of the carbons consumed, which divided by the 2922 hours of lighting, cost per hour	0.221
2. Of the maintenance as before	0.030
3. Of amortisation charges	1.001
Total	1.812 (17.46d.)

Lastly, the account for the Edison lamps stands as follows, allowing a service of 800 hours per lamp:

	francs.
First cost 7.5 fr. (6s.)	0.0094
Maintenance	0.0094
Amortisation	0.0188
Total	0.0376 (.36d.)

It should be observed here that the general expenses connected with the production of motive power are, in the original accounts, grouped together, and that the distribution made has been arranged proportionately among the different systems, which the expenses special to each system, are in all cases kept separate.

An observation should here be made on the hourly consumption of the Jablochkoff candles. Until the year 1883 the lighting of the candles was carried out in multiple thresholden at the Magasins du Louvre, and with hand commutators manipulated by an attendant, when it was necessary to substitute a new candle for one that was burning out. In consequence of this, in order to avoid extinction, it was necessary to be always a little in advance, and consequently to sacrifice a certain amount of the candle which was not burnt. Moreover, when the candles in the first chandeliers of a circuit were lighted simultaneously, it was necessary to regulate the change either by the candle which first burnt the quickest, or by the shortest one of the group. From this it followed that some of the candles were entirely consumed, and a considerable waste was entailed. The suppression of this loss was a problem which long occupied the attention of those using the Jablochkoff candle, and many special devices have been advanced for the automatic lighting of the candles. Unfortunately all these arrangements, more or less complicated, have failed to answer in practice, although great ingenuity has been exercised on the subject. At the Magasins du Louvre, the practical management of the electric lighting is placed, under the superior direction of M. Hospitalier, in the hands of a chief electrician, M. Cherbit, for a long time in the employment of the Jablochkoff Company. This gentleman has carried out, as the result of a very original and very practical, by which, at an increased cost of candling less than one centime per candle, the relighting can be effected automatically and without any failure, and to secure an economy of 20 per cent. on the consumption of the candles, by avoiding the constant use of unburnt ends of candles. This arrangement of M. Cherbit, the description of which we reserve for the present, thus prevents large loses without any delicate manipulation, and with a certainty that has never failed. Thus modified, the cost of the Jablochkoff candle per hour is:

	francs.
Candle	.101
Maintenance	.122
Sinking fund	.149
	.372

In order to afford a means of calculating in what proportion the various systems of electric lighting which have replaced gas, are more economical than the latter, we may add that the Magasins du Louvre pay at present for gas .36 francs per cubic metre (6s. 9d. per 1000 ft.), which is equivalent to a cost of .054 francs per burner of 140 litres per hour (5 cubic ft.). The maintenance would come to .005 francs and the amortisation of the installation, calculated on the same basis as for electricity, to .014, or a total of .073 francs (.68d.) per hour and per burner of 6 fr. of gas. The total cost of gas lighting is thus raised to about 8c. 6d. per 1000 cubic feet. We have already seen in the previous article that there has been established at the Louvre, one Edison lamp for *one* gas burner of 6 fr., and one Jablochkoff candle for *about ten* such burners; while more lately *five candles in one cluster have replaced a Jablochkoff candle.*

Consequently, if we compare the cost of lighting by each system, with the light furnished by one cubic metre (35.3 ft.) of gas, we shall have the following values:

	francs.
Cost of gas per metre	.201
Edison lamps	.206
Jablochkoff candles without the Cherbit arrangement	.316
Jablochkoff candles with the Cherbit arrangement	.260

* Photometrically, *two* Jablochkoff candles appear to be necessary to give the light of a gas burner; actually, however, more very closely to *one* burner is given, because of the fact that the Jablochkoff candle is lighted on account of the greater facilities for distributing the light.

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ENGINEERING.

FRIDAY, JANUARY 13, 1882.

THE ELECTRIC LIGHT AT GODALMING.

GODALMING, a small town of some 6000 inhabitants, standing upon the River Wey, and being about midway between London and Portsmouth, has been for some weeks past in the forefront of the contest of the electric light arena. In September the contract with the local gas company for the lighting of the town expired, and it was decided by the authorities not to renew it, but to give the electric light a chance of showing what it could do. Messrs. Muirhead and Barrett undertook to instal the electric light upon the understanding that the annual cost was to be less than the 200*l.* a year, which was the amount of the gas contract. It was thought that by utilising the water power afforded by the Wey, this result could easily be achieved, the expenses of the arcane being large and a bit of water five feet being generally available. An agreement was come to by Messrs. Calder and Barrett with Messrs. H. and J. Pulsan, leather dressers, who have exclusive rights at this point over the water power, which is used by them for driving their mills, to allow the water power to be used for the light, in consideration of having their own mill and premises lighted gratis. The remainder of this arrangement there are lighted and seven incandescent lamps are placed in their premises, whilst the town itself is illuminated by four arc lights and 27 incandescent. The arc lights are of 2000 candle power each, and are given by Messrs. Siemens Brothers' well-known type, the incandescent are Swan lamps which are capable of giving off 30-candle lights. The current is supplied by a Siemens alternating current machine, working at a speed of 850 revolutions per minute, the field magnets of which are excited by an ordinary Siemens shunt-wound machine, working at 1000 revolutions a minute, and giving off a current of 12 webers. The alternating machine is coupled up into two circuits, one circuit being devoted to the arc lights, and the other to the 34 Swan incandescent lights. The arc-light circuit has a current of 12 webers, and an electromotive force of 2600 volts, while the incandescent light circuit has a current of 25 webers and an electromotive force of 1000 volts. These two circuits are said to require 10 horse power to drive them.

It was at first thought that a single Pouzzolet half-inch cotton water wheel of about 12-ft. 6-in. diameter would be sufficient to drive the machines, but it proved quite unequal to the task, and another similar wheel was coupled up with it. Together the two wheels are, in ordinary times, when the full head of water is available, just about sufficient to drive the required power, but, unfortunately, when the river is swollen by rains, the capacity of the engine is not sufficient to carry off the water quickly enough, and the tail-water stream is thrown back on to the wheels previously fixed and used in Messrs. Pulsan's mills, and not sufficiently adapted to the purpose for which they were now required. It has become necessary to fall back upon the steam power, and for this purpose a semi-portable engine has been procured and is used as an auxiliary to the water power. The ordinary steam is worked up to a pressure of only some 25 lb., but in case of need it is equal to the whole work required.

The strength of the currents in the two circuits in all times observed by means of Siemens' electro-dynamometer, which is fixed in a convenient position, so that it may be seen by the driver of the engine. In this instrument the current passes through a fixed coil of thick wire, and thence through a surrounding single coil of wire suspended in two mercury cups, and in the axis of the single coil, round which it can turn. The upper end of this coil is attached to a light spiral spring, which can be twisted by a thumbscrew, so as to oppose the action of the current and reproduce what amounts to turn the suspended coil about its axis, by an amount of twist of the spring sufficient to bring the coil in a normal position, its plane being then at right angles to the plane of the fixed coil. The strength of the current is given by the magnitude of the couple, and is found by multiplying the square root of the angle through which the spiral spring is turned to bring the coil into its normal position, by a constant which is experimentally determined. It is the duty of the engine-driver to regulate the speed of the engine so that the pulsator attached to the suspended coil oscillates about its mean position. The engine in this case is thus used to control the eccentricities of the water power, the bulk of the power required being generally given by the steam.

The arc lamps are lights, which, as we have remarked, are on one circuit, seem to be almost all that can be desired in the way of steadiness and brilliancy. The four arc lights which are disposed in the town light up the main street very fairly, and the leading lines of the system of installation generally, and the principal thoroughfare, and to supplement the arc lights by the small Swan lamps for the dark corners and side alleys. This system might no doubt have been carried out more completely, and more economically, had it been carried out, despite the work, but unfortunately the arrangements used do not quite meet the necessities of the case. In the interior of one of the shops in Mr. Pulsan's house the Swan lamps are seen at their best, and the light obtained leaves nothing to be desired. In the byeways of the town, however, the Swan lamps, where upon needed, fail to do their duty, their dull and glow contrasting, in some cases, very unfavourably with a few gas lamps which are lit. A little additional current would bring out their full glow, but from some cause or other this was not available. The chief reason of the failure of the Swan lamps in the town is simply the distance at which the source of electricity is placed from the town and the consequent resistance of the conductor. The arrangement of this conductor is worthy of remark. We have said that the wires 35 lamps are on one circuit, but this is not strictly true, and we should rather say that each Swan lamp is on a distinct circuit. One pole of the Siemens machine is connected with the ground through a convenient gas-pipe. From the other pole the conductor is led, like the trunk of a tree, from which branch off some in various directions, and these branching off, and these again, and so on to the required extent. The conductor running from the trunk of a tree is not only in the distinction of its branches and twigs, but also in their thickness, graduated. So the diameters of the various branches being so proportioned as to bring to the pole a maximum effect, we will endeavour to give to each lamp, as far as possible, its fair share of the current. This is effected by itself a spiral copper wire suspended from the houses by ordinary telegraph insulators, which is, we believe, a somewhat novel feature, and cold of course to be employed with economy of low tension. Then arranged the conductor is a tree whose root is the pole of the Siemens machine, and which is otherwise completely insulated from the ground. If the conductor be connected with the ground at any point the circuit will be closed, the current circulating, of course, with the resistance of this point from the machine. It becomes easy to pass the lamps in the order of their distance, which are much nearer to the machine, get much more resistance and have much more brightness than those in the town half a mile off, notwithstanding that a considerable resistance is caused by the long branch which leads to the mill. This resistance is obtained by a series of coils of thick iron wire, through which the branch current passes. The necessity of interposing resistance increases in proportion to the nearness of the point at which the current is taken off to the source of electricity, seeing that of the most serious obstacles to the adoption of this system of lighting on any but a small scale, as one of which the waste involved by the resistance, but also from the impossibility in burning of the lamps unless the resistances are very accurately adjusted.

The Swan lamps are arranged in the same way as lamps-posts of the town. The post is made to serve as one pole, and is connected to one side of the socket into which the lamp slips, the other side of the socket being connected to the conductor wire. This arrangement is at once simple and efficacious.

It is only that the installation has not been carried out in a way which should insure success, that we have alluded to it. Instead of the cut-off-the-way place chosen, it would have been easy to erect the engine and dynamo in the small town, and so to have brought the source of electricity to the centre of the town. As it is, the electricity has to be conducted for a distance of about a mile and a half, and this is the chief reason why the Swan lamps are not more brilliant. Had the town been lighted by electricity, it would have been by the system of *parallel* instead of *series*, and this is the system which we have seen work well, and that in the distribution of its branches and twigs, but also in their thickness, graduated. So the diameters of the various branches being so proportioned as to bring to the pole a maximum effect, we will endeavour to give to each lamp, as far as possible, its fair share of the current. This is effected by itself a spiral copper wire suspended from the houses by ordinary telegraph insulators, which is, we believe, a somewhat novel feature, and cold of course to be employed with economy of low tension. Then arranged the conductor is a tree whose root is the pole of the Siemens machine, and which is otherwise completely insulated from the ground. If the conductor be connected with the ground at any point the circuit will be closed, the current circulating, of course, with the resistance of this point from the machine. It becomes easy to pass the lamps in the order of their distance, which are much nearer to the machine, get much more resistance and have much more brightness than those in the town half a mile off, notwithstanding that a considerable resistance is caused by the long branch which leads to the mill. This resistance is obtained by a series of coils of thick iron wire, through which the branch current passes. The necessity of interposing resistance increases in proportion to the nearness of the point at which the current is taken off to the source of electricity, seeing that of the most serious obstacles to the adoption of this system of lighting on any but a small scale, one of which is

THE ELECTRIC LIGHT IN IRONWORKS.

For industrial establishments are so well adapted for being lighted by electricity as large iron and steel works. Their floor spaces are usually extensive and open, and the operations carried on are such as require a fairly strong but diffused light. The most recent installation of incandescence that we have heard of is that just completed by the Maxim-Weston Electric Company, at the Cengarvern Iron and Steel Works, now incorporated with the New British Iron Company, an old-established South Staffordshire concern. The electric lighting has complicated by the two distinct installations of Weston are large. The installations are perfectly distinct one of the other, being driven by separate engines and dynamos, and the lamps of one installation alternate with those of the other, so that one installation may always be depended on to carry on the lighting of the works should the other be stopped by accident or otherwise. The two installations are both in nightly use, and we understand are giving every satisfaction. A large portion of the iron and steel works must necessarily continue in operation, both day and night, and in such cases the value of the electric light is much enhanced. In the present case two lamps are placed above each of the nine rolling mills, and the remainder in the forge and steelworks. With this arrangement the place is exceedingly well lighted, although, of course, for special purposes, as in the case of setting rolls, &c., a special torch or gaslight is needed near the work. In the manufacture of the iron, however, the company anticipate less waste, a larger production, and better results generally than can be obtained in a place imperfectly lighted. The buildings of ironworks must of necessity—on account of providing ventilation, &c.—be very open, and in rough weather gas jets are often extinguished or blown about to such an extent that but little light is obtained from them, with the consequence that accidents to the machinery—more or less serious—occur most frequently during the night. Again, workmen will not keep gas burners in order, and too often they are removed, or the end of the bracket is broken off and the gas lighted, with the result that an enormous quantity of gas is burnt. With a good light like that from electricity, a much better supervision of the operations in progress is obtainable, and such operations are consistently facilitated. Independently, therefore, of the comparison of relative direct cost, such as would appear in balance sheets, showing the working of gas as compared with electricity, there are many important considerations. But in the installation we refer to, it is anticipated that the cost will not be appreciably more than that of lighting by gas. The cost of attendance is reduced to a minimum, fourmen's as the slushing, the dynamos, and the engines driving them (which are at Tangye's vertical types of 10 nominal horsepower, and specially adapted for electric lighting), are placed in the blowing-engine house, where an engineman is constantly in attendance. Again, several of the lamps are assigned to each of four men, who are in constant attendance on the mill engines, and who have sufficient spare time to clean and keep them in order, and to replace the carbons as required. A small weekly allowance is made to these men, which repays them for the little extra trouble they have, and the cost in this respect is therefore small. The Weston dynamo in the present case, is, in each installation, driven at a speed of about 1,350 revolutions per minute, when supplying the eleven arc lamps and 400 incandescent lamps. The armature of the cable comprising each circuit (about half-a-mile) is 1 ohm when cold, and 1·3 ohms when hot, and the current passing through it is about 19 ampères, the lamps with such a current being estimated to be of about 1,400 candle-power each. The dynamos are driven by ordinary 5-inch leather belts from short lengths of shafting, on each of which are mounted special wrought-iron pulleys 22 inches and 30 inches diameter respectively, the larger ones taking 7-inch belts from the 48-inch flywheels of the Tangye's engines, which have cylinders 10 inches and 14½ inches diameter respectively by 10-inch stroke, and work with a steam pressure of only about 30 lb. per square inch, making about 150 revolutions per minute. Several ironworks are now lighted by electricity, but those of the New British Iron Company are, we believe, almost the first in the South Staffordshire district. The example there set will, we think, not be without speedy imitation, as the advantages gained are considerable.

GULCHER ELECTRIC LIGHT AND POWER COMPANY.—Mr. Daniel de Caster, as a recent meeting, explained that on September 29th, 1881, new directors were elected. The directors reported to the last-paid shareholders of the company, placing before them the exact position of affairs, and from a number of their proposals the shareholders duly received unlimited support, and by means of the money thus obtained the company had been brought round to a safe and sound basis. The capital was originally £100,000, but was made up to November 30th, at which date they owed £9,000 to debenture holders (the renewed authority to borrow having £10,000), and £91,000 to their shareholders. They had no other debt of which to make mention. He trusted the patents as of no value, but that did not appear to be regarded as of great value. The stock stood at 6 to 7 dollar paid, they nominally standing about £7,000 of the stock, and of which there about £2,000 a year. There was hope yet for the company. It had been decided to bring a suit for action against Mr. Cookes on the ground of misrepresentation. Mr. Reeves (who said he was the largest shareholder) moved an amendment, adjourning the meeting and appointing a committee of investigation. The chairman ruled that he would not grant a poll. He afterwards put the original motion adopting the report, which he declared carried, and subsequently the directors were re-elected.

GREAT WESTERN ELECTRIC LIGHT AND POWER COMPANY.—The fifth clause of the agreement submitted to the meeting sets out that the liquidators should, within 21 days after the receipt of the special resolution for winding-up the company, pay to the directors, out of the cash belonging to the company, a sum equal to 10s. either on the written personal undertaking of the directors to apply this sum in paying a dividend of 10s. a share in the shareholding in the company. In addition, each member of the company would be entitled to receive from the Brush Company, at any time within the next twelve months from the date of the conditional agreement, to allot to him three fully-paid £5 shares in the Brush Company for every 20 fully-paid shares in the company. The resolutions to this effect were then adopted by an overwhelming majority.

BRUSH MIDLAND ELECTRIC LIGHT AND POWER COMPANY (Limited and Reduced).—At the second meeting Mr. E. H. Nye presided, and after adopting the accounts, a special meeting was held immediately afterwards to consider a proposal that the company should sell all its assets to the Anglo-American Brush Company, the consideration being that the purchasing company should satisfy all the obligations of the selling company, each member of the latter being entitled to acquire from the Brush Company, at any time within the next twelve months from the date of the agreement, seven 27 shares of £2 10s. each in the Midland Company, and so in proportion for any greater or less number. The proposal was carried, and thereupon the winding-up the company voluntarily under the provisions of the Companies Acts.

MAXIM-WESTON ELECTRIC COMPANY.—At an extraordinary meeting the resolutions were confirmed for reducing the capital by £100,000 to £150,000 by the cancellation of 20,000 shares, being unrepresented by available assets; for further reducing the capital to £150,000 by reducing the nominal amount of all the shares from £7 to 10s. each, thereby leaving the nominal capital as £150,000; and for increasing the capital to £250,000 by the creation of 20,000 shares of £5 each. The chairman stated that within a comparatively short period a great demand had sprung up for the company's lighting and he believed they were now on the road to making a prosperous business. At an extraordinary meeting, called to consider a resolution for the fusion of the company with the new company, the chairman said that the company was unable to go on owing to the fact the shareholders not paying their calls. The object of the fusion were that the present company should pay the whole of the debts of the company, and after that give shares for shares of the Maxim-Weston Company to the shareholders of the Lancashire Company. The fusion was agreed to.

THE ELECTRIC LIGHT ON THE PLACE DU CARROUSEL.

The immense Place in Paris that extends from the Louvre to the ruins of the Palace of the Tuileries, and from the Quai de la Seine to the Rue de Rivoli, has been, until very recently, lighted only in such a way as to magnify the obscurity of the night rather than to relieve it. The illumination was made all the more conspicuous after the brilliant illumination of the Boulevards, and of the Place du Théâtre Français, which is close adjoining. The new Rue de Rivoli, after leaving the Place du Théâtre Français, with the lamps of the Avenue de l'Opéra light, is reached by the quays by traversing the Carrousel, the passage from the one to the other, a short time since, fell into almost complete obscurity, relieved only by a few sparse gas-lamps. This state of things, apart from the inconvenience, as well as danger to the traffic, was utterly unworthy of one of the superb examples of architecture decorating the Place, and it became intolerable when two important departments became installed there; these were the Ministry of Municipal Government, and the temporary Post Office.

Fortunately, since the month of November last, the unsatisfactory condition of the Place was brought to an end by the inauguration of a system of lighting somewhat analogous, by the arrangement of the lamps, and the method of suspending them, to a part of the electrical lighting system in the city of London. This installation, the result of a contract to extend over one year, was made with the Administration of the city of Paris, by the work of the Compagnie Lyonnaise de Constructions et d'Eclairage Electrique, founded about a year ago, under the auspices of the Credit Lyonnais Bank, to work the Lontin, Berlin, and De Mersanne patents, and which has lately acquired the various Brush patents for France.

The lighting of the Place du Carrousel is effected by twelve standards of cast iron bronzed, about 20 ft. high, terminated at their upper part by a curved arm or bracket. This bracket, formed of two flat pieces connected by cross-bars, carries a globe containing two 8-millimetre carbons (or lamps, 8 millimetres in diameter, and about 40 centimetres long; they are covered with a copper coating, and the light is produced in the centre of a bead of ground glass, and placed in the centre with a small hole, that allows a passage for the dust resulting from the consumption of the carbons, and also for any condensed moisture or dampness. In this manner the light is diffused over the ground, without throwing any marked shadows. The length of the carbons is not narrowly limited, and the period of lighting may thus be very considerable, without the lamps requiring to be touched. The lamp is surrounded by a conical reflector, decorated by a mural crown, and by a series of the burners like those of gas-lamps, which form a special characteristic of this lamp, and which are fully illustrated and explained in our recent notice.

Fig. 1 is a sketch showing the design of the twelve standards, which are placed at the points marked *a a* on Fig. 3 around one part of the Place. It will be seen that this part of the installation does not light the whole of the main area, but only the portion between the entrance from the Rue de Rivoli and the gates leading to the quay; that is to say, the portion used principally by the public. This passage widens out into the wide area to the quay. It was therefore necessary to complete the lighting on this side in such a way as to make it uniform. This has been effected by placing at the refuge *o* opposite the principal entrance a post about 65 ft. high (see Fig. 2) formed of four standards, framed with angle-iron and lattice bars, at the top of which is fixed a double T-shaped bracket, carrying two regulators of the same type as the others, the luminous points of which are about 29 ft. from the ground. These lamps have an intensity almost double that of the others already described (nearly 2). The whole installation of fourteen lamps diffuses over the Place a pure white light of a highly satisfactory quality, and very uniformly distributed over the area, the light being sufficiently good to enable a woman's paper to be read with ease at any point. Compared to the prior condition of things the improvement is immense, and is fully appreciated by the mass of people constantly circulating there, who are now able to avoid the passing vehicles which were previously a source of continual danger. As far as the decorative effect is concerned, it is to be regretted that the very natural desire to deflect as much light as possible upon the ground should have led to the adoption of the De Mersanne louvre reflectors, which have the effect of masking out the lower parts of the façades of the pavilions on the Carrousel in such a way as to destroy the proper portions in complete darkness.

The electric current is generated in a large pavilion built in the vicinity of the temporary bureau of the Postal Administration behind the Tuileries gate. This building contains an installation of considerable importance, which is of sufficient capacity not only to illuminate the Place, but also the Pont Olfon, and the Prefecture buildings. It consists of two portable engines of from 35 to 40 horse power each, made by MM. Weyher and Richemond, of Pantin. They both of them drive one transmission shaft situated on the ground, and on the same level are the dynamo-electric generators which include two Lontin oscillating and two oscillating machines. One of these, which is nominally for 25 ampères, feeds 12 regulators on the Place; the other, for six regulators, supplies the two high lamps. Under the present conditions the generators absorb from 25 to 30 horse power. The other electric generators are four Brush machines, intended to feed each 16 lights, or 64 in all, of which 54 will be distributed in the different offices of the Postal Bureau; five will light the building containing the machines, and five others will be placed within the Prefecture. This part of the installation is not yet complete. As regards the lamps for the Prefecture and the Postal Bureau, the Brush lamps will form a part of the general scheme for lighting that building by different systems, which is now being worked out. According to the photometric experiments carried out by the engineers of the city of Paris, the twelve lamps have each an intensity of about 75 Carcels, and the two high ones in the middle of the Place, 125 Carcels each. The former are paid for by the Municipality, at the rate of 6 francs per hour per lamp, all charges being borne by the Compagnie Lyonnaise; the two others are paid for at an increased rate in proportion to their higher illuminating power.

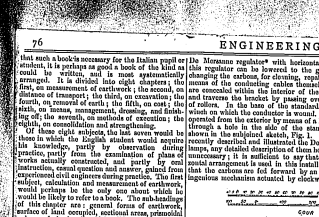

Fig. 3.

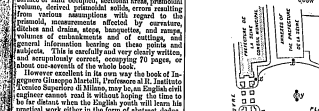
Fig. 4.

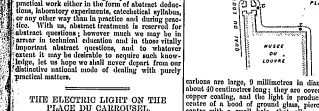
Fig. 5.

See ENGINEERING, page 077 of our last volume.

tobacco-tax, the amount of which has not been as yet officially given. It is, however, known to be improved very materially by the treaty of commerce with Egypt. We may, therefore, rest assured that the revenues thus assigned are amply sufficient for the 1881 and previous loans, though certainly not sufficient to bear the strain of any large addition to the National Debt. Nevertheless, a large addition there must be when the whole of the "New" Loan is absorbed, and the annual charge is augmented by some millions of drachmas. For in the above tabular statement we have only 1,650,000 drachmas given as interest due for the half-year on the 170,000,000 drachmas loan; whereas, if the whole loan had been placed, it would have required 4,250,000 drachmas for interest alone. The total Debt charge would, therefore, be about 26,000,000 drachmas a year. It is true that the revenue assigned to the service of these loans collectively are estimated to yield upwards of 30,000,000 annually; but before any dependence can be placed on these figures, we must have more detailed returns, together with particulars as to further hypothecations, if any, and their probable yield.

While thus scrutinising the finances of Greece, it is but fair to take note of the manner in which the national resources are being applied. One of the first objects which the Government has in view is the abolition of the forced currency. This can only be done with advantage when a State has balanced its Budget, and restored income and expenditure to an equilibrium, a result which Greece considers it has now achieved. Next to that is the improvement in the means of internal communication,—a thing much needed, for of Greece it has often been summarily stated that it is a country without roads. Avoiding all rhetorical exaggerations, it may be said that when the Tricoupis Cabinet came into power there were in the country only about 1,200 kilometres of ordinary roadways, and one short railway of about eight kilometres, from Athens to the Piræus. Since then a line of railway of 12 kilometres, between Pyrgos and Catacolon, and another, the Volo-Larissa line, of 60 kilometres have been laid. Besides these, several important lines are in course of construction or under survey, and a special loan of 20,000,000 drachmas has been voted for the construction of carriage roads of the ordinary type. There can be no question that these measures will have considerable influence in the development of the resources of the country, and are much more commendable than the insane fit which seized it a few years ago, and which expressed itself in a mad effort to become a great military and naval Power.

ELECTRIC LIGHTING IN AMERICA.

No part of the expert evidence submitted to the Parliamentary Committee impressed the members of the Committee more strongly than that elicited from American witnesses. The lucid and confident manner in which the cost of lighting a square mile of London at a little under £100,000 was set forth, gave a high idea of the extent and success of Transatlantic achievements in electric illumination. Not for the first time, John Bull was deceived, not only as to the actual facts relating to the condition of things electrical in English cities, but also as to the state of affairs across the Atlantic. Facts were either misrepresented or withheld.

We have lately had the opportunity of examining, from unimpeachable sources, the cost and revenue of the only electric light station in the world which has seriously undertaken the task of competition with gas. We propose, therefore, to give our readers a brief history of this station from its foundation two years ago, with the financial results at the present time. Financially supported by the firm of Drexel, Morgan, and Co., and many of their clients and supporters—to the exclusion, however, of Messrs. J. S. Morgan and Co., who from the first declined any financial connection with the concern—Mr. Edison opened in New York, in September, 1882, the First District Illuminating Station. This portion of the empire city is the most densely populated part of the business or "down town" quarter. The area lighted is contained in a square of 2,400 feet, and last, therefore, an area of something less than a quarter of a square mile. The district contains about fifty blocks of buildings, and is intersected by some fifteen streets or passages. The necessary permission to open the streets to lay the electric mains was obtained, not by Act of Congress or by other legislative or official means, but by the simpler and perhaps less costly method of a payment to Tammany. The sum which passed amounted to about £10,000, and in exchange for this payment the Edison Company is free to tear about the streets whenever it pleases it so to do for electric lighting purposes. On September 4th, 1882, the station was started with 2,223 lamps, contained in about eighty-five houses. These lamps have increased in number until last month 12,540 lamps had been installed, the present capacity of the station being now attained. The largest number of lamps ever burning at one time was 5,530 in January of this year, and their average life, based on about 12,000 renewals, is a little more than 400 hours. Shortly after the installation of the station, it was found that some customers did not require the light in the summer, and that consequently their custom involved loss. It became necessary, therefore, to call from among the customers those whose demand was less than an average of 2½ hours per day for every lamp connected on their premises. If their consumption fell short of this standard, they were quietly cut off, so that the actual average consumption of light per lamp was artificially raised above the normal gas average of the district. This process of natural selection in New York is important, because, under the English Act, a customer using but half an hour's light in a month can not only claim to be supplied, but must, under grave penalties, be supplied by the unhappy Company. During the first year little money was received from customers, partly owing to the novelty of the enterprise, and partly owing to a natural desire on the part of the management that criticism should be disarmed before claims were lodged for the amount of the lighting bills. The cost of gas in the First District of New York is about 9s. 2d. per 1,000 cubic feet. Competition, therefore, with the other illuminant, having regard to the power of picking the good customers, and of unmeasured access to the streets, was rendered distinctly favourable. Added to this was the fact of Mr. Edison's presence, and the supply of ample funds for the purposes of the momentous experiment. These favourable elements notwithstanding, the financial result, when viewed from an impartial standpoint, is not only disappointing, but absolutely and finally disposes of any idea that electric lighting in England contains the germs of remunerative investment. Before giving the figures of the capital investment, running expenses, and revenue, it must be premised that the management of the station has been—at any rate during the period over which the returns in our possession extend—able, economical, and efficient. Not only is American genius more suited to the *exploitation* of new industrial developments than that of older countries, but there is a general disposition to help along a new scientific undertaking, which is signally wanting in England. The cost of the station is somewhat in excess of £200,000, and the annual expenditure is at the rate of nearly £16,000 a year, without allowing for depreciation, sinking fund, or interest on capital. The excess of receipts over actual cash outlay amount to about £6,000 a year, or 3 per cent. on the capital invested. When, however, a due allowance is made for unforeseen contingencies, such as the bursting of a boiler or other heavy casualties, it will be seen that the alleged profit is illusory, and if, at most, expenditure is equal to revenue, it is certainly not less. In order to appreciate the precise nature of the result of this experiment, it is necessary to suppose that each glow lamp is replaced by a five-foot gas-burner, and that the amount of gas consumed by customers be an equivalent of that consumed. The result of this calculation gives 6s. 11d. as the cost per 1,000 feet of the gas thus consumed. If, however, a sixteen-candle lamp be held to compete with a seven-foot gas jet, then the equivalent is as nearly as may be 5s. per 1,000 cubic feet. To compete with gas at 5s., the cost of maintenance—*i.e.* of production—must be reduced by two-thirds. On examining the means of reducing the cost of establishment, there is no reason to believe that any really efficient economy could be laid down in England for half the sum expended in New York; but it is improbable that the cost of maintenance can be materially diminished. From the foregoing, it is clear that such stations as the Victoria and Holborn installations, established by the Swan and Edison Companies respectively, or the Colchester experiment of the South-Eastern (Brush) Company, must inevitably lead to a permanent consumption of the available resources of the Companies in question. Finally, we are driven to the conclusion that, so far as central station lighting is concerned, the prospects in England are hopeless until a radical improvement in principle has been effected; and Boards of Directors maintaining the contrary, in the face of the evidence adduced on both sides of the Atlantic, incur a responsibility which, for our part, we are disinclined to share.

THE ELECTRIC LIGHTHOUSES OF FRANCE.

An admirable and very detailed account of the electrically illuminated lighthouses to be placed around the French coast has lately appeared in the columns of *La Lumière Electrique*. This account was written by M. A. Guérout, and is now substantially reproduced, together with the illustrations, from the pages of that valuable journal. The numerous lighthouses erected around the French coast are required to fulfil different services to navigation, and their importance varies, in consequence, according to the role they are called upon to play. They have in the first place to indicate to the navigator the proximity of the coast, and the lighthouses erected with this object are placed in preference on the more advanced capes and promontories which form, as M. Guérout puts it, the points of the polygon enclosing the coast. These are the most important and prominent, and are called lighthouses of the first order. Between these main signals which indicate the contours of the shores, there are many more accentuated points, but not so prominent, which serve as the locations of lights of less importance, and guide the navigator to the entrance of the port he is making. These are the lighthouses of the second order, called as not only on account of their position, but because of the smaller intensity of the light that they project. Between these points again are others, the position of which is of importance to show; these may be sandbanks, reefs, sunken rocks, islets, &c. According to circumstances, such points are signalled by lights of various powers, classified into the third, fourth, and fifth orders. Finally there are the lamps which mark the positions of jetties and the more insignificant ports. Passing to another classification based on both sides of the Atlantic, incur a responsibility which, for our part, we are disinclined to share.

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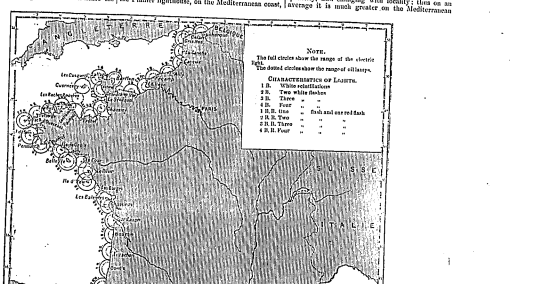
with varying conditions; thus some signals placed in the sea project their light in all directions; others standing on a point of land, concentrate their rays within a certain angle; others again illuminate only a given point; hence the definition of lighthouses for the full horizon, for three-fourths, two-thirds the horizon, and so on.

Until 1863, all the lighthouses on the French coast lighted with oil, and it was only during the year just named that one of the two signals at La Hève was lighted by electricity. After an experience of some year and a half, an experience which was in all respects satisfactory, it was decided to extend the same system to the second of the La Hève lighthouses. This also worked excellently, but nothing more was done in this direction until 1874, when the electric light was installed at Cape Grisnez. Again a long delay took place, and no further progress was made, although in this country six lighthouses were electrically illuminated. Quite recently, however, it having been found necessary to reconstruct the Planier lighthouse, on the Mediterranean coast, not far from Marseilles, it was decided to adopt the electric light in the new structure, and to take the same course with the Palmyra signal, the power of all on the Channel. which was quite insufficient. Both these important installations may now be regarded as complete.

The satisfactory results obtained with the electric light at La Hève and Cape Grisnez, called attention to the more general services the system could offer, and on the 27th January, 1880, after a long study of the question, M. Allard, director of the French Lighthouse Department, presented to the Minister of Public Works a report recommending the general adoption, on all the French coasts, of the electric arc for lighthouses. This report was approved on December 8, 1880, by the Lighthouse Board, and on March 3, 1881, by the Council General des Ponts et Chaussées, and the principle of electric lighting has become universal for grand-


NOTE.
The full circles show the range of the electric light.
The dotted circles show the range of sidelights.
CHARACTERISTICS OF LIGHTS.
1 B. White eclipses
2 B. Two white flashes
3 B. Three "
4 B. Four "
1 B.R. One " Each and one red flash
2 B.R. Two " " "
3 B.R. Three " " "
4 B.R. Four " " "
Ile d'Aix
Les Barges
Fort Boyard
Chassiron
Les Palles
Les Baleines
Ile de Ré
Les Portes
Les Roches
Les Pierres
Les Sables
Les Barges
Les Minimes
Les Ballanes
Les Pierres
Les Roches
Les Portes
Les Palles
Les Baleines
Chassiron
Fort Boyard
Ile d'Aix
Les Barges
Les Minimes
Les Sables

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ELECTRIC LIGHTING IN SHEFFIELD.*

Preliminary Report of COLONEL W. COOKE, *Member of the Institution of Engineers and Architects of Electricians.*

The Corporation of the borough of Sheffield having received a reply to the effect that they could not obtain a provisional order under the Electric Lighting Act of 1882 for a provisional district to supply electricity for public and private purposes within the said borough, and having been requested by the Council to report to them as to the best means of establishing a system of electric lighting, I have the honour to submit the following preliminary report.

The application of the science of electricity to industrial purposes, especially to the production of artificial light, is a question, the importance of which is daily increasing, and the skilled industries of electro-plating and electrotyping, which have been in use for years, stands out in prominent proof that it may fairly be said to have passed from the experimental stage. Many of the most eminent physicists to take the lead among the scientific industries of the world; and the International Exhibitions held at Paris in 1878, and still more emphatically the Exposition of Nuremberg, which was held in the same city last year, have demonstrated beyond the possibility of question the value of the application of electricity to illumination as well as to other handicraft requirements, and the practical success of these practical demonstrations has been such that a strong and insatiable public demand for electric light has arisen, and a large and rapidly increasing number of electrical installations have sprung up in every civilised portion of the globe, not only in but for years, such as in France, Belgium, and Germany, and in the United States of America.

The lighting of a considerable number of the streets of Paris and London was quickly followed by that of the public and a new branch of industry was created, which, by its wide and vast sunplicable fast electric lighting companies, which sprung up in the opposite countries of the world, and enormous fortunes have been formed in benefitting by the new discovery. The success of so many public undertakings is a sufficient antidote to brain pressure, and the effect which was sought in a reduction in the number of the Board of Trade will be entirely defeated by the proposed provisional orders.

Since the commencement of the issuing of this Act it has been the endeavour of nearly all the important towns in the United Kingdom to be supplied by and secured with notices from some firm or electric lighting company, or other proprietors of systems of electric lighting, with the object in view to apply for licenses or provisional orders for the establishing, in each of the towns applied for, of a more or less gigantic system of electric lighting machinery, with powers for the breaking up the public streets and highways, and for placing and fixing the conductors or electric mains, and for the doing of all such things as are necessary to the efficient working of such installations upon a large scale.

The giving consent to the obtaining of provisional orders for such purposes to private companies or bodies, would virtually amount to the abandonment of the rights of the local authorities and other local authorities in the control of the streets and highways, within their own boroughs or districts, over which they have hitherto exercised, and would have otherwise, if they had been left to a very general and very decided feeling on the part of the provisions and other local authorities, to resist or exercise an interference with their rights within their respective districts.

To prevent this interference, there appears to be but one course open to the local authorities, and that is for each district, and that is the course which Sheffield, with the Board of Trade Rules), themselves to apply for a provisional order for electricity supply in their own districts, and then maintain in their own hands the control of the streets and highways, and at the same time to put their local authorities in a position to exercise the same powers throughout the train being equal to 512 standard candles. The lamps are of 42 volts E.M.F., and the motion of the train appears not to have affected their durability. It was almost expected that the jolting of the train would have proved injurious to the accumulators, but experience has shown that they have worked more continuously satisfactory in the train than in installations where they remain unmoved. The connections between the carriages are so made as to be easily joined together, and to sever by the mere slip of the carriages. The system is entirely automatic, and practice has shown that the apparatus requires no attention whatever beyond occasional lubrication. Another important feature in the arrangement is that the apparatus is autonomously reversible. Consequently it works equally well, no matter in which direction the train is running. The electric light was installed in this train by the Railway Electrical Contractors, Limited, of 4, Great Winchester Street, London. The train commenced running on December 10, 1883, and has been in work

OTHER ITEMS IN SCIENCE.

Arrangements of the controversy now raging, and as from being ended, with regard to over-pressure in s it is a noteworthy fact that the question of how pretty constant the generally depressing effects of ster-strikes and lock-outs is now being seriously con sidered, and the measures there taken, if acted should be remunerative here. Official action reference to over-pressure has been taken in B Wurtemberg, Baden, and Alsace Lo Experience in German schools—and the same has doubtedly been found in those of other countries —has shown that physical exercise alone is

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It is necessary that the Corporation, in applying for a provisional order, shall undertake, within a specified time, to give a supply of electricity for private purposes within the district to which the area, with which the order may apply, if required to be compared with the area of the whole borough; but the Corporation may limit the area to be supplied, and thoroughout to supply at a uniform rate of remuneration any intending consumer within such area.

I would therefore propose that the Corporation should, in the first instance, limit the provisional order, required to make an immediate lighting of a certain limited area of the town, and that the area to be so chosen should be the Corporation, or portions from such stations situated respectively at or near the opposite corners of the area to be lighted. The district I would recommend should be limited in its boundaries to a preliminary area, and in order to meet the object of the Board of Trade, that the streets of Sheffield extending, generally speaking, from north-east to south-west, and from south-east to north-west of Worksop, were to be lighted, from the river end, and of Pinstone-street, near to Moorhead, to the suburbs of Broomhall-street, near to Moorhead, to the suburbs streets and thoroughfares, the houses and other buildings in which the electric light should be included in the area of electricity supply :—(1) Wainsgate; (2) Castle Folds; (3) Haymarket; (4) Waingate; (5) Castle Green; (6) Hartshead; (7) Market-place; (8) Market-street; (9) High-street; (10) Churchyard; (11) Fargate; (12) Church-street; (13) Angel-street; (14) Tudor-square.

The above series of streets measures in the aggregate about 2 miles of house frontage, 75 per cent. of which is occupied by shops.

Leaving for the present consideration the public lighting of the above district, I will now proceed to the question of the domestic and general lighting of the houses and other buildings in the streets of which it is composed, and the houses and premises which present the best field for consideration is whether the illumination shall be effected by are lights or by incandescent lamps, or by a judicious combination of the two. There cannot be a doubt that, for large open spaces, for large halls, and for other buildings of similar class, the electric arc light is the most economical, and, on the other hand, that for small rooms, as in private houses, the incandescent lamp is the most convenient; but, on the other hand, there is a class of buildings which occupy a position of middle importance, and the lamps employed require to be fitted with new carbon points every 8 hours, and not only have the carbons to be supplied, but also such adjustments have occasionally to be made to the lamps as can only be effected by a skilled workman. I would not recommend to them, are such as would prevent my recommending any system of lighting for private purposes lighting, for which my reason it is impossible for the apparatus within a private house to be placed in safety, being as it is more or less in the hands of domestic servants and other unskilled people.

For the purposes of public lighting I recommend for the general lighting of the district the employment of lights for by incandescence, of which, as the Corporation will have seen several systems, except by many objections, which I would therefore recommend the laying out of the illuminating as if nothing but incandescent lights were to be employed; but I would, at the same time, point out that, in the event of the Corporation determining to make the employment of arc lights in certain streets where they might be more suitable; for it is quite possible that the Board of Trade may consent to a substitution or are lamp for a corresponding number of incandescence lamps, and thus have both are lights and incandescent lamps, and thus have some circuit. I should prefer (if there were a demand for it) that the supply should be given by a battery, the laying of a separate circuit for them, and, instead of employing a dynamo machine or series of machines, I would recommend that there would be specially constructed a machine whether this should be done or not can only be determined by the local authorities and other local circumstances.

The standards required with incandescence lights is similar to that of gas, there, on or off, as required, and the lights will be entirely free from destroyed; and as the average life of an incandescence lamp is stated to be practically at 1000 hours, and as renewal is so simple as practically to convert gas-fittings into a confidential, the attention required to be given to altogether inconsiderable, and the cost even trifling incidents any lighting operation except the turning on of a switch or the lighting of a gas.

The efficient and steady illumination there is nothing to be desired in incandescence lighting when perfectly steady, being subject to no fluctuation—as cannot be said of the very best are lamp at present in existence—although all the are lamps employed to any considerable extent at the present time are great improvements on those of a few years ago; and I have no doubt are lighting will be still further improved by the introduction of regulating lamps will no doubt be introduced, and also by side with those improvements, the system of the self-adjustment of dynamo machines to the work put upon them, from time to time, will become more and more developed.

To arrive at any thing like an accurate estimate of the amount of illumination required—that is to say, of the number of lights of a given intensity—also of the number required to be supplied with electricity—I would suggest that the following be adopted:—Assuming that the streets to be lighted in the manner of lights they would require (estimating at one-candle power for each compound) or, if that be considered inadvisable, a different number of lights, according as nearly as possible, the number of gas-lights at present existing in the above and other buildings attached to the streets mentioned in the schedule, and from an estimate as to the number of lights which the houses in the above streets might be expected to be in the case of each information, and for the purpose of the requirements of the installation, I have taken an average number of 5 lights to each house in the district by one-candle power lamps; and upon this assumption, during 1 light is that there are 500 average houses, or, say, 2500 lights in a district consisting of private dwelling-houses and 5 or more stories, it is fair to estimate that the average number of 16-candle lamps may be effected by allowing an average of one lamp to every house of an average frontage of 25 feet, on which calculation there would be required 5000 lamps. I assume, however, that the principal thoroughfares of the streets set forth in the schedule on page 2 of this report is crossed, in as large a proportion as 1 in 10, there would be a large number of lights, I think it would be hardly safe to estimate a smaller number of lights per house than 5, and I therefore adopt that number as the basis of my calculations, or 10,000. It is not in the least degree probable that the streets mentioned in the schedule would be lighted at the same time, but I assume that there will be a considerable number who will desire to have lights after midnight. On the other hand, there will be others who will expect many among the proprietors of important shops will require a considerably larger number of lamps than the ordinary dwelling-houses, say eight lamps for every 25 ft. of frontage, and so the additional lights will make up for the deficiency mentioned in the last paragraph, or about 10,000 lamps.

To drive these 10,000 lamps, I estimate, would require about 1000 horse power, and these would be worked together. The dynamos selected at about an eighth of a horse-power per lamp, but I am inclined to think that this would generally be proportion of a horse-power of incandescence system, when, as a rule, state that an average of 10 lamps per horse-power is the most that can be relied on. I do not feel justified in recommending the adoption of a less number than 10 lamps per horse-power for every light in the district, as in outside cases, and should allow a margin for inefficient lamps.

I would here point out that, in most of the recognised incandescence systems, the carbon filament is terminated by a corresponding variety of carbon, and therefore of fuel consumed; so that, if at any time 100 lamps are in operation, or 1000, or 10,000, the power absorbed will bear a proportionate relation to the number of lights in action.

(To be continued).

THE PHOSPHOR-BRONZE COMPANY, LIMITED.—We understand that Mr. James Wallace, C.E., of Augustine, the consulting electrical engineer and inventor of silicium bronze, has joined the board of directors of the Phosphor-Bronze Company, Limited.

IRON MANUFACTURE OF FRANCE.—It appears that the imports of iron minerals into France in the first nine months of this year amounted to 1,062,440 tons, while the total Belgium contributed 65,728 tons; Germany, 265,000 tons; Algeria, 377,360 tons; Italy, 91,000 tons; Spain, 217,520 tons; and other countries, 891 tons.

IRON AND STEEL SECTIONS.—Messrs. Bailey Yeas and Co., of Sheffield, Northern Foundry, 171, Corporation-street, have issued a pocket edition of their list of angle, bulb, tee iron and steel, English and foreign sections, and round channel and deck beam. It contains particulars of nearly 1000 sections that can be rolled in iron, many of which are also marked as being procurable in steel, and is published in a form adapted to be hung upon the wall. To those using rolled iron it will be of considerable value, as it will show at a glance what sections can be obtained. The information concerning steel sections is particularly useful at the present time.

PUBLIC WORKS.—At a meeting of the Civil and Mechanical Engineers' Society, held on the 16th inst., the president, Mr. Herbert Wright, M.I.C.E., in the chair, a paper was read by Mr. H. Mitchell Whitley, C.E., "On the Best Method of Conducting Public Works in the Great Britain." The author directed his chief attention to the terms by which landed property is acquired for the purposes of public works by compulsory power, to one of the main objects of an Act to construct public works, after discussing which, the procedure before Parliament was described, especially the preparation of the Parliamentary plans, and the deposit of the Bill. The author then went into detail if possible to allotted to the subject, especially especially insisted on the need of accuracy in all portions of the work, considering the rigorous examination to which plans are subjected before the sanctions of Parliament is given. The paper dealt with the subject of the estimate, and the method of receiving the tenders, and concluded with an Act of Parliament. A discussion ensued, in which the President and Messrs Bird, Mumday, Walton, Whittaker, Brewster, Burbridge, and Child took part.

ELECTRIC LIGHTHOUSES OF FRANCE.

(For Description, see Page 622.)

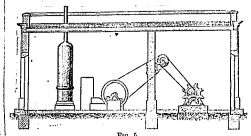


FIG. 5.

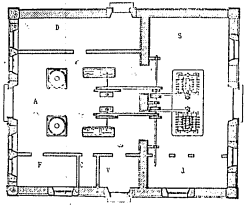


FIG. 6.

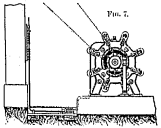


FIG. 7.

FIG. 8.

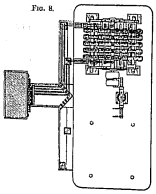
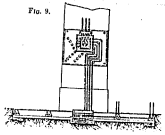


FIG. 9.



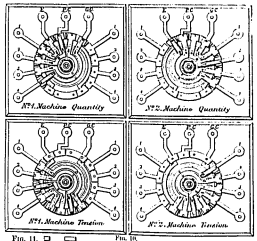


FIG. 11. FIG. 10.

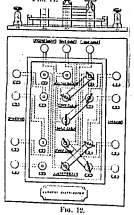


FIG. 12.

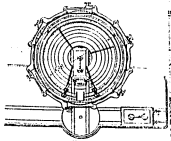


FIG. 13.

THE ELECTRIC LIGHTHOUSES IN FRANCE.

(For Description, see Page 622.)

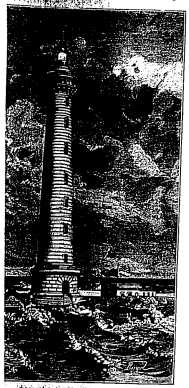


FIG. 1.

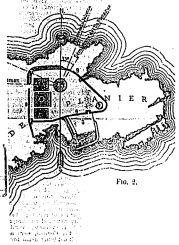


FIG. 2.

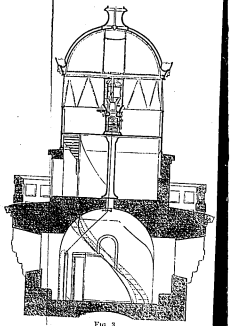


FIG. 3.

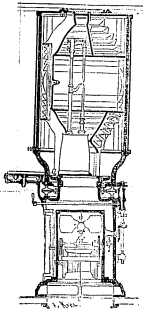


FIG. 4.

THE ELECTRIC LIGHTHOUSES IN FRANCE.

(Continued from page 398).

The Planier lighthouse; see Fig. 1 (page 626), has just been completed, and is situated eight nautic miles from Marseilles, on a rock, the plan of which is shown in Fig. 2. It consists of a tower 19·6 ft. high, and 23 ft. 6 in. in diameter at the base, and springs from the rock at a level of about 16 ft. above the sea. As will be seen from the plan the tower and adjacent buildings are protected by a surrounding wall from the action of the waves; from this exercise an open gallery, protected by sea walls, leads down to the little harbour shown on the plan, on which the following reference figures will be noted: 1 is the new tower now being

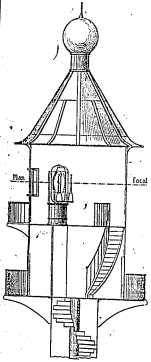


FIG. 14.

described; 2, the engine and generator house; 3, the old lighthouse; 4, an old tower; 5, the 6, is an inclined plane; 7, the tarbinet; 8, a tank-water; and 9, is the exercise above referred to. Fig. 3 is a section of the louvers at the top of the tower, and Fig. 4 is an enlarged view of the lamp; in the latter figure are shown, the fixed light apparatus, and a mechanism for driving this latter is also shown in some detail. In this installation the changing of a regulator is also effected by means of two pairs of rails, but they are not placed at an acute angle like those in Le Hâvre. One of them enters direct into the optical apparatus; the other is placed outside and

As light angles to the first; at this point or junction is a turntable, and with this arrangement the time required for shifting is not longer than with the method as La Hâvre. The De Meritens machines which feed the regulator are fixed in the room marked 2 on the plan; and enlarged views of the installation is given in Figs. 5 and 6, page 634, which are respectively a plan and longitudinal section. These views will explain themselves, with the help of the following reference: *a* is the engine and boiler house, the two boilers being of a vertical type; *b* is the electric generator room, which contains also the transmission shaft, from which motion is taken off the engine and transmitted to the generators; *F* is a forge and heavy repair shop, there being a second adjoining the generator room for the more delicate work connected with the electric machines; *c* is a water tank, and *d* a coal depôt, with a second water tank beneath.

The Planier is a full lantern lighthouse, throwing its rays in all directions. Its distinctive character is that of three white flashes, separated by one red flash, and its range, like that of all the new Mediterranean signal towers, is 27 nautic miles for fourteen-fifteenths of the year.

As the electrical installation at this lighthouse is the newest and most complete in France, some details of the arrangement will be found of interest. The plan, Fig. 8, shows clearly the position of engines, transmission shafting, and generators. The latter are both placed on the same masonry foundation, and the axes of the two machines are in the same line. These generators are not intended to be both worked at the same time; however, that one may be always ready to replace the other in case of accident, both shafts are keyed together, and both machines are driven, the one idle, the other with a closed circuit. Each generator is divided into two circuits, represented by four terminals placed as the upper part of the frame, two at each end. The terminals placed one beside the other at each end of the machine are those which at a given instant form the poles of the same name. From each of them is led a copper conductor taken down along the masonry foundation, and following the ground as shown in Figs. 7, 8, and 9, till it arrives at a commutator placed on the column that carries the transmission shafting. One object of the commutator is to take the current either from generator No. 1 or No. 2; another is to couple either in tension of quantity the two circuits of each machine. The four possible combinations of this commutator are shown in Fig. 10, from which it will be seen that the opposite couples of fixed and movable contacts arranged in a circle. The fixed contacts are fourteen in number, four of them on the left are in relation with the terminals 1, 2, 3, 4, from which are led the conductors of the generator on the left, or machine No. 1. The four corresponding contacts on the right hand are connected with the terminals corresponding to the conductors from machine No. 2. The three upper contact pieces belong to the terminals communicating with the conductors leading to the lamp. It should be mentioned that the return current is led off from the lamp by a large cable after traversing the sea, which it has reached by two smaller cables, in one of which is placed the electro-magnet of the lamp. Of these three upper contacts, the one on the left communicates with the terminal 3, to the next is connected the conductor of the electro-magnet just referred to, the next belongs to the terminal F G of the second small conductor; lastly, the piece on the right, half as large as the others, is in communication with the terminal G C of the large cable. The system of fixed contacts is completed as the bottom of the circle by three pieces, the centre one of which is twice as long as the others; the two side ones communicate by auxiliary conductors, that on the left with the contact piece of the terminal 2, that on the right with the contact piece of the terminal G C.

The movable contacts to the number of eight are also shown in Fig. 10; they are all carried on one plate, free to move around the centre of the apparatus. The innermost pair of contacts are connected together in such a way as to form the letter C; the next outer pair is similar, and the four letters are connected two and two by the metallic strips, concentric with the centre of the commutator. A handle in the middle of the movable plate serves to place it in different positions. Supposing that the movable contacts 1 and 2 are as shown in the diagram in the first position for quantity. The terminals 1 and 2 being at the same instant poles of the same name, the current enters simultaneously by these two movable contacts corresponding to them terminals, and passes thence into the small cable and the cable in which is the electro-magnet. After passing the carbons it is collected into one conductor and returns by the large cable to the terminal G C. On the first contact of double the size, in connexion with this terminal, the two movable contacts rest, by which the current returns to the terminals 3 and 4. In coupling for tension in the same machine the current, leaving the first circuit of the generator by the terminal 1, traverses the most extended pair of movable contacts, and arrives at one of the inner fixed pieces by means of a conductor auxiliary to the terminal G C. It then follows the large cable, passes through the carbons, and then traverses only the small conductor and electro-magnet to arrive at the terminal 3; thence by the second auxiliary conductor to the smallest movable pair of contacts and to the terminal 4. It flows then through the second circuit of the machine, returns to terminal 3; afterwards by the second pair of movable contacts it arrives at the large central bottom contact piece, whence it is conducted by the third movable contact to the terminal 2, and in this way to the first circuit of the generator. In following out the positions of the movable contact indicated in Fig. 10 for the second generator, the direction of the current will be seen to be similar. The contacts are covered by an ebonite disc through which passes the handle serving to manipulate the movable plate; this ebonite disc carries four inscriptions corresponding to the various combinations of the commutator, and a movable index on the handle indicates by its position against one or other of these inscriptions what the actual combination is.

This system of commutator has the advantage of permitting an instantaneous change in the grouping of the two dynamos of the same machine, and of exchanging instantly one generator for the other; the arrangement, however, presents the drawback common to all turning contacts of not being absolutely reliable.

Figs. 11 and 12 show a modified commutator also employed for the De Meritens machines, and which has been fitted to lighthouses in this country. In this arrangement the terminals to which the lamp conductors are connected and the cables from the machines are practically in the same relative positions as in the previous one. From these terminals pass strips of copper which can be locked in position by the handle shown, and these unite on the terminals. The locking pieces in connexion with the generator terminals can be connected with copper strips by the locking screws corresponding to the lamp cables, and by facilitating or impeding by the locking levers are more or less raised in order that the strips may come each either without touching. In the way absolutely perfect contacts can be obtained, but the idea presented is one to be noted as the system combined is longer than with the revolving contacts.

We have already described and illustrated (see Fig. 5, page 597 *ante*) the rails on which the regulators are placed by which they can be exchanged. Fig. 13 on page 634 is a further illustration of this arrangement. These rails are in direct communication with the large cable, and it is thus that the current arrives at the frame of the regulator, and thence to the carbons. The regulator itself is a combination of the Serrin and the Berjot lamps, the former of which is well known, and the latter we have recently described and illustrated. It comprises the two electro-magnets of the Berjot lamp, the armatures of which form an internal core, one magnet having coarse wire, and placed direct in the circuit, the other a fine wire magnet, mounted in a derived circuit. The former acts on the articulated frame carrying the lower carbon; the other influences the disc brake that controls the clock train.

As has been already mentioned that the transformation of the Palmyre lighthouse is complete, the Hâvre do is now in progress; this, unlike the Planier, will throw a beam only in one direction, and the arrangement of its lantern is therefore different, being as indicated in Fig. 14, the general disposition resembling that of La Hâvre. The optical apparatus for the new fixed lights will be 2·3 m. in diameter, instead of 1·91 that figure which was the old one. With the revolving cylinder of vertical lenses the diameter reaches 2·36 m.

Before concluding this article we will give the following data regarding electric illumination for lighthouses in France tabulated from the report of M. Allard, and which will be found of interest.

J. Illum. Engin. Nov. 27/84

Electric Lighting.

The rapid growth of the business of the companies engaged in electric lighting, and the general progress which has been made in the art as indicated by the patents which have been granted, and the improvements which have been made in the appliances for lighting, are subjects of general remark. The literature of electric lighting has developed, perhaps, with just as great rapidity as the art itself. The number of works that have been issued is phenomenal, while the catalogue put out by the different companies and which explain in detail the different systems evince an enterprise in this direction that is scarcely paralleled in any other line of business. An example in point is a small quarto pamphlet recently issued by the United States Electric Lighting Company, whose New York office is at 59 and 61 Liberty street. In paper and typography this book compares favorably with some of the finest publications to be found in the regular book trade, while the illustrations displayed have been done in the highest style of the engraver's art. Each page is embellished by a red-line border, and, altogether, the book is one of the most attractive trade publications which it has been our fortune to examine. It would be impossible in a notice of this kind to describe the contents of the work satisfactorily, for nothing short of a presentation of its entire subject matter would be adequate. The Weston incandescent system is the principal subject discussed, and the various appliances used in lighting it, with numerous pictorial illustrations of large full size, are described. Instructions as to the method of wiring buildings, switching brackets for use in office and factories are also carefully shown. The arc lighting produced by this company is also illustrated, although not so fully as the incandescent system.

Engineering, Nov. 28, 1884.

the phenomena in question resolve themselves into very simple elements when the facts of the case come to be carefully analyzed, and the recent boiler explosion at Hilston, to which we briefly referred in our issue of the 14th inst., and further particulars of which will be found in another column, offers no exception to the rule in this respect. In fact it may be taken as a very typical case of what usually occurs in such disasters. In this case three plain egg-ended boilers in a range of ten set side by side exploded in all appearances simultaneously and scattered their fragments all around.

It is easy to understand that to the untrained observer who judges only from general results, the fact that the boilers were almost new, that no wasting of the plates was visible, and that at the time of the explosion the boilers which burst were working in conjunction with five others alongside which remained uninjured, may present itself as a puzzle by no means easy to solve. To the trained expert, however, accustomed to investigate such phenomena, the disaster did not present much difficulty of explanation, and was comparatively easy to diagnose.

A careful examination of the fragments revealed the fact that in one boiler, and in one only, was there a longitudinal rent, which in the skilled eye had been very severely overheated, and on plotting the position of the rent it was found that it had occurred just at the part which would be overheated in the event of the level of the water in the boiler getting too low. Further consideration showed that it was not probable the shortness of water had been brought about by evaporation in the ordinary way in consequence of the steadiest neglecting his feed supply, but that the lead had been in all probability melted very rapidly from some cause or other, and the evidence of Mr. Morten and Mr. Ramsay at the inquest showed, we think, that the most probable explanation of the loss of water was that the leakage had occurred at a defective joint in the blow-out pipe.

We find that a portion of the blow-out pipe on the boiler was made of wrought iron, while those of the other two were of cast iron, enabled it to be identified as the middle boiler of the three which had burst. The evidence, therefore, showed clearly that in the case of No. 2 boiler at least, the explosion was due to the fact that the water had become exhausted, so that a shearing action is set up whereby a heavy strain is thrown upon the ring seams of rivets, and we have frequently known boilers of this class to explode in consequence of a sudden steam rip starting at the ring seams of rivets in this way.

Barring these facts in mind, therefore, all mystery in connection with the Hilston explosion vanishes, and it is easy to understand how the shock consequent on the bursting of No. 2 boiler from absence of water should have so severely strained the adjoining boilers on each side of it that they exploded in turn. A reference to the plan of the exploded boilers, which we give on page 591, will show that the circumferential rents in the two outside boilers occurred at the part which would be called upon to bear the greatest effect of the blow consequent on the bursting of the middle one. There would in reality be two, if not three, explosions, but the interval of time between each would be so short that they would appear to be simultaneous rather than successive.

The explosion at Hilston is not the first instance in which several boilers have burst together, though happily the occurrence of these disasters is somewhat rare. From the printed reports of the chief engineer of the Manchester Steam Users' Association, it appears that this is the tenth compound boiler explosion which has been recorded in the United Kingdom since the year 1862. The last occasion on which a disaster of this kind occurred was in March, 1879, when six boilers, all of the plain egg-ended externally fired class, went off together. In that case one of the boilers was ripped into a great number of pieces, which were scattered around in all directions, while each of the other five were only divided into two or three pieces at the ring seams of rivets, and the fragments were simply shot fore and aft. Investigation showed that in the case of the boiler which was torn into a great number of pieces the outlet for the steam had been plugged, in consequence of which the pressure had gone on accumulating until the shell gave way, the shock consequent on the explosion being so violent that the five other boilers set alongside also gave way. Another very similar explosion to this occurred at St. Helen's in 1872, when three boilers of the plain egg-ended type failed in consequence of the outlet of one of them being stopped with a wooden plug. On looking over the list of these compound explosions given in Mr. Fletcher's reports, it appears that in no less than six out of the ten cases recorded the boilers were of the plain cylindrical type fired externally, a fact which would seem to show that boilers of this class possess elements of danger that are hardly shared by those of the internally-fired description. That the boilers at Hilston, for instance, been of the Lancashire or Cornish type, the occurrence of shortness of water would in all probability not have involved anything more serious than a collapsed furnace crown. The boiler in question, and could certainly not have resulted in the bursting of two others alongside.

We may just add in conclusion that the Hilston explosion, enforces still more upon steam users the importance in dealing with steam boilers of carefully considering every detail in their design and equipment. The shortness of water was in all probability due to leakage at the joints of the blow-out pipe, which was concealed and heated for that, instead of being open, and free to move with the boiler, while the disastrous consequences would have been averted had the boiler been furnished with a reliable feeding for giving warning in the event of the water in vogue a steam boiler cannot be too well equipped to begin with, nor too vigilantly watched when set to work.

THE ELECTRIC LIGHTING COMPANIES.

Just two years ago the electric lighting companies were besieging the Board of Trade for provisional orders, and were dividing the country among themselves, much as the Israelites had done under Joshua, marked out the promised land before they set foot in it. Every town, which was awarded to one or other of the companies, while London, with its many centres, was more or less equitably divided among several of the principal. The process was not without its expenses, but at a time when investments at 4 per cent. were most difficult to find, it was considered worth while to risk a good deal to obtain possession of a monopoly.

Engineering, Nov. 28, 1884.

would not have a shadow of chance against two of them. In such a case our Mediterranean fleet would have to keep together for mutual protection, but they should fall in with these powerful vessels, when escape would be impossible, having neither speed to run away, nor being a match for fighting; the result would be that our boasted Mediterranean fleet would command a little piece of water extending no further than the range of its guns. On the other hand, the Italian ships might disperse without the least anxiety as to the result, for we have no vessel that could overtake them and then fight them when caught, yet they could catch any of our vessels with ease and destroy them in detail. As for the Indefatigable, she might well, in such a war, be classed with Malta and Gibraltar, and so far as destroying the enemy's ships is concerned, would be no nucleus, for they would keep out of her way, while a ten-knot ship, however handy, cannot overtake another that steams fourteen.

It is most important that something be done to remedy this glaring defect in our Navy; it is very easy to say that building an enormous ship is the cheapest way to carry a given number of men and carrying too many eggs in one basket, or some may say they cost too much money; but if, without considerable additions, our existing navy is useless, all the money hitherto spent is wasted to no purpose. As to expense, the Inflexible cost nearly a million and a half, with all her absurd complication of machinery, and for the same money two vessels like the Dublin, but with more speed, might have been built, if only the Admiralty could be taught to construct vessels in the only way that private enterprise can do business, well and at a reasonable cost.

When the Italian Government commenced the enormous coast. If the constructive department is unable to prepare suitable working drawings, the sooner it is abolished the better, and private firms or foreigners will readily supply all that is necessary.

These alterations to old ships refer not only to improvements, as they are called, respecting armour and guns; but of late torpedoes have made their appearance, and are destined to play a prominent part in the naval warfare of the future, and there is a tendency to adopt all kinds of inventions for the protection of our ships, little regard being paid to the serious consequences they will entail in other respects. In the contemporary before alluded to, a plan has been proposed for protecting our ships by means of steel rods screwed into their sides, sufficiently strong to support a network of smaller rods, which shall surround the vessel, and extend a few feet under water; this apparatus, it is computed, will not reduce the speed of our already too slow ships, more than two or three knots per hour; this sounds quite feasible, at the same time it is quite delightful to conceive the idea of our ironclad fleet, dressed up in petticoats, sitting in state in the middle of the Mediterranean, waiting patiently for the enemy to attack it, the admiral's lady wearing a plaid suite of corset as he watches a few of our vessels being burnt in the distance, and thinks what a thrashing he will give those wretched foreign cruisers—when he catches them. But this is too serious a subject to laugh at, something must be done, and that at once. Foreigners have fully appreciated the importance of these abominable submarine machines; they have already large numbers of excellent vessels, which we do not possess, and there is no doubt that we should soon obtain the best description of boat, which the existing knowledge on the subject can procure. The experiment would not cost much, for all the boats would be serviceable, although not in equal degrees. No doubt a them would be very strong feeling expressed by the builders at the time of the contract, each man thinking his own the best, but a committee of arbitration might be appointed which would be fair to all parties. The importance of torpedo boats has become too serious by endangering the very existence of our Navy, to be brushed up by theories on naval tactics; nor will the public be satisfied with the waste of many money in the construction of such absurdities as the Indefatigable. The Admiralty must face the matter, and, although it may go sorely against the grain, they will be compelled to take some steps towards remedying the many glaring defects, which, most undoubtedly do exist in our Navy, both as regards the small number and weakness of ironclads which are available, their inability as to speed to compete with foreign ships of the same class, and also our great deficiency in torpedo boats. The country has but already confidence in the administration of our Navy and dockyards, and unless some great improvement be made, it will be compelled to try whether it will not be possible to manage matters better, with some other system.

American Machinist, Sept. 20, 1884.

A Bogus Electric Light Company.

A New York electrical expert says he was recently employed by a capitalist to investigate the wonderful claims made for a new electric light on exhibition in a nearby city, to float which a stock company was being formed. The expert called at the electrical headquarters, and found in a single moderate-sized room thirty-six large arc lights pouring forth a bewildering blaze of light, the power for the dynamos used apparently being furnished by a small engine near at hand. On asking if "all that" came from that little engine, the electrical sharp said it did. The expert satisfied himself from an examination of the engine and dynamos that the thing was a physical impossibility, but couldn't lay his finger on the fraud in the face of the electrician's watchful observation. Calling again a day or two later, the expert brought a clever assistant, who managed to engage the "inventor" in an animated discussion, under cover of which he was able to make such an examination of the premises as led to the discovery of a lead pipe entering the premises in a wooded corner not seen without. Whipping out his knife, a few cuts showed wires inside the pipe. A search up and down the street brought to light the fact that five doors away a 100 horse-power engine and several large dynamos were busily engaged in producing the electricity, which proved to be made by the miniature engine and dynamos further down the street. The expert made his report, and the capitalist didn't buy any stock. If all the men who are asked to put money into wonderful electrical or combination companies should adopt a similar course of investigation before buying stock, it is safe to say there would be a good many corporations less in this country, and closer attention would perhaps be paid to the many modest claims of mechanics and inventors, who want to enlist capital and have only legitimate attractions to offer.

AN ELECTRICALLY LIGHTED TRAIN.

The London, Brighton, and South Coast Railway Company have three electrically lighted trains running on their lines, and a fourth is nearly ready to be put into service. It will be remem-

THE PROGRESS OF ELECTRIC LIGHTING.

YESTERDAY a deputation of electric lighting engineers waited on Mr. Chamberlain to confer with him on the modification of certain clauses in the Electric Lighting Act. Whether this interview will have much effect remains to be seen. We much doubt, however, that any change in the law can touch the core of the trouble. Electric lighting is at present in a very anomalous position. So far as the establishment of a house-to-house system of lighting is concerned, it makes no progress whatever. Indeed, the movement is rather in a retrograde direction, for the London, such as the Edison Company's in Holborn, which were established, have been closed. On the other hand, new works are being done in lighting individual buildings, such, for example, as the new Law Courts, Electric Palace in Victoria-street, and the Fleet Avenue Hotel in Holborn; while at no time has so much as lighting been done to docks, railway stations, iron works, &c. A great deal of incandescent lighting, too, is being done in cotton mills in a small way, the dynamo machines being driven by hands from the mill engine; and as we have seen, the question of large has narrowed itself to this.—Why cannot district lighting be established? Plenty of provisional orders have been obtained, districts have been mapped out, designs proposed, companies formed—these last on paper—but nothing has come of it all. On the one hand, it is argued that the Electric Lighting Act has not been severe simply fatal to the novelty it was supposed it would be better and cheaper; on other hand, it is stressed that clauses in the legislation has nothing to do with the matter, and that the great secret of non-adoption by the public lies in the fact that electric lighting cannot be made to pay. It is quite easy to see how both arguments are right; but the influence the one party or of the Electric Lighting Act may be wholly neglected if it can be shown that, even if the Act or no Act, electric lighting cannot be a commercial success. We fear that this is a fact, and that a great deal has yet to be done by way of cutting down expense before commercial success can be claimed for it. Edison is a very clever inventor, but it does not appear that he, more than any one else, can achieve impossibilities; and it is now fully understood that the system of lighting with which he identified is the most expensive ever in existence. We need not stop to say a word about the grace of the idea of incandescent lighting, but like most other beautiful things, it is frightfully costly. The method over which agitated men's minds a couple of years ago, brought to the knowledge of middle-class folk with ostentatious announcements in the daily papers, is now a mere matter of history. One of the very first things they found out was that light, not furniture, not dress-coats, and not papers, to say nothing of dadoes, and pictures, and the like, cost a tremendous lot of money. The appetite for luxurious and light had overlooked this little difficulty. Incandescent lighting must be cheapened, be cheaper, be cheaper, or it will die. Let us first prove that it is possible to be cheapened enough to be acceptable to the average house holder, legislation will not help it. Parliament may alter the Act as often as it pleases, but it will not make any one any more than it is now. Why incandescent lighting has not been a success we have already explained, and we will not repeat ourselves here. Suffice it to say that it has failed, and failed all along the line. It was to succeed in the city, but it has not done so. It was to succeed at the West End, and with Edison himself on the spot to advise, incandescent lighting has not begun to succeed. If it is to succeed at all. In 1882 Edison opened the First Pimlico illuminating district. He undertook to light an area with a little under one-fourth of a square mile, and the supply was found by the Edison Company, Limited, that in a month there were 12,540 lamps up, the number having gradually risen from 2222 lamps, with which the mode was first opened. The mains were all laid underground. Edison's own, so to speak, and he did "all" that he knew how to do to make the speculation a success. But the result, notwithstanding, was a disastrous failure. The gas has been disastrous. The cost of fitting up the district has been £200,000, and the actual receipts last year were £6000 in excess of the working expenses, about £16,000 a year. This means about 3 per cent. on the capital; but then no allowance is made for depreciation, and it does not seem much explanation to sharing with that a return of 3 per cent. in such an undertaking is to be considered a success. In fact, the profit, if there was any, was generally nominal. The average life of the lamp seems to have been 400 hours only, or about one-tenth of the durability claimed for Swan's lamp. Our contemporary, in the Stories, in dealing with the question, points out that about it is impossible that a 16-candle incandescent lamp can be made to last more than a 7th, per 16, with any commercial success. This be the case in London, then electric lighting must be a failure, nearly twice as much as gas—which it decidedly is not.

Are we to assume that this state of affairs is to last for ever? We venture to think not. In the first place, half as much energy had been expended on new inventions as has been spent to the incandescent system, the whole subject would stand to-day on a different footing. There are great possibilities to be seen in electric lighting, possibilities to be found out in the United States. The great fault in incandescent lighting, as we have said, is its variability, and that there seems to be no possible means of curing. Then, although, as a rule, the largest number ever up at one time was 12,540 lamps first only. The average during the year was 6000 lamps, or to the whole of the plant, we only about two hours. Suppose we compare the effect of this with a central electric station with that on a central gas-works. It is easy to appreciate what it involves. The gas-works run steadily day and night, the gas-holders form a reservoir, so to speak, and intercepting irregularities in demand. If the station is a steady falling off in the requirements of the public, the evening, for instance, then one or more retorts are cleaned; with the advent of long nights the retorts are charged; but the plant in action is always worked to the best advantage. The electric lighting station, on the other hand, has nothing to intercept or equalize fluctuations in demand, and a plant adequate to feed a couple of thousand lamps may have to be kept going to supply a few dozen. Let us suppose that all houses in a street are lighted. At midnight all the lights are out, save in one house, where a dancing party is being given, which does not break up till dawn. The whole of the plant provided to supply fifty houses has to be kept burning to light up one house. Nay, more. Lights at the station must keep at the bottom of a sick person all night. The of a few lamps burned in this way must be reckoned up in pounds per hour. Of course it may be urged that this need be got over. We do not deny that it can, but it has not yet been got over. The storage battery promised to make electric lighting by inconsistence a success, but it has not kept its promise, simply because there is no good storage battery in use. We say this with a full knowledge that there are storage batteries which have attained a fair measure of success, but they do not seem to satisfy electricians in general. We stated months ago in these pages that commercial success was not to be expected for incandescent electric lighting without the aid of storage batteries, and nothing has since happened to make us change our opinion. It is, we repeat, absolutely essential either so to construct a central establishment that variations in supply will not injuriously affect its flexible arrangements, or else to introduce between the consumers and the producers some regulator which will equalize the demand on engines and dynamos machines no matter what the fluctuations in the requirements of the public.

ELECTRIC LIGHTING AT MONTREAL.

THE absence of the incandescent electric light in the city of Montreal was commented on in the discussion which took place after the reading of Mr. Preece's paper on "Domestic Electric Lighting" at the meeting of the British Association. The great natural water power, with which several of the largest Canadian cities are so well provided, has not yet been taken advantage of, and should enable a general supply of electricity, both incandescent and arc, to be furnished at a rate that would be much cheaper than gas.

In accordance with most American cities, the streets are lit by electricity, and as the system adopted is one which has not been introduced into this country, we propose describing it. It is the Thomson-Houston dynamo machine, of the continuous current type, and approximately resembles the Brush in that it is wound to furnish a current of 2000 volts electro-motive force. The lamps being differential and worked in series with 10½ amperes current. In detail, the construction of the machine is peculiar to itself, and consists of a spherical armature made up of three coils of wire which are wound in the Siemens' form on the outside of a Gramme ring composed of soft wire. This armature is revolved between four pairs of two cup-shaped electro-magnets, these enclosing nearly the whole of the armature above the horizontal plane, and extending in a powerful magnetic field, which is concentrated where it should be utilized to give the best results. The three coils are connected together at one end of the armature, and the other ends are put through a hollow in the shaft until they come out at the end, where they are connected to the commutator which has only three segments. The electricity is led off by two pairs of brushes which are connected through and their position adjusted by means of suitable levers. They are worked by the automatic current regulator Fig. 3, which is shown in its place on the left side of Fig. 1. The regulator consists of a single pole electro-magnet with a peculiar shaped armature, which is a hinged bar of iron having a curved surface through which the pole of the electro-magnet enters; by this magnetic arrangement the pull of the magnet is the same at whatever distance the armature is from the pole. The current regulator is actuated by a controlling magnet, which, when in place in the line of the main circuit, immediately makes contact instantly alters the amount of current passing through the regulator, which consequently varies by the position of the brushes, and thus more or less cutting out the supplied field.

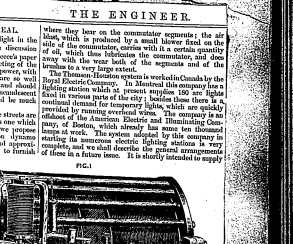


FIG. 1.

THE THOMSON-HOUSTON GENERATOR.

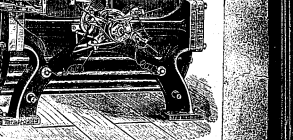


FIG. 2. FIG. 3.

AUTOMATIC CURRENT REGULATOR. CONTROLLER MAGNET.

The position which the pair of brushes occupy to each other, and the commutator bar long will be further determined by the stood by reference to the accompanying figures, Figs. 4 and 5, in which S is the commutator divided into segments K1, K2, and K3, Fig. 4, and 1, 2, 3, Fig. 5. From the brush-arm B, which is of brass, the brushes are in a normal position. Should line current become too great, the armature M will be attracted, and each pair of brushes will tend to separate; so that if all the lights be extinguished, the coils of the machine will be short-circuited, the magnetic field being almost entirely cut out.

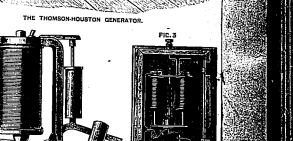


FIG. 4.

MODE OF CONNECTING BRUSHES AND REGULATOR.

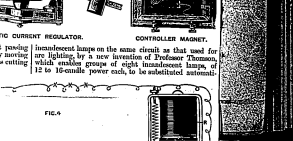


FIG. 5.

It will be seen that one great difficulty is overcome in the Thomson-Houston system, namely, the adjustment of brushes, which are often badly placed by unskilled attendants. Another ingenious arrangement in this system is the air-blast spark controller, which the inventor, Professor Elihu Thomson, claims to provide a complete solution of the problem of controlling the sparking or flashing liable to be so troublesome at the commutators of all dynamo machines. The invention consists in forcing a thin jet of air against the coils of the brushes [illegible] where they bear on the commutator segments; the air blast, which is produced by a small blower fixed on the side of the commutator, carries with it a certain quantity of oil, which thus lubricates the commutator, and does away with the wear both of the segments and of the brushes to a very large extent.

The Thomson-Houston system is worked in Canada by the Royal Electric Company. In Montreal this company has a lighting station which at present supplies 150 arc lights fixed in various parts of the city; besides these there is a continual demand for temporary lights, which are supplied as required by running overhead wires. The company is now offshoot of the American Electric and Illuminating Company, of Boston, which already has some ten thousand lamps at work. The system adopted by the company for starting the numerous electric lighting stations is very complete, and we shall describe the apparatus and arrangements of these in a future issue. It is shortly intended to supply incandescent lamps on the same circuit as that used for arc lighting, by a new invention of Professor Thomson, which is now undergoing trial. The lamps are of from 8 to 12 to 16-candle power each, to be substituted automati-

ELECTRIC LIGHTING AT THE ELECTRIC LIGHT.

As we stated last week, an influential deputation waited on the President of the Board of Trade on Thursday, the 25th inst. The deputation consisted of Lord Thurlow, chairman of the Anglo-American Brush Electric Light Corporation; Mr. Peter Brunswick, Q.C., Mr. Ewart, and Mr. Jacob Aiken, Mr. R. E. Crompton, Mr. Robert Hammond, Mr. Arthur Cooper, Sir Daniel Cooper, Mr. T. H. Cuthbit, Major Flood Page, Mr. F. Cousins-Javal, Dr. Farquharson, Mr. Lane, and others. The object of these gentlemen was to point out to Mr. Chamberlain the expensive and inconvenient character of the Electric Lighting Act. One of these gentlemen—we have not time to say which—drew attention to the property of an electric lighting company at the end of twenty-one years, and pointed out that the power conferred upon the local authorities to supply electricity in any one who may see fit to demand it, involved the necessity of a complete system of mains in which these clauses militate against the prosperity of electric lighting companies. Mr. Chamberlain, it is said, gave Sir Frederick Bramwell and Mr. Crompton. Dealing with Mr. Ribton's case, the first-named gentleman said that under that clause within twenty-one years the local authorities would have the option of the compulsory purchase of the undertaking, and they were to do it on certain terms. They were not to pay anything in respect of compulsory purchase, or goodwill, or profits. Undertakers would be left to be paid for the value of all such lands, buildings, works, materials, and plant of such undertakers as might be used by the local authority for the purposes of their undertaking within such jurisdiction, such value to be, in case of difference, determined by arbitration. The period was twenty-one years, and the matter of those terms was, that all the revenue efforts to get the electric light taken up so as to pay working expenses; and it did appear to him that it was impossible to induce capital to come into such undertaking, after all these years of struggle had been gone through, if the local authority could step in and purchase at a price less than a fair one. He did say that at the end of ten years a company might have to be found further by the expiration of the period, and under the circumstances no one would subscribe capital at that time with the certainty to getting capital invested in such undertakings.

Mr. Crompton confined his attention to the clause dealing with compulsory supply, and pointed out that the Corporation of London had declined to show how this portion of the Act would be worked. In the case of Brighton, they were only compelled to maintain over a given area without any regard to the possible future to be got out of them, so that it was the best system of laying mains to adopt. We had, said Mr. Crompton, practical experience in the fixing and working of detached sets of plant, but that these could not be compared with the case of a district like the city, at all events, few or no public companies had been formed in London, and he thought that prevented us from increasing our stock of knowledge in the one respect which would have to be got out of them, so that the supply of electricity might be carried on in a satisfactory manner. There have been a number of failures in connection with the parallel working of main lying tried in America, and the data obtained have very considerably added to the knowledge of ascertaining what is really the system which best answered the purpose. Another difficulty in ascertaining what was the best system was the difficulty in ascertaining what was the cost of working. Briefly, the two great objections to the laying down of mains for a district like that of the City of London were these:—That it would commit us to a large capital expenditure on a system which was probably mechanically imperfect system; whereas at the

[illegible] every instance certain sums; in pursuance of these they make certain suggestions for amendments. Nothing has been done in connection with the Committee's suggestions, but there may be some chance of practical results now that the Committee has got the Board of Trade to authorize a further enquiry. There can be no question that the system similar to that which prevails in the maintenance of the street was applied by any private company they would be faced with the same difficulty in ascertaining the cost of working. Briefly, the two great objections to the laying down of mains for a district like that of the City of London were these:—That it would commit us to a large capital expenditure on a system which was probably mechanically imperfect system; whereas at the

[illegible] Committee, and the Committee in the following passage hit the blot on the whole matter. They say:—"The great objection which takes place in the dockyards under the heads of repairs and refits is stated in evidence to be due in a great measure to the stringent examination entailed upon the professional officers by the instructions; which were rendered much more rigid in consequence of the circumstances attending the loss of the troop-transport Megaera, and partly to the nature of the supervision exercised by the captain of the steam reserve and his staff." It is well known that this passage does not exaggerate the evil influences which the Megaera inquisition began in the personnel administration. The members of that Commission were well meaning men, but they were unfamiliar with technical questions, and their treatment of the dockyard officers whom they held responsible for the condition in which the Megaera was sent to sea was such as to discourage for future any attempts to economize in the repairs or re-fits of ships. Every officer bearing the strictures of the Commission in mind, would, in the future devote his first place to make himself quite safe, and the "forms" which the officer now has to sign up the completion of a ship's repairs have been made so binding and searching, that without taking a ship practically to pieces it is impossible to satisfy oneself that

THE BOARD OF TRADE AND ELECTRIC LIGHTING.

TO THE EDITOR OF ENGINEERING.

SIR,—Mr. Chamberlain's reply to the deputation of the 29th inst., encourages discussion upon the terms of the optional purchase under sec. 27 of the Electric Lighting Act, 1882. That sets forth a option means a foregone conclusion. To take the discussion out of the region of pure speculation, I shall take a somewhat parallel case in actual experience.

Thirty years ago, the financial practicability of railway enterprise in India was rarely hypothetical. Experimental railways had been constructed, and traffic had been made. So early as 1845, the East Indian Railway Company had been incorporated by Act of the Imperial Parliament, and an experimental line was soon afterwards made by aid of a subvention from Government, then that of the East India Company. The public, however, were not easily to be convinced that railway works could be successfully undertaken in India, and the financial and physical conditions of the country, and the traffic still more to the point, the problem still awaited solution. Under these circumstances the usual rate of the accumulation to be provided. The Indian Government were desirous of attracting private capital to the enterprise, but for this it was necessary not only to confer a monopoly of powers, but to give a guarantee of interest. In consenting to this they did not sacrifice the Government property. In assenting to this terms were sufficiently conditional so as to be fair and not repellent to investors.

The final contract of the Indian Government with the East Indian Railway Company was made in 1854. The Government guaranteed a minimum dividend of 4*l*. per cent.; except in the event that amount in any year were to be shared, one-half of the surplus profits going to the Government for their outlay on the guarantee, and the other half to increase the dividend. And there was a further provision of purchase by the Government, to be exercised by notice to be given within six months after the expiration of

twenty-five years, or within six months after the expiration of each fifty years. The purchase money to be "a sum equal to the full amount of the cost of all the shares and capital stock in the company existing at the expiration of the twenty-five years immediately preceding the expiration of the said period of twenty-five years, or the said period of fifty years, as the case might be."

The Indian Railway Act, which settled in 1854, were the basis of the great railroad system of the East Indian Railway, and it may be said of the railway system in India. The identical terms were embodied in the Government contracts with all the railway companies in the earlier undertakings in India.

To return to the East Indian Railway Company. The Government guaranteed the strength of the contract of 1854; and the undertaking carried out. After some years the profits were found to have exceeded the guaranteed amount, so that, after dividing the surplus with the Government according to the arrangement, the dividend of 4, 5, or even 7 per cent., over the guaranteed 5 per cent., was paid to the shareholder. The stock improved steadily, and at about 25 years from its issue, for exercising the option, stood at about 25 per cent. premium. At this time a necessary result was caused by the option of the Government calling attention to the existence of the option. It was then discovered had time to look into the matter, the terms of the clause were found to have been adjusted with such fairness and forethought, that prices quickly reversed the usual course of events, and, when the Government (the Secretary of State under the powers of the Act of 1858) declined to exercise the option, the stock fell to par in the market was a depressed by the Government to have further to secure the success of the loan financial operation required for carrying out the purchase money. The new arrangement (3 and 4 Victoria) by an Act of the Imperial Parliament, 1840; and the 5th, (sp. cent.) took effect from January 1, 1849; and the Government acquired at the price of 25 per cent. premium—perhaps as an expenditure including all over the original cost—an undertaking of proved and increasing value, with the accumulated trusts of extraordinary profits, and financial management, in every respect, a remunerative purchase. Indeed, so important was the success attributed to the private management, that under the new arrangement, the company retains a certain interest in the control of the undertaking, which continues to be carried on by the directors of the company on behalf of the Government.

A similar result has been lately exercised in the case of the Eastern Bengal Railway, by notice given in 1880, and under an arrangement confirmed by an Act of the Imperial Parliament in 1884. In some other cases the Government have not found it expedient to exercise the option; and perhaps there are cases, but these are exceptional, in which it is never likely to be exercised. Even where the railway has been, financially, a comparative failure, the terms of the option have in practice been a fair compensation for the losses on the investors hard creation. Such a case, however, only illustrates the fairness of the terms of the option. Under the present Government has required the undertakings which have proved successful.

In the case of electric lighting there is no question of experience. All that is asked is that undertakers for lighting on a large scale shall have the necessary powers, and the necessary guarantees to make the enterprise safely. In the case of the Indian railways, the question was not only the consideration for the pecuniary guarantee. The analogy does not justify any condition of an option in the case of electric lighting. But assuming that the principle of clause 27 is unalterable, and the option of purchase a *sine qua non*, the history of Indian railways would suggest a much longer period up to and for some years beyond the actual exercise of the option, in a precedent showing the terms on which the option would be exercised considered not only with the consideration of private enterprise, but also (what is a point of some importance with stockholders in the stock value of the property affected.

Look at the Indian Government, in new railway undertakings, can and does impose harder terms, is only an illusion. The Government can impose new and unfamiliar terms, and no undertaking on which the profits can be estimated by untried experience. This difference is one of degrees of the supposed analogy between electric lighting

and gas and water supply. There is the further difference in the case of water companies, that their concessions involve not only the right to supply so called, but the exclusive appropriation of natural resources. False and misapplied analogies, indeed, seem to be the whole existing legislation upon electric lighting.

I am, Sir, yours faithfully,

13, Old-square, Lincoln's Inn, November 24, 1884. H. CAMPBELL.

EXTENSIVE USE OF THE ELECTRIC LIGHT ON THE CONTINENT.—A scheme is on foot, says *Nature*, having been approved by the Municipal Council of Paris, for lighting with electricity the quarters of the Perfecture of the Seine, in the Tuileries. It is the work of M. Cernescon, and comprises lighting the Salle des Séances with eighty Swan lamps (in place of eighty Carcel lamps), and six Siemens' arc lamps; lighting the library with forty-eight Maxim incandescent lamps (on the present lustres); another room with twenty-four Edison incandescent lamps; another with twenty Swan lamps; the Salle des Pas Perdus with two Werdermann arc lamps, and two Siemens' lamps, and a staircase with eight Swan lamps. The whole will require an outlay of 75,000 f. The horse-power necessary is 42, and while the idea of obtaining this from the Seine has been considered, it has been decided to set up a gas-engine in the Court of the Tuileries. A portion of the motive force is to be employed for electrically ringing the sentinels, and other uses. The Paris-Lyon-Méditerranée Company have illuminated their Paris terminus with fifty-four electric lamps on Jablochkoff's system, and that of Mazarilles with seventeen of the same lamps. Some others which is to be increased by eighteen. The French Northern Company has tried, with success, the of the electric light in the long of locomotives. The Paris Municipality have decided on trying the electric light for the Theatre Royal.

A CHURCH LIGHTED BY ELECTRICITY.—The Rev. Canon Cadogan Churton, of St. John, built by the Marquis of Bute, at Old Cumnock, Ayrshire, has recently been fitted throughout with electric light, under the personal superintendence of Mr. Wm. Massey, Twyford, electrical engineer at the royal palaces. There are in all about 70 glow lamps of 20 candles each, and the effect is excellent. The architectural features of the church have been carefully studied and the lamps arranged with a due regard to the religious character of the building. The current is supplied to the lamps by means of a dynamo and steam engine placed in a small house hidden among the trees of the churchyard, where it is also intended to produce electricity for working the organ bellows.

THE ELECTRIC RAILWAY AT WEST BRIGHTON, CONEY ISLAND.—The only electric railway for commercial purposes in America now in successful operation is that on the new iron pier at West Brighton, Coney Island. Extensive experiments have been conducted by Messrs. Daft, Field, and Ellison, and a very thorough practical test of the Daft system was also made on an existing steam railway last November, at Saratoga Springs, the result of which is that the new railway at Coney Island is worked by the Daft system. It extends for 760 feet along the west side of the West Brighton pier. The track is of 2-foot gauge, the rails being of the T pattern, 20 feet in length, 3 lb. to the foot. These are laid on strips of wood, and are firmly bolted to the pier planking. No attempt is made at insulation, none being needed, as on the wetted wood the leakage would be small even if not compelled. The dynamo is situated, as at Saratoga, at the end of the pier. It is a 6-horse-power current dynamo of Professor Daft's invention, the E.M.F. is extremely low. The intensity of the current varies with the external resistance, and upon this depends the speed of the motor. The weight of the latter is about 600 lb., and its normal speed 1,100. It is driven by an 8-horse-power vertical engine with belts to correspond, manufactured by the New York Safety Steam Power Co. The speed of the engine being 250, direct belting was possible. Two cars are provided for the conveyance of passengers, each 12 feet 2 inches long and 32 inches wide, weighing about 600 lb., and accommodating twenty persons, six on each side, sitting back to back, making a normal load of forty persons. As many as fifty people have carried at one time, a total weight of about four tons. The weight of the motor is about 1,200 lb., and its maximum speed from twelve to fifteen miles per hour, although this is obviously limited on so short a track. The author had an opportunity of practically testing the merits of the Daft system. In the transmission of the power, electrical purposes its advantages have already been demonstrated. No doubt this railway will be the forerunner of many of its kind in America.

REFLECTED ELECTRIC LIGHT.—The experiments which have been conducted on board the *Sultan* at Portsmouth, with a view of ascertaining whether the electric search lights in men-of-war could be protected from the guns of torpedo boats by the adoption of reflected light, under cover, have been concluded. The official trial was witnessed by officers from the Admiralty and the War Department, as well as the local Torpedo School. Four different sets of lenses were tested for the purpose of comparing the intensity of the electric beam being measured by a Bunsen's photometer at first and at 2 cables' length. The apparatus used were a 24-inch search-light lens on ordinary principles, an Ader illuminated their Paris terminus with fifty-four electric lamps on Jablochkoff's system, and that of Mazarilles with seventeen of the same lamps. The force which is to be of locomotives. The Paris Municipality have decided on trying the electric light for the Theatre Royal.

ELECTRIC LIGHTING.

(22/12/84.)—Years leading article of 29th Nov., on "Electric Lighting," must have been read by many others besides myself with much interest; but I should like to point out an omission which inspires greatly its usefulness. I am sure there are many who are desirous of fitting up just a few installations of electric lighting in their houses or business as well as houses; but the difficulty of choosing between dynamos and lamps are the bar? There seem to be plenty of good machines in the market—Which make is the best, combined with cheapness of first cost, and economy in working, both as regards the lamps and the motive power?

You pertinently remark that considerable economy may be effected "by using the same engine to drive the dynamo, and the dropped (not necessarily horizontal) lamp." You proceed to say that there are machines which are superior in several ways to some of the unpatented cheap ones. Just so, Mr. Editor, and I think your readers would welcome a list as to which they are.

My special reason for writing is this: Ina part of my works I have to use gas from 6 a.m. to 9 a.m., all the year round, about 25 lights altogether. I find the atmosphere deteriorated very much, besides there being considerable risk of fire from the naked lights. I am therefore wishful to substitute them by electrical lamps. I have plenty of surplus power available, and I should be extremely obliging nature, so that I shall save the expense of having to purchase the motive power. As I mentioned before, however, I am deterred by the difficulty of knowing whose dynamos and lamps to choose, and I leave it to independent authority to apply to your here to assist me. If I go to an electrical engineer, of course he will advise me to adopt that company's or maker's machine for whom he acts as agent. Some machines are supposed to run more lights in proportion to their size, and the question arises, Is it better to have a large machine some load after being at work a few hours, and some claim to cost very little for repairs. I have closely watched the progress of electric lighting since it entered upon a stage of practical usefulness, and yet I seem as far as ever from being able to decide whose system to adopt, as being the best and cheapest. Perhaps I am over-cautious, but I dislike mistakes, although I am not afraid; only I venture to think you or they will be rendering others, as well as myself, a substantial benefit, if you append to you, with confidence, as having been a reader of your most admirable journal for many years, I have noticed that help is nearly always given to those who require it, and I therefore trust you will not leave my colleague his difficulties. In conclusion, I should say the system which I adopt must not require a skilled electrical attendant. And also, if it is a success, I should probably extend it throughout the whole of my works, having about 200 lights, which, however, are only required from dusk till 6 p.m., and 6 a.m. till daylight.

H. D. C.

Iron — Augs. 8, 1884.

TRAIN LIGHTING BY ELECTRICITY.

Those who have watched the course of events in respect of railway train lighting by electricity will be aware that several systems have been tried for this purpose, as reported in our columns, and we believe some of them are still under trial. Two systems mainly have been experimented with, variations in detail being introduced as suggested either by inventors or by railway managers. One of these is the secondary or storage battery, of which a number are placed in the train and the light distributed from them. Another system is that of primary batteries, of which we have heard little or nothing of late. Another method of electrically lighting a train is to fit up a dynamo in it and run the lights direct off it, trusting for the motive power needed for the dynamo to the locomotive or to a separate engine fed from the locomotive boiler. This is unsatisfactory. The light cannot be supplied to the train unless when the engine is attached to the carriages, and as this rarely happens until a few moments before the actual starting of a train from the terminus, the carriages are consequently left in darkness at a time when they require light most. The supply is irregular, and there is the necessity for a separate attendant, whose wages do not stand the plan as too costly. We do not begin that a system has been tried on which a separate engine and boiler were used, but we are not aware that any practical progress has been made in this direction. The system of train lighting by electricity by means of accumulators has been in use on the Brighton Railway for the past two years, having been applied to the Pullman train, as reported by us at the time. It has, however, been found to be slow, inconvenient, and expensive. In the first place, a steam engine is required for the dynamo to charge the cells. Next, there is the rental premises and the wages of an attendant. Then there is the cost of carrying to and from the train the cells when charged and discharged, and the injury occasioned to them therefrom, for while it is admitted that the travelling in the train does not appear to affect the cells perfectly, it is beyond dispute that repeatedly shifting the position of cells must be most undesirable.

These drawbacks long since presented themselves to the mind of Mr. Stroudley, the locomotive superintendent of the Brighton railway, but he saw that both the economic and the direct dynamo system possessed advantages which, if the two systems could be blended, might produce satisfactory results. In conjunction, therefore, with Mr. Houghton, Mr. Stroudley has devised and perfected such a combined system, and it has been carefully and successfully tried on the Brighton line. The system — which is being introduced by the Railway Electrical Contracting Company, Limited, 4, Great Winchester Street, London—comprises the utilisation of power from the axle of the engine by an arrangement of belting and shafting on to the spindle of the dynamo. The working apparatus consists of a dynamo machine of the necessary electro-motive force to give a sufficiently current never to absorb the accumulator (if when no light is required), and to add to such output the requisite supply of current when the whole of the lamps are on. Beyond this, and most automatically excites the field magnets of the dynamo prior to the closing of the circuit, shuts it out of the circuit until the speed of the train is such as to create an E.M.F. in the dynamo sufficient to charge the cells, or when the speed is so reduced that the E.M.F. of the dynamo is less than that of the cells, then to cut the dynamo out of the circuit, as otherwise the cells would play back on to the dynamo. The apparatus also prevents any excess of current being generated in the dynamo when the train is running at an abnormally great speed. The accumulator or store being always kept full or well filled, a light can therefore be obtained while the dynamo is not at work, and without the necessity of the engine being attached to the train. The only attention that is required is at the terminus, when the brushes of the dynamo have to be looked at[illegible] to see that they have preserved their proper angle. During the day-time, when the light is only needed when passing through a tunnel, the guard can, by turning the handle or lever of a simple switch, put the light on, and by reversing the lever it can be shut off. At night, when a constant light is wanted, the switch is kept on continuously, and the accumulator and dynamo working in conjunction supply the current. Another important feature of the apparatus is that it is automatically reversible, and consequently works no matter in which direction the train is going.

The installation itself consists of a specially modified form of Brush dynamo, a storage battery consisting of twenty of the Electrical Power Storage Company's cells, and the automatic apparatus, the whole being fitted in a portion of the guard's brake van. The connections between the carriages are so constructed that they can easily be uncoupled, and in slip carriages will be so automatically. Two trains on the Brighton line have been fitted up on this system, a local and an express train. The local train commenced running on November 29, 1883, and has worked without cessation ever since. During the foggy weather the light was often burning from two or three o'clock in the afternoon until midnight, and we are informed that there has never been a failure at any time. The express train which has been now fitted up is so arranged that there are two lights to each compartment, to prevent the possibility of a compartment being left in the dark owing to the breakage of a lamp. The present lamp glasses and holes in the roof of the carriage are also utilised, and the electric lamps may be removed and replaced by a man on the roof quite readily. Altogether the plan appears to be a success, and to present the best solution to the question of train lighting by electricity that has yet been advanced.

Dundee — August 21, 1882.

ELECTRIC LIGHTING FOR STEAMSHIPS.

At the first meeting of the session of the Institution of Civil Engineers, on November 11, Mr. J. W. Barzalgette, C.B., president, in the chair, a paper was read on "Electric Lighting for Steamships," by Mr. Andrew Jamieson, C.E., F.R.S.E. The author commenced with the statement, although it was not more than three years since the first application of incandescence electric lighting to the general illumination of steamships, many reasons had arisen which had been as universally adopted as the advantages accruing therefrom had been as universally recognised. The daily cleaning and replenishing of lamps, as well as the keeping in store of highly inflammable oils, paraffin, or candles, could be a greater extent be dispensed with. 4. The expense of maintenance was not much in excess of that of the other methods of illumination (in some cases less), whilst the space occupied by the plant was not great, and its position near at, or in the engine-room caused no annoyance to passengers.

In fitting the dynamo which furnished the electricity for feeding the incandescence lamps had to be driven at a sufficiently high velocity, either the ship's main engine, or, as in the donkey nor winch-engines, were suitable for the purpose. The dynamo must have an engine for itself. In most cases, necessary to place this special engine and the dynamo in such a position that the man on watch at the main engines could, with a minimum of trouble, attend to the working of the electric plant. This position, therefore, was naturally somewhere near the starboard engine, and as close to the ship's frame, so that any excessive vibration and noise might be avoided. Frequently a second dynamo would be provided, either immediately beside the main starting platform or opposite to the thrust block, or, in cases where screw-shaft tunnel does not exist, in large installations would it pay to have on board an electrician to attend to the working of the dynamos, for, as a rule, and in most cases a convenient and cool position was generally selected for the dynamo, in the same compartment as the main engines or near the refrigerating machinery, if such should be on board, so that one man might attend to the whole of the machinery. Where practicable, the axes of dynamos with large, heavy armatures should be placed fore and aft, to obviate as much as possible the effects of gyrostatic action, since the engines would then be working with the greatest advantage. The author here gave Sir William Thomson's formula and example, to show the pressure produced on the dynamo bearings, under different circumstances, by a gyrostatic action.

In selecting a dynamo, it was necessary to determine its suitability for the fulfilled certain requirements:—(1) It must develop electromotive force suitable for a certain lamp when driven at a certain definite speed. (2) must be self-regulating; that was, the electromotive force generated by the machine must remain constant to within 2 per cent., whether working one lamp or more, or the full number of lamps. (3) The machine must be of a light build as electromotive force to the number of lamps was reduced. (5) There must be no sensible sparks at the commutator-brushes. (6) When running light, or with less than the full number of lamps, there must be no undue heating of the armature. (7) The conductivity of the copper wire with which it was covered must not be less than 95 per cent. of pure copper. (8) The insulation-resistance of the armature and electro-magnets should not be less than 10,000 ohms per volt generated at the required speed. The dynamo should be tested mechanically and electrically, and then, when placed on board ship, and afterwards, when fixed in position, by a final trial of not less than six hours' duration, with its own engine, and with all the lamps in circuit. There was considerable discord of opinion regarding the limit of speed of a dynamo on board ship. As a consequence of the general desire for low speeds, most of the best forms of dynamos, the Siemens, the Edison, the Edison-Hopkinson, the Victoria, the Gerard-Siemens, and the Brush-Rickmeyer, had been specially modified for ship use, so as to produce the required electromotive force and current. At speeds varying from four hundred to six hundred and fifty revolutions per minute, the number of failures of an installation of any kind attended so much upon the engine as upon the dynamo, and every care should be taken to procure one that needed the minimum of attention, and was not likely to break down. The engine should be capable of driving the dynamo from Glasgow to Australia and back, without a hitch and without overheating. The demand for small engines specially for these driving direct, had led to the production of a class of machinery, many of which it is unfortunately to be[illegible] frequently necessary that the engine should be capable of driving the dynamo when supplied with steam either from the main boilers or from the donkey-boilers, so that the electric light might be kept in operation when the ship was in port. The author here referred to various suitable engines, and then to the size of the engine best suited for driving the dynamo. One of the most important attributes to the engine was its governor. It should be sufficiently sensitive to enable it to keep the engine within 5 per cent. of its normal speed, with a load varying 50 per cent., and a boiler-pressure varying 10 lbs. per square inch. No one mechanical governor, and consequently a good electrical governor, which would act automatically upon the throttle-valve, to perform unintermittent work with the load, or when required to do so, and leave the valve in the position until a change was made either in the load or in the steam-pressure, was greatly to be desired. The author showed how this difficulty had been solved by means of his electrical governor.

Then were detailed the different methods of driving dynamos on board ship by belts, ropes, gearing, direct from fast-speed engines, such as Rothenfield's and Worthington's steam-pumps, and from slow-speed engines, by various applications or methods of fitting leading wires into vessels, including a method which, in some cases in place of the steamship *Arabistan* and the steamship *Arcadia*, and gave a practical rule which he had been in the habit of using for the dimensions of such wires. Insulation-resistance was too often neglected by electric-light engineers. Amongst submarine telegraph engineers it was considered of vital importance to obtain high insulation resistances with the most rigid accuracy, not only during the manufacture of a cable, but during its submersion, and after it had been laid; whereas, in the case of electric lighting, those charged with the fitting up of an installation gave little thought of, or even knew how to take, insulation tests, either of the dynamo or of the leading wires. It was far from right to allow leads to be run up like bell-wires, without the slightest knowledge as to whether a screw or a knife had crept in; and all engineers should insist upon rigid inspection, as well as thorough and searching tests, before an installation was passed. The insulation-resistance standard need not be nearly so high as in the case of submarine cables; but, nevertheless, it did require to be several hundred times more than the copper resistance, otherwise there would soon develop and short circuiting occur, under the combined influence of the electromotive force and damp or wet. The dielectric should, therefore, in addition to having good insulating properties, be highly water-tight, and as little affected as possible to be affected by atmospheric changes. The author then gave a description of what he had found to be the best form of switches, fusible plugs, lamp-holders, fasteners, and glasses. Finally, he directed attention to the powerful search lights used on board men-of-war, and to the more sophisticated use of lighting for salvage and fishing purposes. The paper was illustrated by a large number of diagrams.

The Engineer — May 13, 1882.
2 York Buildings, Adelphi, W.C.

THE ELECTRIC LIGHT.

An Exhibition Last Night that Reveals the People of York With Admiration.

Our people have treated last night with the grandest electric light exhibition ever shown in York. The Overland Electric Light Company, who are introducing the Edison incandescent light, gave an exhibition of their powerful illuminant last night from THE AGE office, which was satisfactory in every particular. This was the first exhibition ever given in York with lamps arranged in groups upon the gas fixtures and hand lamps. The light is really powerful and steady, and in such a treat and as superior to gas as to make that illuminant look very sick and dull.

Crowds of people visited THE AGE office where the dynamo was located, to witness the light and workings of the wonderful machine. Crowds of spectators were also at the Morris drug store and Hoffman's clothing store, and went into ecstacy over the brilliant scene there presented. The exhibition last night was given at a disadvantage, as our press room and engine house is so crowded with machinery as to give but little room for the manipulation of the dynamo and attachments. The pulleys on the shaft for driving the dynamo were not sufficiently large to give the requisite speed required, and the engine had to be run at a very high rate of speed, making over 200 revolutions per minute, which used up steam very fast. Notwithstanding the hurried trial and the imperfect arrangements made, it resulted most satisfactorily, and only one stop was made in the three and a-half hours run. An engine running at such a high rate of speed is very likely to encounter hot boxes and journals, but there was no difficulty of this kind last night, and the whole machinery, engine and dynamo, behaved admirably.

The dynamo and exhibition is under the superintendence of Mr. Joseph Gunther, a thoroughly practical electrician. Another exhibition will be given to-night at the same places as last night.

Now that our people have seen the light, and are satisfied that it is better, safer, cleaner and cheaper than gas, the question is, are they ready to encourage the company in going ahead with and making a plant large enough to supply every store, and private residence in town? If sufficient business is guaranteed the company will be ready in thirty days to furnish a plant that will put you in a light that puts out the fame of gas. Turn it off or on at will, without the use of a match—a light from which there is no danger. Turn for it in any other way. We hope our people will encourage the company, which is a local one, and composed of citizens of York. The price will be as cheap as gas, and the service much better.

IRON.

No. 603.

LONDON, FRIDAY, AUGUST 1, 1884.

THE ELECTRIC LIGHT FOR AMBULANCE WORK.

IT is hardly necessary for us to point out that army ambulance work presents a high degree of perfection, and that the eminent humanity on the battlefield is well served by those who are attached to the corps or are connected with the army medical department. But there are circumstances in which the best intentions fail, and the most resolute endeavours are sometimes frustrated from a cause at present entirely beyond control, namely, the want of an efficient light. We refer here to that part of ambulance work which relates to the search for the wounded on the battlefield at nightfall after an engagement. Now, it is a matter of fact that in a driving rain or a heavy wind the field lanterns are frequently extinguished, so that the work of humanity has to be carried on under almost prohibitory conditions. Even if the rain or wind were quite stopped, in this respect electricity now steps in and promises to render invaluable aid in rendering the necessities of the wounded to be efficiently attended to on the field of battle. In darkness such as that which enveloped the battlefield of Sedan, and last year afforded the opportunity of demonstrating for the first time the use to which the electric light might be turned in enabling the necessities of the wounded to be attended to on a field of action at night time. The Viennese Volunteer Society for Aiding Life in Time of Warwill on February 20 next, have organised a demonstration for putting this application of the electric light to practical test. The demonstration was given with an electric light waggon, as constructed for military purposes in France by Messrs. Sautter, Lemonier & Co., of Paris. The French army and navy have long possessed thirty of these electric light waggons for use in the defence of their fortresses and magazines, and a certain number of similar electric light waggons, though of a different pattern, is employed in the military equipment of the German army. The Vienna demonstration took place in October 1883, and proved a thoroughly successful one. The night was foggy, but the light was found to be sufficient, in spite of the darkness and fog, for everything to be done by the medical staff and transport departments that was needed. The experiments were organised by Baron Mundy, to whom it has since occurred that the Health Exhibition might be made the occasion for introducing the electric light waggon in England, and more especially for making known its applicability to the purposes to which we have referred. On behalf, therefore, of the Viennese Volunteer Society for Saving Life, Baron Mundy took the necessary steps for composing his commendable scheme, and with the active co-operation and assistance of Mr. John Furley, a waggon was sent from Paris, the necessary fuel was also sent over for the purpose, and for exhibiting the light and its application in England, being provided by the National Society for Aid to Sick and Wounded in War.

Messrs. Sautter, Lemonier's electric light waggon consists of a wrought iron travelling carriage upon which is fitted a Field Artillery Motherhood three-cylinder engine of 3 horse-power is also mounted upon the carriage, together with a Gramme dynamo-machine, driven direct from the engine. The arc lamp is carried on the waggon, but is removable for use at any desired point, the practice being to operate at a distance from the waggon. The light from the carbons is not thrown direct on to the field, but is reabsorbed in a small concave reflector on whence it is reflected on to a larger one, the rays from which are thrown forward on to the object to be illuminated in a concentrated form, and portions comparatively limited from a circle of 300 yards in diameter. It is this form of light that is used for examining and bandaging the wounded, but for making the search the light is diffused over an area about three times as large by means of a lens which is hinged to the lamp and in fact forms its door. In order to give a practical demonstration of this light in England it was rightly thought that Aldershot presented the best possible facilities for the purpose. The authorities were, therefore, communicated with, and the lieutenant-general commanding Highness the Field Marshal Commanding-in-Chief, sanctioned and ordered through the Director-General, the Deputy Army Hospital Corps, Aldershot, a thorough trial of the apparatus with reference to its fitness for the purposes of military surgery. The demonstration of July 24, Baron Mundy personally superintending the working of the light. Surgeon H. T. O. Cross, A.M.D., was detailed to direct the tents and to report upon the demonstration by Surgeon F. B. Conolly, A.M.D., and Woolhouse and Beeson took charge of the experiments. A number of guests were invited to dine with the officers of the Medical Department, and afterwards to witness the demonstrations. Among these present were General Mackinnon, C.B., Sir Hugh Low, Dr. Crawford (Director-General of the Army Medical Department), Dr. Farquharson, M.P., A.M.D., Professor Longmore, C.B., Mr. Lieutenant Maclure, Commissary-General Major-General de Lint (the Russian military Inglis Irvine, and H. Gilmore, of the Peninsular Society.

We have said that Aldershot offers for such a demonstration, and this not on the presence of the troops and of the army department, but to the formation of the of the northern side of a valley stands the the moveable field hospital, consisting of up for the various purposes connected with ment of the wounded. About a third of ward of the field hospital was the dressing about a quarter of a mile to the south and down in the valley was the ambulance From this point the ground rises to the forming what is known as Rodan Hill, constituted the field of the imaginary electric light station was on the bottom of valley, the distance between the light's of the hill being nearly a mile. The volume is of from 2,000 to 3,500 candle power, of illumination is from 2,000 to 3,000 candle power, the application of wagon in searching for, succouring, and 100 men acting as wounded from the dressing station on the night after a sup by a hearty colonial meal at 8.30 p.m., with nude, mountain, and wheeled transport. The demonstration commenced at 9.30 p.m., the night being very dark but starry, with wind, and occasional very frightening to the men. The first column marched out from the field hospital, which was supposed to be established about six miles from Rodan Hill, where the imaginary action had just taken place. At this point we have previously pointed out, which was assumed to be about two miles from Rodan Hill, a dressing station was detached from the column. The column then proceeded to the front, and the mile (assumed) of the battle-field, where the collecting station was formed with the ambulance waggons of the first line. From this station the bearers advanced to the field with litters to search for the wounded. A large volume of light from the electric lamp naturally aided the bearers, not only in their search for the wounded, but in applying temporary dressings to the imaginary wounds. The nature of the wounds had been easily ascertained had they existed. Beyond this the conveyance of the wounded would have required higher surgical skill to have been brought to bear on the more serious cases, and present ease of necessary. The work was very easily performed, as the investigation of the numerous little groups dotted over the hill-side was made. It would be, moreover, that the men were well up to their work in applying the temporary dressings to the various cases of assumed burns, hæmorrhages, fractures, and limbs coming in the later stages of action and bandages. The passive and helpless attitudes assumed by the supposed wounded as they were being bandaged with white linen, and also whilst under transport, gave a strong semblance of reality to the scene, the illusion only being dispelled by the joke of a comrade as he finished his work. From the battle-field the wounded were conveyed down to the collecting station, some being lifted, while the transport out of the more seriously wounded was effected by means of litters, cacolets, stretchers, and improvised methods. The cacolet is an arrangement consisting of a seat on each side of a horse in which such are able to sit are placed and stepped on to after the fashion of children in swings. Others placed in stretchers were carried full length on either side of a mule or conveyed upon a litter. At the collecting station the ambulances were loaded and carried the wounded to the dressing station where the necessary operations were supposed to be performed and more elaborate dressings applied. Considerable pleasure existed between the collecting station and the battle-field round the whole of the hundred wounded men had been brought in. From the dressing station

Progressive Age - Jan. - 1884

DO EXAGGERATIONS PAY?

The following from the *Public Ledger* of this city contains a lesson that it would be well for more than one journal to take to heart. It says:

A technical paper commenting upon the exaggerated stories of dangers lurking in conductors for electric light says: "Electricity, always a subtle and mysterious agent, suddenly became in the eyes of the people a novel mystery and bug-bear. It is for the interest of all engaged in dealing with electrical energies to endeavor to subdue this needless alarm." Exactly so, but the best method of allaying needless alarm is to tell the exact truth. The practice heretofore has been to meet exaggerations with sweeping denials, plainly false in themselves. It is the truth alone that is needed to allay such apprehensions as should not be felt. Just so long as electric-light companies and their representatives declare that there is no danger in naked wires carrying currents capable of overcoming the resistance of as many as forty arc-lights, they may expect to be met with facts frequently exaggerated, that go to disprove their assertions. It has a very ugly enough proved that two can play at the game of exaggeration; and it is only a game, after all. It would be better to give it up, and be re-born to facts and business.

There is too much of this exaggeration business all around, and we are inclined, as we always have been, to the belief as expressed by the *Ledger* that the original source of the exaggeration lies within the electric camp. We do not take the *Ledger* lesson as intended for ourselves; for, although this journal for the past year has been an ardent advocate of the best and purest kind of gas for all possible purposes, its columns have not contained a single statement concerning any of the various electric systems that cannot be sustained and proven. We have made statements that have been repudiated by the electric-light folks and which have called forth several attempts termed "answers," but which for the most part have been merely volleys of vituperation. We have not indulged in billingsgate. Our staff, "from captain down to powder-boy," has been differently trained. We have simply held on our even way of truth-telling, and to-day as always we challenge any reader of this journal—and we have a goodly number of the electric-light folks on our subscription-list—to find in its columns a single word inimical to any system of lighting that the Western Department has opposed, that can be termed exaggeration. This invitation is open to our rival-gas friends as well as all others.

Perhaps the hardest words we have printed about any of the electric-lighting systems have concerned the Edison incandescent and its sprawling attempts to pull down gas-light stocks in New York. Our New York correspondent, who is a thoroughly gentleman and thoroughly posted in what he writes of, has given us some pretty hard facts concerning the Edison, and we have printed them just as he has sent them on. In this issue, in our correspondence columns, will be found one of the sequels to this gentleman's *expose* given in the November issue of the JOURNAL. We trust the inquiry made in this instance will be found sufficiently answered. If not, our columns will be open for any discussion that does not lead to scandalous advertising. We charge fair rates—and put them,—for our advertising columns. In this Edison matter we think the greatest mistake made by the incandescent folks was in opening their batteries upon a district lighted by water-gas.

In this connection we wish to state that this journal does not intend to and will not enter upon any crusade against the electric-lighting systems. This fact has been given out before in these columns, and we take this opportunity of re-stating our position upon this point. Elsewhere is given the platform of this journal and the interests it will represent. We can find nothing in any of the electric systems conflicting with the real interests of these interests, either in the present or future, and hence there is no reason for belittling the efforts they are making to give the world "more light." We are embarked in the same profession and with the same object in view, though our ways and means are different. We can but look on these electric systems as directly aiding the cause of gas illumination, and this view is borne out by a glance at the growing business of gas companies in all cities where the electric systems have been introduced. We believe there is a field for the electric light, and we shall not only not put a single stumbling-block in its path, but stand ready to aid in rolling away the stumbling-blocks that already lie therein.

Water gas and electricity have much in common, and the future will be found to bear out this assertion. While, however, we have naught but good-will too and for light that is older than gas-light, we shall take no hand in bolstering up its false pretenses and its exaggerated assertions. We shall give fair play all the time, but never foul play, for or against. We will not aid in the dissemination of the false statements put out in behalf of some of these systems, and above all things we will not rate a seven-candle lamp as the equal of a twenty-five candle gas-jet. A system that demands this much from its friends is not wanted within our circle. The gas-systems THE PROGRESSIVE AGE will advocate for the furnishing of light, heat and power, never to false or prevaricating statements to aid their introduction. They stand upon their merits and the merits alone. The electric systems that can so stand will have the co-operation of this journal,—if they wish it. Any system that cannot so stand had better keep on the other side of our fence.

pointing out that he misleads when he says the increase of mileage of 1884 over 1883 is only 140½ miles. He adds :—

"You have further included the Midland Railway as an additional line in March, ignoring the fact that the Midland existed and was self-dependent, as regards the interest on its securities, in 1883."

We should like some facts about the "self-dependence." We certainly do include the Midland as an additional line in a comparison of this year's figures with those of 1883 as stated last year. If not, how account for 280 additional miles of road, as shown in the following table?—

	1883 Miles Worked. Stated in 1883.	1884 Miles worked.
Grand Trunk and Great Western...say	1,255	1,262
Georgian Bay, &c.	1711	1714
Wellington, Grey, and Bruce.....	1611	168
Michigan Air	95	100
Montreal and Champlain	1611	624
Midland.....	.....	402
	3,222	3,902

This table shows 140½ miles plus 440 miles of the Midland.

We stated that the inclusion of the five subsidiary lines in this year's monthly revenue statements for two months had yielded £1,860 more than on the mileage as stated in 1883 :—

Net Earnings of Two Months Jan. and Feb., 1883 and 1884, Compared.

Miles.		
2,905 ...	Net Earnings in 1884 (Two Months)	£117,783
2,765 ...	— 1883 (Two Months).....	115,923
140	Miles more in 1884 than in 1883 Yields a Net Increase for 1884 of	£1,860

We may add that the adjusted statement of 1883 figures as given this year, compared with the statement as rendered in 1883, shows a net receipt of £8,600 in two months of 1883 on the 440 miles of Midland line then worked, or, say, about half the amount required to cover the bond interest of that Company. We tabulate the figures for reference, thus :—

Two Months' (Jan. and Feb., 1883) Net Earnings.

Miles.		
2,765 ...	Adjusted Statement, lately published ...	£117,518
2,325 ...	Statement as given in 1883	110,912
440	Miles of Midland Company Produced Net Earnings of	£8,606

On Tuesday, at the meeting, we had an answer to our demand for information respecting the interest charge on the subsidiary lines, though the facts were not so clearly stated as they might have been. Hamilton, Niles, St. Catharines and St. Lawrence, Buffalo and Lake Huron, and one or two small lines, requiring about £75,000 for interest, or, say, £37,500 for the half-year. The bond interest on five subsidiary lines we are now told is £78,200 for the current half, or about £13,000 a month. So we have an approximate visible half-year's charge of :—

Rentals—Atlantic and St. Lawrence, &c....	£75,000
Interest—Midland, Michigan Air, Georgian Bay, Montreal and Champlain, and Wellington ...	78,200
Total Rentals item for June, 1884....	£153,200

This £153,200 will compare with £83,814, the item for "rents" in the net revenue statement for the first half of 1883, which, however, did not contain the receipts of the Midland (40 miles and the 140½ miles referred to above.

A valuable item of information given by the President was that the Chicago and Grand Trunk, although in 1883 it paid off £10,274, is still indebted to the Grand Trunk £67,726 for interest paid by the latter during the period when the Chicago extension was not earning sufficient to cover its bond charges. Why, we would ask, has this fact been so long withheld from the proprietors? How has it happened that, with this debt accumulating half-year by half-year, credit has been taken in the Grand Trunk accounts for Chicago and Grand Trunk bond interest, as if it had been earned and received? We directed attention to the Chicago and Grand Trunk deficits on May 12th last year (*Statist*, page 522), and have asked again and again for particulars. Now we have them; and we see how ridiculous were the estimates made about eighteen months ago as to the imminent dividends on Chicago and Grand Trunk Ordinary Stock, even although the Chicago and Grand Trunk gross earnings in 1883 exceeded those of 1882 by just £118,000. Meanwhile, the Grand Trunk proprietors have been kept in the dark for eighteen months or two years, and have been beloaded with sanguine statements from quarters where either this debt of £78,000 must have been known of, —in which case the calculator who misled the public must be called by a hard name; or, if he did not know of it, he must accept the cap and bells. But we are dealing with the Company now, and we must say that particulars of a debt of such an amount is information which is manifestly withheld from their proprietors by Companies of respectable reputation." If any more similar debts are possible, the proprietors ought to insist on having the detailed information given them in the report.

Space will not admit of our considering the position of the 1,562 miles of roads none of which, we said, are worked on traffic guarantees. Last year the Grand Trunk Company hardly issued monthly statements of two of the Companies out of the six we named. More information might be given in future reports as to the North Shore and the Montreal and Sorel lines. The conditions between the Canada Atlantic, also the Central Vermont and the Grand Trunk Company too are little understood here. The Secretary says the Canada Pacific Company has not made arrangements with the Grand Trunk to acquire the North Shore road. By latest advices from Canada, we learn that it is expected another line is to be laid parallel to the North Shore, making three roads between Montreal and Quebec.

We have only endeavoured to do our duty in directing attention to the inadequate information afforded by the Company to the Shareholders—really a mild way of putting the case. One really might with justice express the opinion that the Company had resorted to *suppression vari*, even if its enabling interest-sheet debt was accumulating was not tantamount to *suggestio falsi*. Friends of the Grand Trunk Company have made much absurd calculations, and have caused so much misapprehension as to the real position, that we have endeavoured to warn the public against accepting misleading prophecies of only present things in the future. We have sought to tell the public the truth, so far as we have been able to dig it out of the well of meagre evidence, and we have warned them for months past of coming competition. It is now recognised that competition between Montreal and Chicago will be watered at once. We retain our opinion that the Grand Trunk policy of acquisition of subsidiary roads, which do not secure all their own bond interest, has failed in the main object of averting competition.

ELECTRIC LIGHT COMPANIES' PROSPECTS.

In returning to the subject of Electric Lighting, which we considered in our issue of April 12th—principally in connection with the Report and accounts of the Hammond Company—we now revert to the position of the Anglo-American Brush Electric Light Corporation, which, financially considered (as we have already shown) to be briefly summarised, as at December 31st last, as follows:—Against assets in hand in the shape of plant and buildings, stock, book-debts, and cash, amounting together to £129,549, the liabilities to creditors were only £7,898, and to Shareholders on capital account £118,277. This latter, we may here repeat, is on 7,791 shares of £5 fully paid (reduced from £10), and 26,992 shares of £3 with £2 paid (reduced from £8). With reference to this particular part of the subject, we confess we cannot follow the Chairman's line of argument in support of his proposal for the holders of the partly-paid shares to pay up their balances, as an advantage to themselves; although, of course, if the Company requires and can make good use of further capital (which is not represented as being the case), such a recommendation can be understood. This, however, is a point on which Shareholders must wait, if not to obtain the necessary information and decide for themselves. Neither do we by any means agree with the proposition, which has been informally mooted, to continue the system of extra remuneration to Directors when profits exceed a certain point. Any reason or excuse there may have been for such extra remuneration in the past, now, we imagine, no longer exists. The alleviation suggested with reference to this point would have the effect of giving the Directors a claim on profits when these are of only half the amount fixed under the old plan, 10 per cent. on the reduced capital representing an amount equal to 5 per cent. on the old. We suggest, however, that this is an undesirable method of remunerating Directors, which it would be better to abolish altogether.

As in the case of the Hammond Company, the process of "writing-off" in recognition of depreciation, &c., has been of a decidedly drastic nature—to the extent of £22,300 on patents, £8,300 on plant and buildings, and £17,200 on stock, making, with sundry liquidations of accounts, a total of upwards of £295,000 carried to the debit of profit

Engineering - Dec. 26, 1884

ELECTRIC LIGHTING NOTES.

ELECTRIC LIGHTING AT LAMBS.

A PERMANENT and very successful electric lighting installation has recently been carried out in the south of London, for the business premises of Messrs. Lamb, Limited, Incandescents, having been entirely fitted up with incandescence lamps. There are 32 lamps, each of 20 candle-power. Sixteen lamps are always running, and the remaining six are disposed in different parts of the premises. The dynamo used is an "A" Gramme, which is capable of giving current to thirty 20 candle-power lamps when running at the rate of 700 revolutions per minute. Power is obtained from a 7-horse engine of the horse-power nominal, and fitted with patent governor. Besides the six incandescence lamps already referred to, which principally form the auxiliary circuit, it also embraces a Jamin arc lamp of 1000 candle-power placed in the front shop on special occasions for lighting the street outside.

CONNECTING FOR PRIVATE ELECTRIC LIGHTING.

The question of allowing private electric lighting firms to run overhead wires or to open streets to lay conductors, was brought under the consideration of the Town Council of Glasgow at their last meeting. Messrs. Muir and Mossy, of that city, had sought the permission of the public authorities to do both of those things, for the purpose of successfully carrying out a contract which they have entered into for continuing the electric light at the General Post Office in Glasgow. Instead of having their motive power generated on the premises, as has been the case during the past three years or so in the contract originally taken by Messrs. Crompton and Co., they propose to have a power station in Miller-street, a very short distance away from the Post Office, and to lead their conductors either underground or overhead, or both. Their application was first considered by the Statute Labour Committee, and while engaged in their deliberations they adverted to a former minute which they passed when a somewhat similar application was made by Messrs. Mirrlees and Dawson, of Govan. The result of their deliberations was to recommend that Messrs. Muir and Mossy's application be not granted. Mr. Osborne Reynolds is to be informed of the great grounds on which the Committee had arrived at the decision recorded in their minutes. The contractors waited, he said, to take up the streets at once, where they would be at it all the way of every one; and he thought that every member of the council would be agreed that nothing could be more desirable than overhead wires. The question of power to lay wires under the streets was refused because they were to be used for the purposes of a general supply of electric light, whereas the application which they then had before them was one for a specific supply and besides that, the streets would only be opened for a very short distance. Under the circumstances he desired that the matter should be sent back to the Statute Labour committee for further consideration, as he could hardly believe that they had given it the consideration which it deserved, or they certainly would not have refused the authority asked. The convener of the committee replied that the reason which had induced them to refuse the application was simply that the applicants were private contractors, and that it was known that if it were granted other contractors would ask for similar permission. A discussion ensued in which several members took part. Some of them thought that the electric lighting enterprise should be encouraged by granting the permission asked. Another thought that the subject was not ripe for consideration, and he also urged that the corporation should by no means treat new required and erect a rent for the use of them. Two of the speakers urged that the matter should be reconsidered by the committee, and if they or the Police authorities were to ask the permission a reasonable exception might be made in their favour that would not be granted to private persons. It was eventually agreed that the matter should be taken back by the committee.

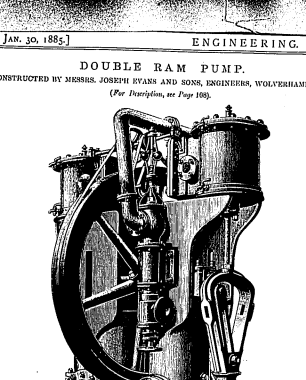
ELECTRIC LIGHTING IN AMERICA.

On Wednesday, the 10th inst., Mr. Preece read a paper at the Society of Arts giving the results of his observations on electric lighting in America. He said that there were probably 90,000 arc lamps in action every night in the States, and that there were many central stations doing a large business, and some even paying dividends to their shareholders. In nearly every case the wires were carried overhead, and the general outdoor installation showed a defiance of basis. The charge per lamp varied from 35*l.* to 60*l.* per annum, and the wires placed on high poles about 50 yards apart on alternate sides of the streets, no other lighting being used. The light was steady. Whilst using high voltage, as in Cleveland, where it was over 2500 it. high, the illumination was very poor. Incandescence lighting has not flourished to the same extent as arc lighting, and it has not been applied to private houses as freely as here. The principal system in practical use was that of Edison, but Mr. Weston was now introducing a new lamp. (This has already been described in our notices of the Philadelphia Exhibition.) The Edison central station, in New York, was opened on September 3, 1882, there havenearly been two and a half hours' stoppage since. There were now 587 subscribers, using altogether 12,761 lamps, served day and night. The price charged was the same as that which would be paid if gas were supplied at 7*s.* 8*d.* per 1000 cubic feet. The price of gas was 3*s.* 2*d.* per 1000 cubic feet. The system was worked at a profit, and during the past twelve months the balance on the right side had been sufficient to pay a dividend of 3 per cent. on the capital invested, but on dividend has yet been declared. The earnings per lamp-hour were 1.01 cents, while the cost of production for the same time was 0.71 cent. The charge made in New York was equivalent to 72*l.* per Board of Trade unit of 1000 volts. The average number of hours of lighting appeared to be 2.4 per day per lamp. A record was kept of every lamp, so that the average life was known, and it came out at about 477 hours. The consumption of coal was .82 lb. per lamp-hour, and there were five lamps per horse-power, rather a low result, due probably to the inefficiency of the old system of condensers. The average number of lamps per subscriber was twenty-one, while the average amount paid annually by each subscriber is 40*l.* The area lighted was about a quarter of a square mile, comprising fifty blocks of buildings and fifteen streets, and the capital invested was 200,000*l.* The system worked upon two more central stations, of much larger dimensions, in the upper part of the city. At Brooklyn, N.Y., there was an installation of 1200 lamps, supplied by three dynamos, in series, the lamps being also in three in series. Overhead wires were used, and the charge was 60*l.* per annum per lamp for each of the 1200 lamps, equivalent to 72*l.* on 2.5 mile, per 1000 cubic feet. At Brockton there was a station with 700 lamps in operation, and 1000 about to be started. The charge was one cent per hour per lamp, and there were 108 subscribers. Mr. Preece said he gave considerable attention to the question of safety, in which the current is measured by the electrolytic action of a fraction of it upon two silver electrodes immersed in a solution of plate of zinc. The method was scientifically accurate, and in practice gave results correct within one per cent. Two men spent their time in New York collecting these bottles, drying them, and weighing them to find the loss. There are 1160 bottles, fifty of which are measured every day. Mr. Swinburne, Mr. Preece is of opinion that the only feasibility of the electric light is amply demonstrated in America, but that it is unreasonable to expect that the great advantages can be obtained in this country at the price of gas. He believes that a greater cost and steady reduction will be made in the cost, and that in time people will find the advantages are worth the extra price.

DOUBLE RAM PUMP.

CONSTRUCTED BY MESSRS. JOSEPH EVANS AND SONS, ENGINEERS, WOLVERHAMPTON.

(*For Description, see Page* 108).



THE SOCIETY OF TELEGRAPH ENGINEERS.

ON Thursday, January 22, Mr. C. E. Spagnoletti, the new President of the Society of Telegraph Engineers and Electricians, delivered his inaugural address in the theatre of the Institution of Civil Engineers. The paper was a general review of the progress of the electrical industries of late years, more especially in the direction of telephony, railway signalling, electric lighting, and the transport of energy by electricity.

In telephony the recent establishment of the London to Brighton trunk line is a new departure which followed on the extended privileges granted to the telephone companies by the late Postmaster-General, the Honorable Mr. Fawcett. We understand that subscribers to the Brighton exchanges can use the new line without extra charge, thus making, as it were, a part and parcel of the metropolitan exchange system. The projected establishment of all-night telephone offices in the West-end, and the probable introduction of public call offices for talking by telephone at a fixed tariff according to the time the instruments are used, are other advances in telephonic development which are likely to ensue in this country.

The high rates at present charged by the telephone companies for the annual hire of the telephone, in exchanges and private wires, were adverted to by Mr. Spagnoletti, who expressed the opinion that these rates stood very largely in the way of the general employment of the telephone.

In telegraphy there was little that is new or late, except the extensive preparations that are being made by the Post Office to meet the requirements of the six-penny telegrams which are to come in August next. These preparations not only include the equipment of the new story added to the General Post Office at St. Martin's-le-Grand, but the erection and laying of new telegraph lines, both aerial and underground.

Railway signalling, a department with which Mr. Spagnoletti is himself intimately associated, has made steady progress of late, and as railway engineers and the directors of railway companies have their eyes opened to the advantages of electric signalling, they are showing greater readiness to adopt new arrangements.

The electric lighting of railway carriages is another still in its infancy, but destined to great importance in the future. There is no reason why a person travelling in a railway carriage should not be as comfortable in respect of heat and light and ventilation as if he were at home. The slight saving effected by providing a feeble glimmer which just enables a person to decipher the type of his newspaper by screwing himself into some uncomfortable attitude, is out of all proportion to the discomfort caused to travellers. Railway travelling ought to be a real pleasure instead of a kind of penalty which people undertake because they must. The delight of motion through new districts and in the fresh air of the country, the feeling of change and expectation, are elements in railway travelling which ought to make it positive and agreeable for its own sake. On the other hand, the uneasy seats, the draughts, and above all the bad light, very seriously neutralise these advantages. If the railway companies would only see that it is to their interests to entice people to travel by turning the journey into a pleasurable experience rather than a mere or less trying ordeal, the point would be grasped, and we should soon enjoy in every railway carriage not only a cushioned seat but efficient heating appliances, and what is still more needful, a bright and cheerful light enabling every passenger to read his book or newspaper in ease and comfort where he sits without the least undue taxation of the eyes.

Electric illumination promises to supply such a light; but Mr. Spagnoletti takes the view that it must be so arranged that however a train is disconnected and broken up or has fresh carriages added, none of the carriages should be in temporary darkness. Dynamos, primary batteries, and accumulators have all been tried for train lighting, but in Mr. Spagnoletti's opinion the problem has not yet been quite satisfactorily solved.

With regard to general electric illumination, Mr. Spagnoletti referred to the changes or as Mr. Ellison termed it, the "throttling" influences of the Electric Lighting Act. It seems tolerably clear that the terms of the Act were such that the money required to introduce the light on a large scale in one of the licensed districts, could have been raised from the public with difficulty; since it was quite problematical whether or not sufficient profits to compensate for the interest could have accrued to them. The recommendations of Lord Thurlow's Committee seem likely, we think, to remedy, if not altogether obviate, the defects which Mr. Chamberlain's Act manifested in the minds of undertakers without sacrificing its real efficacy in preventing the formation of exclusive monopolies.

The experiments of M. Marcel Deprez at Creuil on the transport of energy by electricity were also alluded to by Mr. Spagnoletti, who saw a useful future before Professor Fleeming Jenkin's telpherage system which is now at work on a small scale, and is capable of being used for conveying coals from mines, or slag from furnaces, and such like purposes.

With regard to the Society of Telegraph Engineers itself, Mr. Spagnoletti had only a good record to give. It is rapidly increasing in numbers and influence, and is now one of the youngest of the learned societies.

The Scientific library is being enlarged gradually by the donation, purchase, or exchange of books, and more space will soon be required to accommodate these. Mr. Frost, the librarian, has nearly completed the classified catalogue of which the intention on which he is engaged, a catalogue which will greatly aid to the economy of time in literary labour. It will enable a student to refer to works on special subjects, although he does not know the names of their authors. It is, we think, a serious imperfection in the British Museum catalogue that, in order to find a book on a particular subject, one must know the name of the author, for purposes of research it is the subject which is of most importance to the student, who is frequently ignorant alike of the names of the books treating of it and the names of their authors. The plan in high literature it is oftener the title of the work than the author's name that a reader is likely to know.

Mr. Spagnoletti expressed the hope that the Society would before long possess a lecture-room as well as a library.

Such an institution would no doubt be useful to some members of the Society, especially students. A place to which a student or an inventor can go and make a few experiments to test an idea or verify a fact, would seem in theory to be a real boon, and the satisfaction of a want which has sometimes been felt. We must remember, however, that such a laboratory would have to be at once a free and a private place. To insure its useful character there would have to be very few restrictions or official red-tapism imposed upon its use by

ELECTRIC LIGHTING NOTES.

The Electric Lighting Act.

Soon there came the "Dynamiters," the association of electricians and others interested in electric lighting, appointed a very influential Committee, under the presidency of Lord Hury, to consider the Electric Lighting Act of 1882, and its influence upon the progress of the new industry it was professedly designed to foster, and this Committee have published their report. They have received: 1. That the Act of 1882 may be made workable by the omission or alteration of two or three clauses. 2. That the forced provisional order adopted by the Board of Trade is wisely severe, and requires no amendment in two principal and a few minor points. 3. That the form of provisional order adopted by the Board of Trade proceeds on erroneous interpretation of the third clause of the Act, and should be remodelled. The principal clause to be modified or altered is the 27th, which provides that the whole cost of the undertakers may be compulsorily purchased by the local authority at the end of twenty-one years, or at the end of each seventh year afterwards, at the net value, free of all compensation or goodwill. This means that the undertakers are subjected in for a fraction of what it cost them, and if they are to avoid loss they must commit themselves to an exorbitant sinking fund annual equal to their original capital. If district electric lighting were an established industry of which all the details were understood, there would be still somewhat serious conditions, because a very considerable portion of the term of years must elapse before the enterprise gets into full working, and during that time the provision could be made for its dissolution. But as matters now stand they are simply prohibitory. No sane person would invest money in an unknown industry if he knew that inquiry many and costly experiments to perfect it, and which will be fought tooth and nail by powerful opponents in Parliament, with the certainty that all the profits will go to the municipality, and all the losses to himself. It is simply a case of "heads I win, tails you lose." The Committee therefore expressed the opinion that if the term of twenty-one years should be extended, and they recommend that it be extended in perpetuity, or, in short, be repealed altogether. They also object to Clause 24 by which the undertakers are deprived of all power of controlling the use to which electricity is to be put by consumers. At present if there is no nuisance to be abated, and therefore the only basis of payment is an agreement of as much per horse-power, the kind of lamp being necessarily specified by the undertakers, a system which is distinctly contrary to the interests of the public. The Committee also recommend that when the local authorities are themselves holders of provisional orders, they should not have an absolute veto on applications for licenses in their district. As to the form of provisional order which has been adopted by the Board of Trade, they recommend that it shall be amended by two fundamental points: (1) the provisions as to the compulsory laying down of mains should be altered, and the undertakers should be allowed to determine for themselves what sections are to be laid down; (2) the power to register a supply should be limited to customers who are prepared to take the supply continuously for during 1000 hours in the year at least. The Committee further are of opinion that all inspection of the undertakers' wires and works should be in the hands of the Board of Trade and not of the local authorities. They hold that the Board of Trade has proceeded on an erroneous interpretation of Section 3 of the Act in regard to the limits of area, and they recommend that this should be amended so that the holders of licenses should be permitted, with the consent of the local authority, to use stations for the generation of electricity for supply on any way undertake to give without being required to give any other or public supplies. In undertaking the Committee has not offered a definite working proposition in place of his existing (27th section. All are agreed that it must be modified, and the only question at issue is to what extent should the alteration go. But it is not of the question that it should be simply repealed. There are some who hold likewise the public have a claim has been imperative, matter of electricity that it would not accept any scheme. But of this we have very grave doubts. At present, it is about the maximum interest that can be secured for investments, and the risks are considerable in some respects which will, we should produce a considerable energy competition and pressure, and many available spot in the kingdom would be pounced upon. It would matter little whether there were one hundred undertakers or not, if a steady 10 per cent. dividend in the first few years, with the license in the hands of the local authority, and the control of the provisional order it would be easy to keep the installation in the district. Until some new discovery in electricity intervened to put the whole thing on a perfectly different footing, or the monopoly of the electric light there is no doubt, and would be deferred for many years, and in the meantime those who can well afford to secure their capital by doing the monopoly of the supply at the expense of a present loss. The clause I mention upon which the struggle turns, and until that is settled it is useless to discuss details of provisional orders. We await with confidence the report of Lord Thurlow's Committee on this point, for we expect it will contain a graver sense of responsibility than that possessed by Lord Bury, and Mr. Chamberlain has promised to give their proposals his earnest consideration.

The Electric Light in Industrial Establishments.

It is now universally conceded that the value of electric illumination in industrial establishments is measured by its intrinsic worth in several particulars, each tending to increase or improve the production summed up in the one general phrase rather than its cost in comparison with other methods of lighting. An unexpected merit in electric illumination was recently forced upon the attention of the agent of a large mill corporation in the United States, engaged in manufacturing fine sheetings, who introduced an incandescent electric lighting plant, which lighted about half of the mills, the remainder being lighted as before by gas produced from the destructive distillation of petroleum. He received a letter a short time later from the bleachery where the goods were finished stating that the force of workmen reuse about one-half of their goods appeared dead and lustreless in comparison with the extra finish obtained upon the remainder of the goods, which had been subjected to the same processes. The result of a very careful investigation showed that the unsatisfactory appearance of the cloth was due to the small motes of carbon deposited by the burning gas, and that the freedom from such unsuccessful matter in the mill where the electric light was used rendered possible the more brilliant finish to the goods.

The German Edison Company at Berlin.

Electric illumination is making considerable progress in Germany, and some of the installations recently executed probably count among the largest in Europe. Berlin is about to have a central station for the supply of current for both arc and incandescent lamps, the former Siemens, the latter Edison; and the plant now being erected will be capable of supplying 1800 incandescence lamps, distributed in shops, restaurants, and private houses.

A central installation recently inaugurated is that at Münich, supplying the two chief theatres of the town, the Hof and National Theatre and the Nindtne Theatre, with a total of 2500 incandescent lamps. Steam is generated by three boilers of every 1000 square feet of heating surface each, fired by Bavarian coal, which hitherto could not be used for lighting purposes, being a very poor gas-producing coal. Three high-speed compound engines with a total of about 350 horse-power drive the Edison dynamos of 450 lights each and one smaller size for 250 lights, all of 16 German standard candles each, which is equal to 20 English standard candles. The small machine is chiefly used for night time. The engine-house being nearly 300 yards distant from the theatres, eight underground copper cables of nearly half a square inch area each, well insulated, and laid buried 3 ft. deep below the surface carry the current across and supply a network of nearly 22 miles of leads. The lamps are used all over both houses, on the stages, the auditoriums, and all other offices, rooms, &c. Several are hanging for the purpose of special stage effects are also provided. The Münich Edison installation on the opening day of the two theatres, the 19th of January, gave every satisfaction. We hope in a future number to be able to place before our readers more detailed information relating to this at present largest electric light installation in Germany.

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would dread lost under some contingency it would fetter his action.

Thus in two extreme cases, very far apart, it would seem that the scheme of co-operation before us, in spite of its great theoretical advantages would not work, and if we were to make intermediate examples it would be evident that they bristled with formidable difficulties. The conviction is forced upon us that in social, as in physical questions, a mean in one part of the organised structure cannot take place with an alteration in other parts, and must be very gradual. Changes in our business environments are doubtless taking place, but the present question must have grown much more unsatisfactory than it is, before capital and labour, the most fluid and the most indiscriminating elements of our system, will voluntarily adopt a change, the effects of which cannot be clearly foreseen. Doubtless something of the kind will come, and cautious experiments are to be recommended. The plan of giving managers a consciousness of the profits has worked well for a long time, and affords a machine for extension in time to come, and even to leading hands. Such a trial, if successful, would furnish a base for which a plan such as Mr. Waring's might grow. It is when trouble is very bad indeed, and for the same reason we do not expect to see any earnest attempt at co-operation until the workman feels that his real interests depends upon it, and the capitalist find it to be the only means by which he can employ his money.

ELECTRICAL PROGRESS IN AMERICA.

At the meeting of the Society of Telegraph Engineers and Electricians on Nov. 26, Prof. D. E. Hughes, F.R.S., gave a most interesting discourse on the present condition and future prospects of electrical engineering in America. The author visited America in 1877. In order to meet the heavy tireless of the system, on behalf of the Postal Telegraph Department; and his second visit was made during the recent meeting of the British Association at Montreal and the holding of the Electrical Congress at the Philadelphia Exhibition.

After explaining the work done at both of these scientific gatherings, Mr. Preece went on to speak of the enormous progress which had been developed in the United States, remarking that since 1877 there had been an increase in the number of telephones from 30,000 in 1877 to 433,726 in 1884, while the number of messages per annum has increased from 28 millions, to 48 millions, in the same space of time. The number of offices has risen from 11,000 to 19,000, and the capital invested from 40 millions to 80 millions of dollars. One telegraph novelty had indeed appeared, namely, the system of Professor Hughes. Prof. Preece speaks very favourably of this rapid telegraph, and we hope to try it on the Postal Telegraph lines. The apparatus itself will, we understand, be exhibited at the forthcoming International Inventions Exhibition in South Kensington.

Passing from telegraphs to telephonic operations, Mr. Preece alluded to the recent attempt to set aside Edison's patents on the ground of Dolbear's claim to priority of invention; a claim which has been for ten years before the courts, pending an appeal to the Supreme Court, and Judge Wallace has decided that notwithstanding the testimony of some 200 witnesses who could be called on board, or here after the Dolbear telephones prior to the date of Bell's patents, the evidence was not sufficient to show that Dolbear had not invented a practical telephone prior to that date. The case has been pending for four years, and the interests involved are at present valued at 10 millions sterling. That is a question will, if unnursed, give an impetus to telephony in America by preventing threatened litigation. From 150, the stock of the Bell Company has risen to 270 in less than six months, owing to the termination of the case in the Circuit Court.

The telephone in America (to return to Mr. Preece's lecture) is used on a far more extensive scale than in this country, notwithstanding the fact that it is far more heavily taxed than here, one company being taxed as much as 75 per cent. of its receipts. The reason of this is that it is practically necessary to business, partly owing to the excessive heat during summer. The charges for the use of the telephone are also much higher in America than here, the annual charge for the "law" exchange system employed by lawyers being 120 dols., while the ordinary charge is 250l., as against 20l. in London. In some American towns a service—for example, Philadelphia—the rate is 25l., and in Buffalo they charge by meter as high as 2 cents, or 1d., per message, according as the minimum number of calls is 600, 1000, and over 1000 per annum.

The exchange system is very promptly worked in America, the maximum time of "putting through" being four seconds, as in Brussels and Berlin. There are 10,000 subscribers to the exchanges of New York alone, whereas in all England there are only 11,000. In the whole United States there are 97,400 circuits, comprising 90,000 miles of wire, and some 517,000 instruments have been manufactured.

Turning to electric lighting, Mr. Preece remarked upon the extraordinary progress it has made in the United States as compared with Great Britain. There are some 80,000 arc lamps alight every night in the States, and in most of the large cities they are in constant use, and are brilliantly lighted by them. The contrast between New York and London in this respect was, as Mr. Preece stated in a recent lecture to the Society of Arts, most depressing. "On the night of October 21st," he said, "I drove from the Windsor Hotel, down 5th avenue, the Cunard Wharf, a distance of about four miles, through streets entirely lighted by electricity. On October 30th I drove from Euston to Waterloo without seeing a single electric light." One manufacturer told him that he was turning out 800,000 carbons for arc lamps per month, and another that the output was 50 arc lamps and 3 dynamos per diem. These are only samples of the items now working regularly, both with arc and incandescent lamps, and where these are established they pay dividends; while the manufacturers seem to be all busy.

The principal systems in use are, for arc, the Brush, Weston, and Thomson-Houston, and there are other systems not so well known on this side of the Atlantic, such as the Hochhausen, the Van de Poel, the Western Electric, the Fuller, and the Sperry. The chief incandescent system employed are the Edison and the Weston.

In his lecture to the Society of Arts, Mr. Preece entered rather more fully into this part of the subject. He first described incandescent lamps as employed in the United States, remarking that since 1877 there had been advances made, notably that the carbons, a remark which is contrary to the received opinion. It is a fact, however, in a scientific rather than a material sense, as Mr. Preece pointed out, and he showed a slide to illustrate it. The Edison dynamos of 1882 were 125 horse-power each, while those now in use are of 350 horse-power each. The Edison lamps of 1882 were 16 candle-power each, while those now in use are of 20 candle-power each

CENTRAL RAILWAY STATION, BUDA-PESTH.

NZ AND CO., ENGINEERS, BUDA-PESTH.

(For Description, see next Page.)

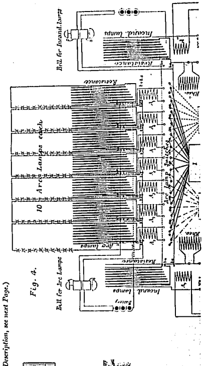

Fig. 4.

ELECTRIC LIGHT AT THE CE
STATION AT BUDA-PESTI

An electric light installation of some
has been in regular work for some time
so far proved very successful; it is t
tion of the new Central Railway Station at
to which we have already previously ref
columns.* It has been carried out by M
and Co., of Buda-Pest, and contains sevent
of 600 standard candle-power each and
descence lamps, of which 250 are of 20 c
and 435 of 12 candle-power each. The ar
distributed as follows: Two outside t
over the entrance, two on the arrival pl
four in the sliding roofs. The departur
which has a roof nearly 100 ft. high, is ligh
gether fourteen arc lamps, of which four
roof and five on each side platform. T
nent way has independent illumination, c
twelve arc lamps mounted upon wrought-
posts 27 ft. high; two more lamps ar
lighting the line on the starting side of t
while ten are placed in the ticket offices an
in the refreshment rooms. The postal offi
four lamps, the luggage offices five, the
waiting-room three, and the covered yard
postal service contains the remaining t
These arc lamps, which are all of the Z
system, are partly constructed for a single
bons, capable of giving light for eight hours;
have double carbons with automatic switc
burn for sixteen hours. The wires are l
arranged in such a manner inside the lam
they are not visible from the outside. T
lamps are divided into seven series of ten l
each lamp working with a current inte
ampères and 40 volts. The main wires ar
and each 0.16 in. in diameter; any lamp ca
of the main circuit, the length of which
750 to 1200 yards, while their aggregat
nearly 12,000 yards.

In the distribution of the incandescence
space to be lighted was carefully consid
lamp of 15 candle-power provided for ever
feet. Every lamp can be cut out of the cir
also any series of lamps be cut out of t
system. The main cable consists of a polis
rod 0.67 in. in diameter, insulated by co
soaked in shellac; this is placed in iron pi
halves, spaced by wood bearings, and the v
up by molten asphalte. Each single lamp
each series, is fitted with a fusible cut-o
the leads are made of such dimensions tha
admit of additional lamps to the extent of l
Figs. 1, 2, and 3 of our illustrations on page
arrangement of the boiler and engine of th
tion. The building is 88 ft. long, 45 ft.
16 ft. high, and is divided by a central wal
equal parts; one containing the three boilers
provided
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as 970 s
two work
or level
ft. chin
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The Iron Age
Oct. 9, 1884

The Cost of the Electric Light in France.

A paper was recently read by M. Ph. Delahaye before the Société Technique de l'Industrie du Gaz en France, says London *Engineering*, giving an account of the progress made by the electric light during 1883. He commenced by a brief account of the inventions of the year, and then turned to the question of expense, as compared with that of gas, founding his conclusions upon figures derived from typical installations. He stated that among manufacturing establishments the installation at the Cail workshops was among the most interesting, as it comprised both arc and incandescence lamps. The total superficial area illuminated is 251,880 square feet, and the number of lights is 177, of which 94 are arc lamps and 83 incandescence lamps. The cost, without land and buildings, was £4900, and the maintenance per hour is 1 07d., for the arcs and 10d. for the incandescence lamps, the power required being 1.38 horse-power for the former, and 10 km. for the second. The total working expense is 19/2, or .003d. per carcel hour (1 carcel equals 9.5 standard candles). The amortization and interest on capital, and the maintenance, taken together at 15 per cent., represent £736. Assuming a mean of 500 hours lighting per annum, there must be added on this account. 0046d. per carcel hour, which will bring the total cost to .0076d. The total expense is £2.44 per hour, or equal to the cost of 7167 cubic feet of gas at 6/9 per 1000 feet, a quantity of gas which M. Delahaye does not think will ever be broght to yield the same amount of light as is furnished by the electricity. He next takes the case of the Grand Magasins du Printemps. The lights burn five hours per day for 300 days in the year; with the exception of 30 Jablochkoff candles in the basement, which are in use nine hours per day. The annual cost for candles, carbons and electric lamps is 60,900 francs (£2436); the cost of the motive power (490,065 horse-power hours) is 39,200 francs (£1568); the expenses of the staff are 33,000 francs (£1320); the amortization and interest, at 10 per cent., 68,400 francs (£2736); and the maintenance, at 5 per cent., 29,200 francs (£1168). The total expense is thus 230,700 francs (£9228). M. Delahaye institutes two comparisons between this and gas lighting. First, he estimates what would be the price of a gas installation and what it would cost per year; and, second, what consumption of gas corresponds to the light furnished by the electricity. In the former case, assuming that there would be 3000 gas burners, giving 9.5 candles each, and taking the price of gas at 6/9 per 1000, and adding thereto 33 per cent. for amortization, interest, supervision, &c., the yearly expense is 221,625 francs (£8865), or almost the same as electricity. According to the latter mode of investigation, the consumption would be 69,509,760 cubic feet. At the price given above, the cost would be £31,015, or three and a half times as much as electricity. Of course such an amount of gas could not be burnt, as it would render the place uninhabitable. M. Delahaye did not adduce any precise instance of incandescence lighting, but he gave a detailed estimate of its cost and came to the conclusion that in an important installation it need not be dearer than gas at Paris rates.

The Iron Age
Sept. 25, 1884

The Electric Light in the Mechernich Mines.

The electric-light installation at the Mechernich mines, in its once volcanic Eifel district in Rhenish Prussia, says *Engineering*, has now had a fair trial for more than three years and has proved a complete success. The expectation that it would both facilitate the operations and increase their security has fully been realized, and an extension of the plant is now being carried out. Messrs. Siemens and Halske, of Berlin, undertook the work. An open working 2000 feet long, 1000 feet wide and over 300 feet deep, in which 300 men and 20 horses are continually occupied, was first to be supplied with the electric light. This part of the mine is excavated in steps, the horizontal terraces being provided with rails. Ordinary lamps in globes on poles were out of the question, as blasting operations continue throughout the day, and the shots would soon have made havoc of the lamps. After several trials two powerful lamps of 3000 candles each were erected at the upper margin of the pit, where they were fairly out of the reach of the projected stones, and reflectors were fixed to throw the light down upon the steps. To find the proper positions for these powerful lamps and to avoid too dark shadows caused some difficulty. But the illumination was finally rendered most efficient, and the open pit, with the light playing on the whitish-gray rock, affords a fine spectacle. As any interruptions, even for short periods, such as those occupied in renewing the lamp carbons, would be dangerous, the whole plant is double, each lamp receiving its current from a D_2 dynamo. No hitch of any kind has occurred, and the safety of the miners has decidedly been augmented. It was formerly not always possible for the superintendents to see whether the loose mass resulting from the blasting operations had been properly removed, and frequent minor accidents arose from the *débris* falling down upon the miners engaged on the step next below. The work can now be controlled much better than before, when petroleum lamps and hand lamps were in use. The cost shows a saving of about 4d. per hour in favor of the electric illumination. The satisfactory results obtained in the open working induced the company to introduce the electric light down in the subterranean galleries. The ore forms little concretions of sand and galena scattered all through the rock; the whole mass has therefore to be brought to day to be disintegrated and sifted, and the mining proceeds in parallel and cross galleries, which are constantly being widened until they become 90 feet in width and 70 feet in hight, by sometimes 300 feet in length. The operations in themselves would not require much light if there was not always danger threatening from loosened pieces of rock. Pitch torches were formerly employed to examine the bore holes and fissures round them after each explosion. It was a question whether the arc lamp would answer for this purpose in the smoky atmosphere. For the first experiments, arc lamps of 3000 and 1000 candles were used, with the positive carbon in the lower holder. The effect was brilliant, yet the light did not penetrate the white smoke cloud which collects at the upper wall immediately after the shot. But as the smoke settles within 10 minutes, it was thought advisable to acquiesce in this interruption of a few minutes, and to use smaller lamps of 350 candles, which proved quite efficient. Of these there are 10 in use, with about 10,000 feet of lead cable, the cable being partially elastic, as the lamps, with their wires, have to be removed when the blasting is to take place. The lamps, were originally supplied with hexagonal lanterns with obscured glass to protect the eyes of the miners. The glasses were, of course, soon broken, but no complaints are said to have been made about the naked electric light.

THE YORK DEMOCRATIC

THE EDISON LIGHT.

ITS WONDERFUL ILLUMINATING POWERS.

And Adaptability to the Use of Stores, Banks, Hotels, and Private Families—Another Grand Exhibition of the Light on Saturday Night.

The exhibition of the wonderful Edison and only incandescent system of electric lighting, on Saturday night last, eclipsed all the former displays of the light made in York. Hoffman's Clothing store and the Morris Drug store were in a blaze of soft, beautiful white light, which illuminated the sidewalk and street to the opposite curb. From the top of the hill on East Market street, looking in the direction of them two stores the difference of the Edison light over that of gas was so marked as to almost leave the impression that the two stores using the electric light were on fire. The same night presented itself from any of the elevated points of view in one looking in the direction of these stores. At THE ERA office, where the dynamo is located, there was a flood of light, to which you could look into for all its transcendent intensity and not tire the eye or affect it in the least, and this is the only light which does not dazzle the eye and blind the sight. The wonders of the dynamo were witnessed by hundreds of people, all of whom were in ecstacies over the simplicity of the arrangement, and the grand results obtained from it. The light speaks for itself, and so magnificently that our people are overwhelmed by its perfection.

We have had exhibitions here of Arc lighting, with its flickering, dazzling and painful effect upon the eyes, and the difference of the Edison incandescent is so marked and so different, that all unprejudiced people vote the Edison the nearest approach of artificial light that of sunlight yet invented.

THE SAFETY OF THE EDISON LIGHT.

There is no danger to life, health, or person, in the current generated by any of the Edison dynamos. The electric current is so feeble that the wires at any part of the system, and even the poles of the generator itself, may be grasped by the naked hand without the least effect; in fact, the current is imperceptible to the touch.

WE MUST HAVE THE LIGHT.

York can now the opportunity to secure this grand illuminant, and it is to be hoped that the opportunity will be taken advantage of. The canvas made among our merchants has met with success. Quite a large number have subscribed for the light. But it should on account of its safety, cleanliness, freedom from odor and great brilliancy find its way into every store, church and dwelling in York. Our street lamps should also contain this light, as it would make our thoroughfares as bright as day and safer than they are under the very inferior gas lamps. The much needed reform in street lighting, however, has a little sleepy position to overcome on the part of some of the gas people in the old Council. When it came to the renewal of the gas contract for the city, the borough was trapped into a three year contract. We question the right of this procedure and hope the Chief Burgers will use his influence to annul it. We have no right to be bound to a monopoly, and compelled to use their inferior light, no matter how bad or inefficient, just because, fearing the electric light would come into York, they would block its way by introducing themselves with a contract for the city lighting with gas for three years. Annul the contract and give us a good light.

SOME OF THE ADVANTAGES OF THE EDISON LIGHT.

Add to this pecuniary economy the healthfulness of the light as compared with that of gas, its freedom from odor and from danger by fire, its steadiness, adaptability, completeness, and beauty, and there can be no doubt that the Edison light is unsurpassed by any other method of artificial lighting whatever.

The advantages of this light are so great that it would occupy our entire paper to enumerate them, we will therefore speak of only a few.

In the cities where this light is now in general use, all the merchants and banking houses have a button placed at some point on the door or window framing known to the policemen on the beat. If the policeman on passing the store or bank hears a noise within or is suspicious of a burglar operating there, he touches the button and turns on every light in the store, allowing him to see all through the place at a glance. In private residences a button is often placed on the head board of a bedstead. Should you need a diurnal light in case of sickness, or by the entrance of a burglar, press the button and you have a light as by magic; and all this you can have just as cheap as gas, and much cheaper when you consider the superiority of the light furnished. Then there is an almost entire absence of heat in the Edison light, which will be a very desirable thing in its favor during the hot nights of summer, especially in the churches and public places.

THE ARC is progressive. Quite a few days ago it was the same as tallow dips, and it is time to shoot the gas and turn on the electric. Other towns and cities around and about York have long since adopted the electric light system, and can't let us lag behind any longer, but light up the town with a decent illuminant.

The gentlemen who are interested in the Edison light are our own citizens. They furnish you the light anyway you want it. Will contract with you for a certain number of lamps by the hour and you in a meter and register as amount you consume. Let us show our storekeepers and everybody in line, and even in the suburbs to use the grand illuminant.

STEAM HEATING.

The company introducing the light will also be able next winter to furnish steam heat for public and private buildings, which is another progressive step, and one that will meet with success. We don't know much about the company's plan of operation, but we learned from what little we have learned, that stock can be purchased and anybody allowed to come in and share in the investment who desires to do so.

INCANDESCENT REFRACTORY SUBSTANCES FOR ILLUMINATING.

A PATENT has been recently taken out in this country, by Otto Pulvermüller (5416, 1883) which has for its subject a method of obtaining or producing light of superior quality by convenient and economical means. We are unable to ascertain whether the patentee has made any practical experiments; but the method seems to be of a promising nature, and we therefore give an account of it for what it may be worth. The invention relates also to the manufacture of suitable refractory substances in the form of small wire, plate, or bands, these being fixed in suitable holders that they may be capable of the necessary adjustment; and secondly to a method of causing the incandescence of these refractory substances by the action of the heat caused by the combustion of the mixture of gases, commonly known as "coal gas" in air, at the ordinary temperature and under the ordinary conditions of the atmosphere.

The substances out of which the small wire or plate are constructed are refractory oxides, such as those of magnesium, calcium, strontium, or silicon, either singly or mixed together in suitable proportions; magnesia has been found to be generally preferable. (Cf. Clamond incandescent light, p. 144, Vol. XXXVI.)

A convenient method of manufacturing the small wires, plates, or bands is by wet mixing the finely-powdered oxide with a solution of starch, gum, or other gelatinous substance, in such proportions as to obtain a plastic mass. By pressing this through a small die, a thread may be obtained of a desired thickness. This thread, while still soft, may be cut into pieces of the required length, and these may be made straight or bent into any desired form. They should then be dried, and afterwards burnt at a high temperature. If the burning be omitted, the wires are liable to twist and bend when exposed to the heat of the "coal gas" flame. A number of these small wires are fixed in rows or rings in a socket, so as to be capable of certain adjustment in order to obtain the full effect of the heat. Both supporting and holding is proved in "combs" the model is contrived of two, which, in other words, are two rows of wires, set into a frame. This is filled with a plastic mass, such as damp clay or magnesia, and the wires are fixed in such a manner as to be capable by inserting one and in the soft mass which is afterwards well dried. The combs may be straight, curved, or circular, according to the kind of burner for which they are intended, and to subject the wires, and they should be provided with some device for the adjustment necessary for fixing them to a support, by which they are suspended in the burner. This support should be capable of being moved at will in every direction, in order that the necessary adjustment of the comb may be thereby obtained. If the wires, pins, or bands are to be used in the form of loops, a comb may be formed by arranging the wires so as to cross each other. The wires may also be mounted on the supports that they may be easily replaced, because as the high temperature of the "coal gas" flame all the refractory substance of which they are composed are more or less volatile.

The modes of producing "water gas" are well known, and have been made the subject of several patents. A convenient method of production is by passing steam over coal or coke at a high temperature, the mixture of gases thereby produced consisting principally of hydrogen and carbonic oxide.

This "water gas" may be conveniently burnt in gas-burners of the form generally used for the combustion of ordinary illuminating coal gas; a modification of burner which has been found preferable is that known as a fish-tail burner.

The Engineer — Sept. 2, 1881

DOMESTIC ELECTRIC LIGHTING.

By Mr. W. H. PREECE, F.R.S.

The author commenced by expressing his surprise that he had been only one example of domestic electric lighting in Canada. In 1879, however, had been the first in England to do this, and before leaving the Continent had followed suit, himself being one of three. Of course, in the first case, there were not what troubles and difficulty would be avoided if a number were estimates to be had in plenty, which were themselves a source of losses, three did not represent the whole aspect of the question. He had built in his garden an engine house, and had placed in it a 3-horse power gas engine and dynamo, the current from the latter being 30 lamps, with an electro-motive force of 42 volts, and consuming 2 horse power. The horse power as the result, which showed a very high efficiency. There was a gas into secondary batteries, and the gardener, when he comes on duty, first charges the gas engine and charges the cells, but Mr. Preece now proposes to have a sufficiently large battery to enable the charging to be done only once a week. The author then proceeded to give an account of various special features in the lighting of his house, and the experience gained. The cost of the whole was £700, the actual cost per lamp was £7 10s., and he could not understand the actual cost was greater, when working twice as much as he was only employed from one-half to one-third of the time, and caused no trouble, it was greatly to be preferred. He spoke of the great tolerance to the progress of electric lighting by the most unfortunate Act of legislation which had been enacted for some time, but in spite of the Act the progress was steadily going ahead, and mentioned some of the places in which this was actually the case.

Under W. Preece, in the discussion on this and the previous papers of Mr. Preece, said it would be vastly more convenient to have a unit of work regardless of a name power, and, about 1866 Watts, instead of dividing constantly by 746, which involved a troublesome sum in division, had proposed to work strongly for the adoption of the electric unit. Speaking of lighting, spoke of the application for the purpose of the water power at Niagara Falls. Canada, and considered it of the highest importance, which was so close to the town of Montreal. He also emphatically endorsed what Mr. Preece had said with reference to the dangerous effect of present legislation with regard to electric lighting. Professor Crompton, the well-known engineer, both spoke of the cost of electricity, the latter saying that a friend had supplied his mews with energy immediately behind his house, and the cost of the whole assembly has cost him 7s. 6d. per week. Professor Crompton mentioned that Mr. Preece had originally wanted to employ a 50-horse power engine for per hour, and produced a light of 32-candle power, whereas if he had used a 10-horse power he found he could produce light, only 24-candle power would have resulted.

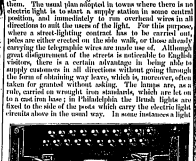
Iron — Aug. 8, 1881

THE WERDERMANN LIGHT FOR THEATRES.—A most successful experiment with Werdermann's illuminant was tried on March 30, at the Athenæum of the Rue des Mathurins, Paris, with the kind permission of Mr. Perrin, the director. The peculiarity of it is that it can be produced at will for scenic effects, either by introducing resistance and so varying the velocity of the Gramme machine. These experiments were witnessed by several influential members of the Municipal Council, who on the following morning proposed an inquiry into the pecuniary advantages of the illuminant compared to light their halls with electricity.

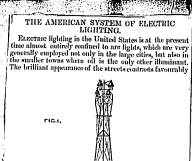
THE ELECTRIC LIGHT AT THE CANNON STREET STATION.—The Electric Lighting Street lights were not the only systems which lighted up on Monday last. Work for the first time. The electric light was also used on the first time on the same evening at the Cannon Street Station. The premises are supplied with 4 Gramme machines and 2 Brockie arc lamps, and the work has been carried out by the British Electric Light Company who own these patents. Eight powerful lights of 6000 candles each are suspended from the roof of the station at a height of about forty feet from the platforms, and there are two lights outside the station. There are two circuits for the two lights, five upon each, and the current for each circuit is produced by one of the large size Gramme machines recently introduced by the British Electric Light Company, which work a number of lights in series. The same class of machines is used by them for lighting Lincoln Station, Manchester, and numerous other places, and for the purpose of lighting the telegraph instrument galleries and letter sorting rooms of the General Post Office. Although as small a number of lights are employed at Cannon Street the station is filled by a brilliant and well-diffused light. Although the British Electric Light Company have taken no part in the City lighting they have entered into a contract with the Liverpool Companies for lighting about 25 miles of the principal streets of that city, and it is expected that the lighting of this large area, with city lamps will commence on the 1st May.

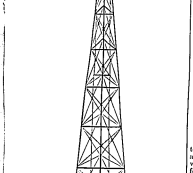
light; still it was found that each of them cost the city just about double what was being paid for electric light. Those torches, as they are called, were set up to show that gas is improved burners could compete successfully with electricity for extensive illumination; but the result has been most disastrous to those concerned in the undertaking. The average price of gas in the United States may be taken at 2·4dls. per 1000 cubic feet; in some places, however, it is customary to allow a rebate for each of 20c. to 30c. per 1000ft. The usual contract price for electric light is 80c.—5s. 7½d.—from dusk to midnight, or 7hr. from dusk to daylight; and this price includes carbons and maintenance of the lamps in good repair. The Street Commissioners of the city of Hartford report: "Where the gas lamps burning twenty-six nights per month cost the city 25·30dls. each per annum, experience shows that each electric light displaces 62 gas lamps, and gives at least ten times the light. At 62c. per night each, these electric lamps burning twenty-eight nights per month instead of twenty six, cost the city 211·20 dls. per annum each, against 227·50 dls. for the 25 gas lamps, showing a net saving of 15·80 dls. per annum for each electric light."

The companies principally engaged in this business are those employing either the Thomson-Houston, Brush, or Maxim-Weston systems; the first, although the latest in the field, is rapidly distancing its competitors both as regards the number of lights maintained and the cost of them. The usual plan adopted in towns where there is no electric light is to erect a supply station in some central position, and immediately to run overhead wires in all directions to suit the users of the light. For this purpose, where a street-lighting contract has to be carried out, poles are either erected on the side walk, or those already carrying the telegraphic wires are made use of. Although a good disfigurement of the streets is noticeable to English visitors, there is a certain advantage in being able to supply customers in all directions without going through the form of obtaining way leave, which is, moreover, often taken for granted without asking. The lamps are, as a rule, carried on wrought iron standards, which are let on to a cast iron base; in Philadelphia the Brush lights are fixed to the side of the posts which carry the electric light circuits above in the usual way. In some instances a light



tower is erected, which is either of an open work design, as shown in Fig. 1, or consists of a central pole, round which the arc lamps swing in a frame, which is lowered for trimming purposes. The tower system does not appear to increase in favour, but has its advantages for open sites, and has been adopted by the authorities for lighting the land of the East River, New York, where the obstructions known as Hell Gate has been removed. The tower in question is of the description illustrated, and is 175ft. high. The question of lighting from central stations has often been discussed, and certain difficulties have been brought forward, such as the noise, and the consequent nuisance in adjoining property. These objections have been met by special arrangement of the machinery, and stations are now found in the most busy streets of the American cities. One of the newest is that erected by Moreland's Light and Power Company, of Boston, which consists of a basement and dynamo-room above, the length of which is 110ft., basement, ventilation being maintained by two fan blowers. Coal is run into bins from the street; it is then mixed, weighed, and transferred to the furnaces by small cars. The engines, which are all of the Armington and Sims pattern, are in the dynamo room, and are in the centre of the room, the Thomson-Houston dynamos being in a long line on each side. The wiring is arranged so that the negative wires from the dynamos run under the floor, as are also the short-circuiting field wires, while the positive wires are run along either wall, and on the ceiling are those leading to the arc lamps, one of each is included in each working circuit. The switch board is of special design, the plugs being used which are so arranged that the circuit can be easily changed, and by means of wire leading from the field magnets to the board, they can be short-circuited so that the current may be interrupted without causing any flash. In smaller installations the distribution switch shown in Fig. 2 is employed, which fulfils the same purpose. When finished, this station will contain sixteen engines and thirty dynamos, each producing thirty lights. There are forty smaller supply stations now at work under license, and as prices of a single system, and only represent the motive power. Very lustrous arc lighting throughout the United States and contrast it with the results obtained during the same period in England. With reference to Fig. 2, it should be noted that the loose handles on each side are slid on the brass pieces





with those in England, as with a very few exceptions are lighting for streets is a thing of the past, and we are relegated to what, under the very best conditions, is a poor substitute, namely, gas. In America, as at home, the gas interest is controlled by powerful companies, and it is to be supposed that these have given up the battle and allowed their electric rivals to obtain the contracts for lighting the streets without great opposition. In New York and Boston large lamps were erected burning each from six to sixteen lights at such gas as the ordinary street burner; the price of gas was cut down to about one-

* This number varies according to the arrangement of wire gear adopted.

ELECTRIC LIGHTING IN THE CITY.

OUR readers are doubtless aware that a portion of the City is to be illuminated experimentally by the aid of electricity. Three districts, in fact, are to be electrically lighted, the first by Brush, a second by the Siemens, and a third by the Lontin light. The Jablochkoff light was to have illuminated one district, but circumstances have arisen which prevent this arrangement being carried out, and the district has been allotted to the Lontin light. The district which has been undertaken by the Anglo-American Brush Electric Light Corporation embraces Blackfriars Bridge, New Bridge Street, Ludgate Circus, Ludgate Hill, Saint Paul's Churchyard (north side), and Cheapside, as far as King Street, and is the second largest of the three districts experimented upon by the City authorities. The lights are thirty-two in number, although forty lights could be maintained on the same circuits. The whole of this section is worked by a single small copper wire strand of 8 B.W.G., and 20,000 feet, or over 3¾ miles, in length, starting from the works of the Anglo-American Company, near Waterloo Station. The whole number of lights are connected in one circuit and worked by one machine, absorbing for the entire circuit about 28 horse-power indicated. The machine is worked by the same engine which works the lights running at Charing Cross and Waterloo Stations, as also all the machinery and the testing circuits of the Company's factory. The lamps are fixed upon the present gas-lamp standards, above which they are raised about 4 feet 5 inches. The street lighting, in fact, is being carried out by the Brush Company, so as to show the utilisation of existing gas standposts with the view of demonstrating how economically a large town gas in the electrical supply and lighting streets can be effected. If it is considered that the present effect would be increased with the higher standards, they can, of course, be easily fixed; but in the experimental trial, both as to gas and lamp-posts, the greatest economy has been aimed at. Keeping this point in view, all the lamps in the district lighted by the Brush Company are of a power which is estimated to be that adopted for such a purposes, but light of any greater degree of power can be substituted if desired.

The district allotted to Messrs. Siemens Brothers and Co. extends from the south side of London Bridge, through King William Street, the Poultry, up to the Guildhall Yard, taking in Queen Street as far as Queen Victoria Street. The number of lights employed is thirty-four, comprising six powerful lights, and twenty-eight smaller ones of about 200 candle power each. The six large lights are mounted on latticed iron poles 80 feet high, two above the level of the street, and are disposed, one in Adelaide Place, a second at the New William Station, a third at the junction of Lombard Street and King William Street, the fourth in front of the Royal Exchange, the fifth by the Mansion House, in Queen Victoria Street, and the sixth in the Guildhall Yard. This last light is nearly three-quarters of a mile from the dynamo-electric machine which creates the current for it. The twenty-eight smaller lights are fixed on iron posts resembling ordinary gas lamp-posts, more so feet from the ground, and interspersed between the larger lights in the best manner to secure a good general illumination. Each large light is supplied by its own dynamo-electric machine, separate conductors being led from the dynamo machines to each large. The twenty-eight smaller lights are arranged in four groups of seven lights each, and are fed from two alternate current machines, each supplying two groups, or fourteen lights. It has been thought advisable to make this subdivision for convenience in working, instead of arranging all the lights in a single group, as could easily have been done.

The regulators, or lamps, are constructed to take carbons of sufficient length to last eighteen hours without renewal. They are enclosed in lanterns fitted with reflectors designed to be internal and throw down the upward and horizontal rays. The lanterns are suspended from the tops of the latticed iron poles by projecting brackets, against which they are drawn tightly to prevent their being blown about by the wind. About 16 feet above the street a platform is fixed to the pole, upon which the lantern is lowered when it becomes necessary to replenish the carbons, guide wires, passing through openings in the collector, being stretched between the platform and the bracket to guide the lantern during its ascent and descent.

The leading wires which convey the current from the dynamo machines to the lamps consist of strands of copper wire coated with gutta-percha. With the exception of London Bridge these conductors are laid for protection in earthen pipes, which run continuously to the furthest lamp. Those crossing London Bridge are provided with an outer sheathing of iron wires and rest upon the broad ledge of the parapet. At the foot of each post is placed a cast iron box, in which the conducting wires from the lamp join those which come from the machine. The electrical generators, and their steam-motors are situated in the basement of a warehouse in Old Swan Lane. With a view to provide against possible accidents, the generators are divided into two equal groups, each of which is driven by a 60-horse power nominal steam-engine by Messrs. Marshall, Sons and Co., of Gainsborough. A third steam-engine of the same power is placed, as a reserve, between the other two, and so arranged as to be able to drive either set of generators, when their own engine requires clearing. In the room over the engines are placed the instruments for measuring the current and for switching it from either dynamo machine to either lamps, and other accessories. Here also indicators are provided so that the electrician in charge can see at a glance if the machinery is working regularly.

Such are the details of two out of the three systems of electric lighting which by their inauguration last evening mark the commencement of the largest and most important experiment in Electric Lighting that has yet been carried out in London. It is to last for a year, and the streets are to be illuminated by the aid of electricity all night, thus entirely superseding gas. The district allotted to the Lontin system comprises Southwark Bridge, Queen Victoria Street, Queen Street Place, and part of Queen Street. This light has taken the place of the Jablochkoff, and was to be in operation by the 31st ult. The lengths of streets covered by the various systems, and the cost of lighting, are as follows:—The Brush system, 1698 yards, at a cost of £1,119; the Siemens system, 1521 yards, at a cost of £3720; the Lontin, 1703 yards, the cost being £2930, the same as was to have been paid for the Jablochkoff light. The total cost of the experiment will thus be £7600—but the expense of gas lighting for the year will be saved. It will be observed that there is a considerable difference in the cost of the three systems. According to the figures furnished, the lighting by the Brush system will not exceed in cost that of the old lighting by gas, the sum to be paid to the Brush Company being fixed upon that basis, viz., £666, an amount which it is stated, will leave a very substantial working profit if the lighting is carried out upon an extensive scale. The total to be paid as above for the year's work, inclusive of installation, is £7416, as compared with a total of £2930, to be paid for the trial of the Lontin system, and £3720 for that of the Siemens system, over an approximately equal area. It will be interesting to see, therefore, whether the lighting by the Brush Company, upon the commercial principle of competing with gas in price, and at same time affording an increased volume of light (the only practically useful result to be attained by these experiments), will commend itself to the public sufficiently to ensure its general adoption. With regard to the appearance of the illumination itself we can only say that it forms a splendid electrical display, the pains being unquestionably carried off by the Brush light. We cannot, however, say that we regard the appearance of the lanterns and some of the standards with feelings of unmixed satisfaction, but when we get the best light fully developed in practice it will perhaps be time enough to criticise its accessories.

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Society of Civil and Mechanical Engineers.—Mr. B. Houghton, on Railway Statistics, 1879.
Royal Institution.—3 p.m. Mr. Tindall, on the Electro-Magnetic Speed, Light, and Heat.
Chemical Society.—8 p.m.
Chemical Society.—8 p.m. Anniversary Meeting.

FRIDAY, MARCH 21.

Royal Institution.—4 p.m. Weekly Meeting. 9 p.m. Dr. William Spottiswoode.
Astronomical Association.—7 p.m. Mr. J. P. Seddon, "On Astronomical Observations."
Royal United Service Institution.—3 p.m. Captain P. H. Colomb R.M., on the Manœuvring Powers of Steam and other Ships.
Institution of Naval Architects.—10 a.m. Annual Meeting (at the Society of Arts).

SATURDAY, MARCH 22.

Royal Institution.—3 p.m. Professor H. G. Seeley, on Vulcanoes.

METALLURGY AND MINING.

Large Make of Steel.—Messrs. Bolckow, Vaughan and Co. have recently produced in one of their large pits the enormous make of over 1700 tons of Cleveland steel, which is probably a larger make than has been turned out of a single pit working an hematite in England.

The Future of Iron.—The following passage, taken from an article on "Dephosphorisation in the Converter," by M. Wahaul, late manager of the Creusot Works, in one of the Valenciennes Steelworks), which appears in the current issue of the *Revue universelle des Mines*, deserves notice, as showing the views of a practical man on the immediate future of iron. M. Wahaul observes:—"Those who are occupied in the manufacture of Bessemer steel know how difficult it is to obtain with regularity the extra soft steel employed for boilers in the French navy. Such metal appears to be made in the Martin furnace, and even then it was necessary to employ picked material in its manufacture. But by the new Thomer dephosphorising (Thomas-Gilchrist) process the same extraordinary degree of softness can be obtained with ordinary material, and at a price less than that of ordinary rail steel. By treating a pig containing from 1·5 to 2 per cent. of phosphorus, we obtain, after the blowing and dephosphorisation is finished, a non-oxydised metal which does not contain more than traces of carbon or manganese. If it be desired that the steel should be entirely free from any tendency to red shortness, we may add from 0·25 to 0·30 per cent. of a rich ferro-manganese to remove any traces of oxygen dissolved. Ready precaution to be taken to obtain a soft steel is to charge pig (if direct working be employed) which contains sufficient manganese (with 2 per cent. as a maximum) or to make a judicious mixture of pigs if capable be employed. But this will be by no means the only outlet for dephosphorised metal, for up to the present time the high price of soft steel has been the obstacle which has prevented many people from employing it in connection. But, by the new process, soft steel can be produced at a less price than ordinary (puddled) iron; therefore, therefore, no longer any reason (apart from routine) why steel should not be employed in place of iron, to which it is so much superior in strength."

ELECTRICITY AND TELEGRAPHY.

A Third Electrical Exhibition.—We learn that Vienna is to have its exhibition of electricity in the coming autumn. A committee has been formed, under the presidency of Count Hans Wilczek, and the Austrian Board of trade has offered the committee every assistance.

Electricity in Railway Travel.—Some important and interesting experiments in the application of electricity as the motive-power of trains have been carried on by Regnyi, on the section of the Eastern Railway of Hungary, between the Tzeyo-Szt-Peter Paths and Gerie. All the trains in carriages were provided with electrical intercommunication and the continuous brakes were worked by electricity, while all the compartments were lighted by electric lamps.

Domestic Electric Lighting.—A lecture on electric incandescent lamps suitable for domestic lighting was delivered in the concert-room of the Crystal Palace on March 15, by Professor Silvanus P. Thompson, of University College, Bristol. So far back as 1841 the attempt had been made to convert little electric lamps by enclosing in glass on the passage of an electric current, grew white hot. This method of procuring light from electric currents was revived in 1845 by Mr. Edison, who at first attempted to construct platinum lamps, which—however, in spite of many ingenious contrivances to protect them from over-heating—could not be kept from fusing up. Eventually Edison, employing carbon filaments in carbon, but not before a similar experiment had been made by Mr. Swan, of Newcastle. Edison arranged his filaments in the bamboo fibre, Swan from cotton thread. In each case the carbonised fibre was fixed in a small glass shaped globe, and exhausted as perfectly as possible of air by a mercurial air-pump. A filament of carbon thus treated became an elastic coil. Similar lamps had been constructed by Lane-Fox and by Maxim, with slight differences of detail in the manufacture. These little lamps gave a light of about equal brightness to one bright gas jet. They were destined to work a revolution in domestic lighting, would not only be cheaper than gas, but would be far more readily managed and kept in order. There was no unhealthy vapour or products of combustion produced, very little heat, no sound, and no risk of explosion. The incandescent lamps lent themselves with extraordinary facility to the purpose of decoration, and would doubtless rapidly become favourite modes of lighting. The experience of the theatre showed that it was practicable to apply them to large buildings. The public safety demanded that no fire be lost in making the electric lighting imperative in all theatres and public buildings. It might also to be made compulsory to use electric lamps in coal mines. The experiment would

Iron — June 1, 1882 — Iron — May 20 1882

Cost of Gas and the Electric Light.

Some additional data as to the relative cost of street lighting by electricity and gas are supplied by the new contracts for lighting New York, which have just been concluded. The price to be paid for gas lighting for the closely inhabited part of the city, in which by far the larger portion of the lamps are located, is $17·50 per year per light. In the outskirts and sparsely inhabited districts, from $19·50 to $22 per gas light is to be paid. The use of the electric light will be continued in portions of Broadway, Fifth Avenue, including certain parks and squares, in all a length of about six miles, at 79 cents per night per light. Arc lights are used by the Brush Company, also by the United States Company's styles. Each electric light displaces six gas lights. The contract price for each electric light amounts to $223 per year per light, which is rather more than double the cost of gas in the chief parts of the city. It is conceded, however, that the quantity of light furnished by an electric lamp is much greater and better than that yielded by the six displaced and dingy gas lamps. The streets that are illuminated by the electric light present an attractive and brilliant appearance. Reckoned by quantity of light supplied, the arc lamps are far cheaper than gas. Not so, however, with the incandescent system—the Edison system, for example, which is not at present used for street lighting in New York. Each small Edison light, not quite equal in force to an ordinary gas light, costs rather more than gas.

The Electric Light at the Reform Club.—The electric light is now being tried in two of the principal rooms of the Reform Club, in Pall Mall, with a view to its ultimate adoption. The new dynamo machine invented by Lord Elphinstone and Mr. Charles W. Vincent is being used with fifty Woodhouse & Rawson incandescent lamps. The new light shows off the rich gilt decorations on the walls and ceiling of the reading-room with much effect; and this was increased last night by fixing the lamps upon a crystal chandelier and using ground glass bulbs for the lamps. The motive power is supplied by an Easton & Anderson 3-nhp engine, dating from the building of the club, but which has long been put aside in favour of a high-speed horizontal. Nevertheless, on this occasion it is found to work well.

Iron — May 20 1882

The Electric Light in Sweden.—Besides the lighting of the royal palace in Stockholm by electricity, the chief dockyard at Carlscrona, the Portsmouth of Sweden, is supplied by means of Siemens machines. The motive power is furnished by a 60-horse engine feeding 30 Siemens incandescent lamps. The light is also now being introduced at the dockyard at Brunswerke, in Dalarne, the largest in Sweden. Two lamps of 3,000 candle-power each will light the dry docks and the military station, while two others of the same power will light the principal buildings; 100 incandescent lamps, 6,000 candle-power, will be used for lighting the interior of the engineering works. The total power of the light employed here will thus be 18,000 candle-power.

managed, through a highly influential channel, to put the Directors' story into the hands of the Liverpool Shareholders before a point was referred to. He (Mr. Hart) had not been expressed, that until there was something like an able and powerful Board, not only for the undertaking, but also for the Company, there was little chance of success which the Company required in the law, it would be wrong to waste money in litigation. He (Mr. Hart) had a further point of opposition to deal with to-day. He observed would bring F. J

From - Dec. 7, 1883

ELECTRIC LIGHTING OF THE *ADELAIDE*.

THE steamship *Adelaide*, a fine passenger boat, intended for the Australian passenger trade, and built on the Clyde by Messrs. D. and W. Henderson & Co., of Glasgow, has just been despatched for Australia. As the steamer is specially intended for carrying passengers, her internal arrangements have received special attention, and amongst other improvements she has been fitted up throughout with the electric light, under the superintendence of Professor J. Jamieson, C.E., Principal of the College of Science and Arts, Glasgow, as consulting engineer. The dimensions of the *Adelaide* are—length, 370 feet; breadth, 40 feet 6 inches; depth, 27 feet 6 inches; with a gross tonnage of 4,700 tons. She attained a speed of 14·9 knots at her official trial, and in every way reflected great credit on her builders. In the electric lighting installation there are 315 Edison incandescent lamps of 16 candle-power each, and four lamps each of 100 candle-power. The 16 candle-power lamps are disposed about the ship as follows:—20 on the awning deck, 73 on the main deck, and 42 on the lower deck and in the engine and boiler rooms. The four high-power lamps are intended for lighting the gangways and the spacious deck, when required for loading or unloading the ship, or for the reception or removal of passengers or luggage. The Westinghouse engine and dynamo employed for this purpose illustrated on page 761 of our present issue, is very compact and occupy a small space. They are placed beside the thrust shaft of the main engine close to the starting point, in order that the engine-room may easily attend to both. Besides this, the position being on the ship's floors, no noise or inconvenience is felt from vibration by the passengers. Extra precautions were taken by the consulting electrician to have large and well-insulated conducting wires, with the positive and negative wires carefully separated from each other by being encased throughout in wooden-grooved cornices, a precaution which unfortunately has not always been attended to, and to the neglect of which some at least of the failures which have attended some of the installations of electric lighting may be attributed. The lighting is not engineering, Limited, of 57, Queen Victoria Street, E.C. (whose address is Alley & McKellar, of Glasgow), consists of two cylinders C C, containing duplex pistons attached direct to connecting-rods, with their heads to lower ends, as well as the crank shaft to which they are coupled, working in oil inside the watertight crank-shaft casing C B C. There is but one eccentric keyed between the cranks (which are directly opposite to one another), and it works a piston valve, the casing of which is seen close to S P, the steam pipe, between the cylinders. This piston valve, by its up-and-down movement, admits steam alternately to the two cylinders, the exhaust, taking place near the end of the stroke through E P, the exhaust pipe. The engines are thus short-stroke single-acting engines. The steam is regulated by the stop-valve handle, S V H, and the governor, G. The whole engine, with its fly-wheel, F W, and shaft, S, is fixed on the same iron bed-plate, B P, as the dynamos, B, the whole resting on very strong and compact arrangement. The dynamo shown is one of the Edison-Hopkinson type, similar to that fitted on the *Tasmania*, but the dynamo used on the *Adelaide* was one of Edison's well-known L type. The different parts of the dynamo B may be described as follows:—S the dynamo spindle coupled direct to the engine shaft, A the armature (fixed to S) revolving between the poles of the dynamo, of which N S are the magnetic circuits, C C the electro-magnets, B the brushes bearing on A C the armature commutator, and C S the current switch. Each of the eight (fixed N S) revolving between the poles of the dynamo, of which N S are the magnetic circuits, C C the electro-magnets, B the brushes bearing on A C the armature commutator, and C S the current switch. Each of the eight (fixed with spindles 7 inches diameter and 5-inch stroke generated 22 brake horse-power with 90 lb. of steam pressure, and runs well at from 300 to 700 revolutions per minute.

From - June 29, 1883

THE MOSCOW ILLUMINATIONS.—The following are the details of the method by which the late fête illuminations at Moscow at the coronation were produced:—The towers of Iwan the Great and the belfry of Ivan Veliki had 3,000 small Edison lamps, fed by 18 accumulators, of which served a number of small electric machines of every existing system. The portable engines and machines were kept at the other banks of the river, and communicated with the towers by aerial electric conductors. The towers of the Kremlin towards the river sight large and ten smaller electric suns threw their light over the river. The rest of the illuminations consisted of 200,000 lamps and 30,000 coloured glass globes, 50,000 lanterns of Venetian glass, 600,000 taipers, and 10,000 lb. of fireworks.

From - June 29, 1883

ELECTRIC LIGHTING AT HEVERSHAM PALACE.—The ordinary method of illuminating the hall-room at Heckingham Palace has recently been superseded by electric lighting on the incandescent principle with excellent effect. The success, in fact, has proved so great at the recent state ball and concerts that it has been decided to continue the use of the electric light for the remainder of the season. It can well be imagined that the brilliant effect obtained in the hall-room places greatly in the shade the ordinary methods of illumination adopted in the adjacent supper-room and other parts of the state apartments. Steps are therefore now being taken to extend the electric lighting to these portions of the palace, which will then equal the hall-room in point of brilliancy of illumination, instead of appearing somewhat dark, as they are now said to. The arrangements are still of an experimental character, and portable engines only are in temporary use to drive the various dynamo machines required to produce the current for the lamps. Nearly 1,000 incandescent lamps have already been fixed, and all the arrangements are very complete so far as they go. Over 4 miles of wire, about two-thirds the cost of gas, but he was sure that it would be found to be the cheapest light in the end, and not the whole of the work with the assistance of Mr. W. Massey, consulting engineer, of Twyford, who has charge also of the electric lighting arrangements at Windsor Castle.

From - June 21, 1881

THE ELECTRIC LIGHT AT BRISTOL.—After considerable dispute with the Bristol United Gas Company as to an advance which the directors of that company wished to make in the price of gas supplied to the city for public purposes, the Bristol authorities have made elaborate arrangements to test the use of the electric light in some of the principal thoroughfares of the city. The machinery and lamps of the Brush system have been selected, and the lamps were lighted for the first time on Saturday night last.

THE ELECTRIC LIGHT IN THE GENERAL POST OFFICE.—Arrangements have just been completed with the British Electric Light Company for the experimental lighting of certain important parts of the General Post Office, St. Martin's-le-Grand. The first series of the experiments will be conducted in the telegraph instrument galleries.

Expecting from 7/1884

ELECTRIC LIGHTING NOTES.

MR. RUTHSHAM, boilermaker, has just lighted his works by means of electric lamps, driving the dynamo from his works' engine. The work has been carried out most satisfactorily by the Rutshamel Electric Light and Power Supply Company, Limited.

From - June 1/1881

ELECTRIC LIGHTING FOR DOMESTIC PURPOSES.—Mr. Swan's new incandescent electric lamps are shown to-night in actual operation at the establishment of Messrs. Edmonstone and Co., of Newmarket. The main feature of his invention is that a large number of small lights, four of which are stated equal to the same number of 'dropper' gas burners, may be obtained from a single apparatus. The latest arrangement of a small thread of carbon placed in a moderately large globe from which the air is exhausted, while it is a variety of the invention that the small carbon threads are prepared in a manner which prevents them from being easily broken. The electricity was generated on the above premises with the aid of a 4-horse steam-engine, described. Seven lamps were used in four rooms. In one there were two lamps with pendent glass globes, burning very steadily, and emitting no heat at all to speak of, while by turning a switch or key they were easily extinguished and re-easily relighted. In another room there were three small lamps without globes, giving abundance of light for rooms of moderate dimensions. In a larger room than either of the others were seen about a dozen lamps with opalline globes, screened globes. Some of these globes concealed gas, and others electric lights, the two kinds being undistinguishable from each other without a close examination, the effect being to meet the objection so frequently urged against electric lighting of painful whiteness or brilliancy. It seems to be considered that for the present the orders given for the Swan lamps, including necessary generating apparatus, will be confined to large private houses, whether in London or the country, such lighting, except on an extensive scale, for taverns, being in fact a luxury for the wealthy.

From - June 3/81

THE JABLOCHKOFF LIGHT.—We are pleased to hear that the committee appointed by the Metropolitan Board of Works to consider the proposals for lighting by the Thames Embankment on a contract for five years at a reduced rate (4½d. instead of 5½d. per lamp per hour) have reported favourably, advising the Board, however, to limit the contract to three years. The number of lamps to be supplied is eighty, and the hours of lighting extended from sunset to sunrise. The report will be read at the Board to-day. This decision, after nearly nine years of experience, speaks well for the electric light in general, and Jablochkoff's in particular.

THE JOEL ELECTRIC LIGHT.—An exhibition of Joel's system of electric lighting was given last evening, at the offices of the Prudential Assurance Company, 142, Holborn Bars, where it has just been applied to the lighting of a portion of the company's extensive premises. The light, which is of incandescence, will be found fully described and illustrated in our issue for April 22 last. There are nine lamps, which are equivalent to forty-five gas-burners. They are mounted on brackets, and so contribute the light very equally through the office in which they are fixed. The Gramme machine for generating the current is placed in the basement of the building and is driven by one of the engines belonging to the company used for generating air for the pneumatic despatch tubes which are laid all over the building. Should the present trial prove successful, it is intended to adopt throughout the company's premises.

Mr. Scott. may 3/94

ELECTRIC-LIGHT COMPANIES' PROSPECTS.

SIMILARITY to the way in which we have already discussed the position of the Brush and Illuminating Companies as bearing on the prospects of electric-lighting generally, we now offer a few remarks on that of the Maxim-Weston Electric Company, as disclosed in the Report and accounts to March 31st last, a *résumé* of which appeared in our last week's issue.

Following the plan adopted in other similar cases, the Directors of this Company carry large amounts to the debit of profit and loss, as the result of diminished estimates of patents, stock, plant, machinery, and shares in other Companies; as also £96,245, net expenditure to March 31st, 1893. It is worthy of notice that the loss on shares issued at a discount, £20,625, is fairly faced, and charged also to profit and loss account, which on the other side shows £250,000 as the result of the sale of licences and concessions; the outcome, after also crediting £2,665 profit of the past twelve months, being a child having carried into the balance-sheet of £102,150, which will be met by the proposed reduction of capital from £200,000 to £100,000. After the alterations thus indicated, the assets of the Company in the form of machinery, stock, book debts, and cash amount to £264,945; the other side showing liabilities to creditors £1,650, and its capital account £100,000. Besides the above £26,845, the other assets consist of patents now valued at £70,000, and shares in other Companies (as 2s. 6d. per £1) £2,453.

With the general line thereby, the production of relations and of capital, for future operations, with plant in thorough working order, with important improvements in lamps, dynamos, &c., and with engagements related to about one-half, the Directors eager for the Company a successful future, and hope to be in a position to declare a dividend for next year. With regard to expenses for the past year, one economy, which the Shareholders will doubtless appreciate, has been the relinquishment of fees by the Directors, besides which we notice an item of £500 abated from the expenses to March, 1893, for fees written-back.

As on working account is published, the amount of business done during the past twelve months is not shown, nor can we form any idea of the per-centage of profit represented by the gross profit of £5,817, brought into the accounts as a guide to the probable result of future operations. The amount of £8,295 for machinery and stock appears to indicate but a small quantity of machinery in work still, and such as would require to be turned over many times in the course of the year in order to yield a sensible dividend. Not that we consider this no unquestionable value, long aware that an unnecessarily large stock-in-trade is often the bane of an otherwise prosperous business. The explanation of the smallness of this item may perhaps be found, to some extent, in the comparatively heavy amount of book-debts. The figures of the two items invite comparison with corresponding items in the balance-sheets of other Electric-light Companies; but after all, may perhaps be indicative merely of a particular stage of things at the date of making-up the accounts, rather than of their normal condition. With reference to past business, the Directors submit the receipts of testimonials from every purchaser of their installations, which have included the lighting of mines, mills, warehouses, docks, theatres, and private residences.

Judging by the information thus given, and by what we gather also from the Reports of other Companies, it would appear that electric-lighting is gradually advancing in public favour, at least for private establishments. Its more general adoption turns, of course, to a great extent on the question of cost, estimates of which, in comparison with that of gas, for lighting even a single establishment vary widely, say, 150 (12 c.p.) gas-burners or 60 (30 c.p.) electric incandescent lamps, make out a *prima facie* case greatly in favour of the latter, without taking into account the saving on the score of the attendants non-determinable in figures. But the real proof of economy is to be looked for not in estimation, but in the results of actual use. Such proofs should, we think, be by this time forthcoming.

It is in its general adoption for house-lighting that, in our opinion, lies one of the principal, if not the principal, uses of electricity as an illuminant. If supply Companies can see their way to the production of the electric light at a cost not exceeding that of gas, and will undertake the house-to-house lighting of certain districts on such terms as to satisfy householders who have hitherto been gas consumers, the advantages of electricity are so manifest—especially, as regards private lighting, on the score of health and comfort—that it appears its general adoption should follow as a matter of course, any accidental difficulties, as distinguished from essential defects or constitutional prejudices, which may at present form hindrances to its becoming generally available being dealt with and removed as speedily as may be.

Engineering - Aug

THE ELECTRIC LIGHT IN THE MECKENBACH MINES.—The electric light installation at the Meckenbach Mines in its once volcanic lifeless district in Rhenish Prussia, has now had a fair trial for more than three years and has proved a complete success. The expectation that it would both facilitate the operations and reduce the cost of working has fully been realised, and an extension of the plant is now being carried out. Messrs. Siemens and Halske, of Berlin, undertook the work, which was superintended on their behalf by Mr. Boddinghaus. An open working 2000 ft. long, 1000 ft. wide, and over 300 ft. deep, in which 300 men and 28 horses are continually occupied, was first to be supplied with the electric light. The part of the mine is excavated in steps, the horizontal terraces being provided with rails. Ordinary lamps in globes or poles were out of the question, as blasting operations continue throughout the day and the whole would soon have made havoc of the lamps. After several trials two powerful lamps, of 3000 candles each, were erected at the upper margin of the pit where they were fairly out of the reach of the projected stones; and reflectors were fixed to throw the light down upon the steps. To find the proper positions for these powerful lamps and to avoid too dark shadows caused some difficulty. But the illumination was finally rendered most efficient, and the open pit with the light playing on the whitish grey rock affords a fine spectacle. Many interruptions, even for short periods, such as those occupied in renewing the lamp carbons, would be dangerous, the whole plant is double; each lamp receiving its current from its D, dynamo. No blinds of any kind are required, and the safety of the miners has decidedly been augmented. It was formerly always necessary for the superintendents to see whether the loose mass resulting from the blasting operations had been properly removed, and frequent minor accidents arose from the debris falling down upon the miners engaged on the step next below. The work can now be controlled much better than before when petroleum lamps and hand lamps were in use. The cost shows a saving of about 5d. per hour in favour of the electric illumination. The satisfactory results obtained in the open working induced the company to introduce the electric light also in a the subterranean galleries. The new forms little conversions of sand and galena scattered all through the rock; the whole mass has therefore to be brought to day to be disintegrated and sifted, and the washing proceeds in parallel and cross galleries, which are constantly being widened until they become 80 ft. in width, and 70 ft. in height, by sometimes 200 ft. in length. The operations in the meantime would not require much light if there was not always danger threatening from loosened pieces of rock. Pitch torches were formerly employed to examine the bore holes and fissures round them after each explosion. It was a question whether the arc lamp could answer for this purpose in the smoky atmosphere. For the first experiments, arc lamps of 2000 and 1000 candles were used, with the positive carbon in the lower holder. The effect was brilliant, yet the light did not penetrate the white smoke cloud which collected at the upper wall immediately after the shot. But as the smoke settles within ten minutes, it was thought advisable to continue in this interruption of a few minutes, and to use smaller lamps of 250 candles, which proved quite efficient. Of these, there are ten in use with about 10,000 ft. of lead cable, the cable being partially elastic, as the lamps with their wires have to be removed when the blasting is to take place. The lamps were originally supplied with hexagonal lanterns with obscured glass to protect the eyes of the miners. The glasses were of course soon broken, but no complaints are said to have been made about the naked electric lights. The proprietors of the mine have decided upon an extension of the installation.

Engineering - Aug 17/94

ELECTRIC LIGHTING NOTES.

THE electric light formed a prominent feature in the city illuminations on the occasion of the visit of the Queen and Princess of Wales to Newcastle-on-Tyne on August 20 and 21. Three powerful arc lights, each of 2000 candle-power, were erected in different parts of the city, one of these was placed in the beautiful pastern tower of St. Nicholas' Cathedral, and was visible for many miles around. The light shining through the stone tracery threw dark shadows across the sky in the shape of a gigantic cross. The other two lights were placed in the principal streets, one of them being just opposite to the gas offices, where an extensive gas illumination was exhibited. All these installations were carried out by Messrs. J. H. Holmes and Co., electric light engineers, Newcastle-on-Tyne. The same firm has also lighted a Polytechnic Exhibition at Hutton, County Durham, for which purpose a number of forty-five Swan lamps and one arc lamp worked in parallel circuit from the same dynamo, with perfect success.

The managers of the Covent Garden Theatre have again adopted the electric light for this season's promenade concerts. The Maxim-Weston Company have supplied the installation, the work being carried out on their behalf under the superintendence of Mr. Hugh Watt, the managing director of the Company. The systems of this company are certainly well known, but that is to say, they range, and all reputable appliances. And incandescence lamps, and all reputable appliances. In the installation now noticing, the generating plant is situated on the ground floor basement of the Floral Hall, and comprises three Maxim and three Weston dynamos. The current from these machines is conveyed through 600 Maxim incandescence lamps, those in use being arranged in the auditorium and over the stage. The Weston machines could supply current to forty-five Western arc lamps; these lamps not given out a light equal to 1500 candles, actual. The positions of the arc lamps have been carefully selected, and give very fine effect, more especially in the auditorium and over the stage, while the Floral Hall is lighted by by arc lamps. The Maxim generator in outward appearances resembles its likeness. It differs, however, from the machine in the construction of its armature, and the method of coupling up the coils differs from that employed in the Gramme. The principal feature of the new Maxim incandescence lamp lies in the preparation of its filament by a new process just patented, which the company claim, gives 20 per cent. more light for the same power, than any other. The Weston arc lamps has long been known as remarkably steady in its action, and the simplicity of its construction renders it especially suitable for public illumination. Covent Garden is one of the largest theatres in Europe, and the cables employed in this contract amount to several miles in length.

Engineering 8 Aug 17/94

ELECTRIC LIGHTING NOTES.

THE splendid paddle steamer Olympe, lately built and engined by Messrs. A. and J. Inglis, Glasgow, and owned by the Messagerie Fluviales à Vapor of Monte Video, and intended for passenger service on the River Plate, was thrown open to public view on the evening of Friday, the 11th inst., when she presented in her beautiful and extensive and highly successful electric lighting installations, might be inspected. The Olympe is a sister ship to the Sabrina which was sent out to the River Plate a number of weeks since, and the contract for which the electric light installation is the same as the one in that vessel, although a little more extensive as regards the number of lamps. In all there are about 330 Swan lamps of 20 candles power each, which are distributed throughout the whole of the vessel. The electrical current is obtained from an Elwell-Parker and Vincent dynamo capable of working 600 such lamps, and power is provided by one of the ship's main engines (we've high-speed engines of 40 horse-power. The most important novelty in this installation is the use of 45 secondary batteries which are placed in the engine-room, and which, it is said, are capable of supplying light to 50 lamps for a period of twelve hours, when the vessel is in port, or when the engine is at rest. So far as we are aware, this is the first time that an electrically lighted ship has been provided with accumulators or storage batteries in addition to the dynamos. Messrs. Woodhouse, Rawson, Limited, and Co., have been contractors for the installation.

On Tuesday, the 10th inst., judgment was given by Lord Kinnear in the Court of Session, Edinburgh, in the action of the Aylsham Electric Light and Power Company (Limited) *v.* Howard and Wyndham. The pursuers sued the defenders, who are the proprietors of the Lyceum Theatre, Edinburgh, for the sum of £226 5s. 6d., as the contract price of supplying and fitting up an installation of machinery and fittings for electric lighting in that theatre. The gist of the defenders' it was stated that they agreed with the Electric Carbon Storage and Apparatus Manufacturing Company of Scotland (Limited), for the furnishing of an installation of the electric light, at the price of £3262. In the event of the apparatus working satisfactorily, which the same should be ascertained by certificate under the hand of Charles Johnson Spencer, Kent, London, the defenders, according to the agreement, to grant a bond for January 31, 1894, for payment to the pursuers of £1000 on the expiry of twelve months; but if payment of the work proving unsatisfactory, such a bill was not to be granted. The Electric Carbon Storage Company having gone into liquidation, the pursuers agreed to take over the contract for supplying the theatre with the electric light. On February 11, 1894, Mr. Phipps reported that the work had not been properly completed, and the defenders pleaded that they were not entitled to pay the price until the defects were remedied. The pursuers refused to be reason payment on the principle of *quantum meruit*, for work done and materials supplied to the order of the defenders. The defence was, that the work was done under a special contract, the conditions of which had not been performed, and therefore the pursuers were not entitled to recover payment. The case was led at the end of last session. In giving judgment in the case on the 10th instant, Lord Kinnear held that the question for consideration was, whether the defenders' letter of December 1, 1893, was a binding upon the pursuers, he accepted as one bound by the contract which he thought it was. He then in the course of employment, he was the builder for them in the course of employment, he was the builder for them in the course of employment, he was the builder for them in the course of employment, he believe that he had authority so to contract. In these circumstances, his lordship thought that the defenders were justified in relying upon the contract by Mr. Monk; and if the pursuers were, in his opinion, therefore barred from denying that it was not in keeping with the expressions of that agreement. He thought that it was proved that the installation had been worked satisfactorily, and that it was not defective; that it was worse than useless for the purpose. Sir William Thomson had made an inspection, specifies of the installation, and in evidence that, for its part, he would not have accepted it for a single evening, supposing he had been contracted to light up the theatre for such evening. In his opinion, it would be better to have gas or proper for the defenders to light up the theatre for a single night. The result of the defender's finding was that, if the pursuers' claim was rested upon contract, the defenders were entitled to reject the installation as defective, and if it was rested on the ground unlimited at the bar, that the defenders had taken the benefit of work done without any antecedent contract, he was of opinion that they had taken no such benefit and had incurred no liability by permitting work to be done upon their premises which turned out unsatisfactory. He therefore assoilzied the defenders and granted them expenses.

The Globe, Toronto, Dec. 1, 1883

THE EDISON LIGHT.

On another page will be found a description of the installation in THE GLOBE building of EDISON'S system of incandescent electric lighting. The Globe is the first of Canadian newspapers to adopt permanently the new method of illumination. The light has been on trial for a time sufficiently long and under sufficiently searching ordeals to entitle us to speak positively as to its advantages. We have no intention in saying this to sit easily. Elaborate wires strung on water-power is already in use for the incandescent light can be substituted for it with economy, and with great advantage to the health and eyesight of the persons who have to work under it.

INCANDESCENT LIGHTING.

The Edison System as Applied in the "Globe" Building.

THE PROPERTIES OF THE LIGHT.

How It Is Laid On and How Run.

THE "GLOBE'S" ENGINE ROOM

The Dynamo-Electric Machine—The Mains —The Lamps—Their Power and Life—Other Installations in Canada.

It is now about six years since W. A. Edison, the well-known inventor of the Grand Trunk Railway, startled the world by his announcement that he had solved the problem of the subdivision of the electric current, and so had made the question of electric lighting a practical one. From discovery to discovery Edison went on till about two years and a half ago he opened in the most densely inhabited part of New York City, his first central station, whence his incandescent light was distributed to customers in the adjacent offices and stores. A representative of THE GLOBE was present at the opening of that station. He was struck an enthusiastic account of the virtues of the new light, stating that it was but a question of time, no matter what the cost of the light, when it would displace gas and all other illuminants in large establishments. From that day to this the cost of incandescent lighting has been steadily decreasing and the efficiency steadily increasing, until now there is

WITHIN THE REACH OF ALL LARGE ESTABLISHMENTS,

and it is to be hoped will soon be within the reach of the ordinary householder, a fact which is not very near perfection that only the most inveterate of anti-Edisons has any objection to offer. The incandescent light can be supplied at any power to which the engineer in charge chooses to run it. The light is absolutely steady. It has neural the glare or the flickering of the arc light. It shows colours faithfully, but—half it not in fault—it does not, as the arc light does, show up every little bit of soap or pearl powder as though it were laid on with a house painter's brush. In other words, the incandescent light is fitted for the hall or opera room, and for public assemblies of all kinds.

SMALL SCALE IMPROVEMENTS

which have been lately made in THE GLOBE Office, the Edison incandescent electric light has been placed throughout the building. The motive power for it is supplied by a fifteen automatic cut-off engine, which was introduced to the printing establishment a couple of years for the old water pressure engine which had driven the presses for a quarter of a century. The engine is of 35 horse-power nominally, but will work up to 50 horse-power. The cylinders are 14 inches in diameter, and the stroke three feet. The ordinary steam pressure is 60 pounds per square inch. This engine is one of the very best of its class, and is a credit to the establishment of which it forms a portion. It was manufactured by T. Wheatley of Guelph. A few days ago it was pronounced by a competent judge to be the finest engine in use in Canada. There is also an auxiliary engine which has lately been put into thoroughly repair by the above maker. It is a slide valve machine of 12 horse-power, with a stroke of 12 inches of cylinder and twenty-inch fly wheel. This engine is usually kept in reserve in case of the breaking of either, and is hardly ever used. When these new machines were being put in great changes were made in the engine room, and now that they are finished, THE GLOBE has one of the

MOST CONVENIENT AND WELL-APPOINTED ENGINE ROOMS

in the Dominion. The job printing department of THE GLOBE having been disposed of to the "Globe" Company about a year ago, the casting of the extensive plant for the latter, which had previously been occupied by the lithographing type and machinery, necessitated, of course, a good some important changes. The casting room was re-modelled and fitted up in a style worthy of the institution, and the rooms on the first floor underwent and improved. The front of the building was completely altered with the result of improving it greatly much. The most recent improvement, however, and by no means the least important, was the introduction of the system of incandescent electric lighting throughout the building. The arc light, that wonderful tool for street lighting, is protected by the completion of the electric circuit at high pressure through two carbons, whose points almost touch. The incandescent light is subdivided in

A MORE DEFINITE CURRENT

consisting of the circuit through a loop of fine carbonized thread, which looks like a very fine wire, and which has its ends attached to platinum plates, etcher, in which form it is put up, for economy as can be produced. The insulation of the carbonized thread under the influence of the electricity, excess with a soft golden light, pleasanter to the eye than either gas or electricity directly. There are 110 of these lamps distributed throughout the establishment. Each lamp is supplied by a Swan-light burner, with a candle power of 100 lights of 20 candles each. As a matter of fact, however, it is considerably more than that is needed for the 110 lamps in THE GLOBE building. The suggestion is the light of the machine is produced by wasting round the carbonized thread. The lamps are firmly attached through a great number of connections at copper wire, and are of the best form or manner, two and each, and are connected that one lamp is at each end of the other of a distributing. These lamps are hollowed out to a diameter of a little over $\frac{1}{2}$ inches. Between these recesses is a carbon filament of very fine paper and bowed to a separated by sheets of tissue paper and bowed to a horse-shoe form. Over these there is a winding of copper wire laid on longitudinally commencing at of 60 section of the carbonized thread with other and connected at the ends to

A COMMUTATOR

having an equal number of bars separated by mica. This commutator revolves at a speed of 1,500 revolutions per minute—power being obtained from a counter-shaft driven by the engine-room, running at a speed of 700 revolutions. The electricity flowing into the machine is generated in the armature in its own winding, passing by the bars "one the terminal turns generated and meeting the brushes which are connected to the field blocks, whilst on the other side of the fibre in the inside takes a direction through the magnet. On the commutator-armature—making a while two brushes—those one bar rest on each positive, and those on the other the negative. The current passes from the armature through the positive brushes, and, instead through the negative through the lamps, returns through the negative of the type known as

SIEMENS-HOUSING

has the strength required by a resistance placed in the circuit. The current may be cut off entirely being switch on the fuse-block, to which the leading wires are attached. These leading wires, a short distance from the dynamo, pass through a

"GALVANIC CUT-OUT,"

which is worked by the 35 horse-power. This is a most important improvement in case of excess of current, which it allowed to pass on through the wires might cause fire by overheating. If there should be an excessive current on the wire where it passes through the "cut-off," the lead wire therein would be melted and the circuit thus destroyed absolutely. The above-notice "cut-off" is the invention of Mr. Swan, and is finally constant, and is all composed of lead. The lamps are placed between the wires in what is know as "multiple arc," in contradistinction to the arc lights, which are invariably placed between branch in the wires or "in series," which therefore require an increasing electro-motive force as the number of lights is added to the circuit from the "mains" are also in "multiple arc." The rest of the branches throughout the building there are switches for turning on and off groups of lights when required. For instance, on the

LIGHTED INTERMEDIATELY AND EXTINGUISH,

the group for each room is independent of the others, so that as to turning the light on and off is concerned, this being regulated by a small switch, or key, in the centre of the room beside the lamp. Each lamp has a separate safety fuse, so that if one lamp should burn out it prevent the fuse should the wires of any lamp to any additional be crossed together or by those of any lights, or cause the fusing of a stretch of fuse-wire. The wire in the plug would in such case be instantly melted, just as in the "cut-off" at the dynamo, and the result for the lamp affected would be the same as at the dynamo. The fusing of the whole lamps would not be affected in any way. About 125 of the lamps are sixteen candle-power, and the remainder twenty are of ten candle-power. The lamps are of a very fine glass, specially made for the purpose, and which is exceedingly thin, otherwise the light would not be so powerful. The bamboo carbonized thread mentioned would work to extend before the entire surface had been warmed, would lead to frequent breakages. Within

THE PEAR-SHAPED GLASS

there is, as stated, almost a perfect vacuum. The air has been exhausted by a mercury pump until only the millionth part of an atmosphere remains. Each lamp has a guaranteed life of 400 hours, but it is expected that it will average 600 hours. The experience of THE GLOBE building this life has already greatly exceeded. The light was first started on 2nd November last, and has been used every working night since then. The lamps have thus burned about 600 hours, but only 7 out of the 110 have burned out. The life of the lamps has thus been 1,400 hours, and the remaining lamps are by no means dead yet. The shortest of bulbiferous, but, on the other hand, their life may be shortened to a few hours by accidents, and by frequently exceed that standard. The wires in the building are laid along walls or ceilings in wood moulding. From wall or ceiling to the lamp the wires are enclosed in a

HOLLOW METAL TUBE

like a gas pipe. The ornamental fixtures are much the same as are used for gas lighting. In the dining-room, for instance, there is a large group of lights in the centre, and others in various parts of the room, and in the main hall, the fixtures are exceedingly handsome. Over the type setters' frames and over the pressmen porcelain shades are used, which, instead of diffusing the light as would be required, because of the direction in which it is required, have a reflecting power. The general effect is much the same as gas, and many enter and leave the office without noticing that a change has been made, where the lights are not covered by glass or porcelain globes. However, the fact that the light is not diffused, but is instead of spreading out as gas does, is likely to add greatly to its economy. Those who have to use the light for any length of time find its superiority to gas in the

AMOUNT OF GLARE AND HEAT,

and its absolute steadiness. So far the lights have been used in THE GLOBE Office for the seven darkest weeks in the year. The result of this experience shows that allowing for interest on the investment, wear and tear of plant, extra coal, etc., the bill for light for the year will be less than it was for gas for the past year. Messrs. Gurney & Co., North Western Canada installation agents, under the superintendence of Mr. A. J. Lawson, the Manager of the Canadian Department of the Edison Company at Hamilton. Several other Canadian installations have been made in Canada. The following is a list of the places already supplied with the Edison light:—Toronto: Queen Street of the Canadian Institute, 100; Globe Office, 100; Canada Cotton Company's Mill, Cornwall, 1,000; Dominion Cotton Company's Mill, Valleyfield, 650; Canadian Sugar Refinery, Montreal, 350; St. Lawrence Sugar Refinery, Montreal, 250; Halifax Sugar Refinery, Halifax, 200; Canadian Pacific Railway Company's Shops, Montreal, 200; Tallman's and Co.'s Canneries, 1,200 and Guelph; McCulloch, Galt, 120; Gurney Building, 100; Grand North Western Telegraph Company's offices Toronto, 80. The lights in the last-named establishment are not yet running, but will be shortly. The force will be supplied by a dynamo of 1,000 lights. Other Canadian establishments being almost 100 last from each other. The current will be conducted over a copper wire the equivalent of an inch in diameter. This wire, like the smaller ones used within THE GLOBE building, has, for instance, a lead installation applied to the bare wire. Over this is a covering of vulcanized rubber, and over the rubber is a braiding. The whole being covered with woven cotton saturated with a special fire-proof paint, laid on under hydraulic pressure. The lamps, switches, lamps, sockets, and other accessories of the Company are manufactured in Hamilton by the Edison Co.

The Iron Age
Dec. 18, 1884

Electric Lighting on Railways.

An examination on behalf of the British Board of Trade was recently made of a train lighted by electricity on the London and Brighton Railway. Nearly six years ago, observes the London Engineer, the Brighton Company lighted up a Pullman express train by means of secondary batteries. The company have now adopted a combination of a dynamo machine, driven from the axle of one car, with accumulators. The advantages of this combination are very great over that of driving an engine and dynamo direct from the bolter of the locomotive. There is very little cost for power—perhaps a hundred-weight of coal in a journey of 50 miles. For some time a train then worked has been running upon the southern suburban line of this railway. The train has for the past month been running and now runs with a current of 40 ampères and 40 volts, which enables 40 incandescent lamps of 20-candle power each, distributed through the compartments of the train. The advantages of which means of this system of secondary lighting the train possesses is the automatic arrangement by which the dynamo is brought into action when the train has attained sufficient velocity to drive the dynamo at the requisite speed. In the present instance, as soon as speed of 20 miles is attained, a governor connects the machine with the accumulators, and the charging of the batteries proceeds, but so long only as this velocity is maintained. Provision is also made for reversal in the direction of the train by the same governor which shifts the brushes. No electrician attends this train, the plant being left in charge of the guard.

GOOD-BYE TO GAS.

The Edison Incandescent Light Introduced Into the "Post."

A Thing of Great Beauty, Brilliancy, Economy and Convenience.

The First Michigan Newspaper to Adopt the Edison Light.

The offices of the Detroit POST are now lighted by the Edison electric incandescent lamp, which is the most perfect light in the world. The POST is among the first newspapers in the West to adopt the Edison system, and this is the only newspaper office in Michigan illuminated by the Edison incandescent light. In this respect, as in all others, the POST leads.

Of the Edison incandescent lamp too much cannot be said. The soft brilliancy of the light, its mellowness, beauty and convenience, are fit subjects for unstinted praise. In comparison with gas the Edison light bears the same relation that gas does to a tallow candle, except that the introduction of Edison lamps is unaccompanied by noxious odors which affect the lungs and other organs of the body, breeding consumption and divers deadly diseases, as some gas is known to do. One might dilate to the extent of columns on the relief experienced in getting rid of a sickly, flickering, ill-smelling light, with its concomitants of smoke, heat and dangerous flame.

WHAT A VISITOR WILL FIND.

Readers and friends of the Detroit POST are invited to call and witness the perfect working of a perfect light. They will find over each desk in the editorial offices, and over each printer's "case" in the newsroom, a pear-shaped bulb about five inches in length. Within each bulb is a loop of carbon gleaming at an apparent white heat, but the hand finds the bulb but slightly overheated. The light is emitted steadily, constantly, without variation, and that given out by each lamp equals in volume that of two gas jets.

THE ABSENCE OF HEAT.

Going into the newsroom, which is supplied with fifty Edison lamps, equal in point of light-giving service to twice that number of gas jets, the visitor will be surprised at the almost total absence of heat. With a like number of oil lamps or one-third that number of gas jets the atmosphere in the newsroom would be almost unbearable on a summer night. Altogether it requires but 150 Edison lamps to sufficiently light the POST offices. The main entrance to the POST building is splendidly lighted by a single lamp of fifty candle power. In the six halls are ten lamps. Five suffice for the engine and boiler room and eight of sixteen candle power for the press room. The mailing room requires seven, the store room three and the counting room twelve.

THE EDITORIAL FLOOR.

Upstairs, the office of the chief editor has two lamps, the managing editors' room three, the city editor's and reporters' ten. In the state and commercial editors' room are four, proof-readers' five, and the night and telegraph editor's three.

The POST has its own plant. In several large cities central lighting stations have been established by the Edison company, as stated further on, which supply light to consumers the same as gas companies do. This plan is found very convenient and economical; but the POST preferred putting in its own plant, which has been in operation two weeks, and has been thoroughly tested and found to be unexcelled.

The machine producing the electric current, called a "dynamo," is erected in the basement, and is driven by its own engine, to which it is attached by a paper friction contrivance instead of a belt; a simple device, the invention of John R. Markle of Detroit, the local superintendent of the Edison company. This device permits of the engine and dynamo occupying one bed piece and thus economizing space. The electricity is produced by the rapid rotation of an induction coil near a magnet and is taken up on the commutator by metallic brushes and thence carried by the wires to the lamps.

A century hence posterity will say of the present generation: "Those people used to actually light their factories, stores and dwellings with little fires spread all about. They used to feed these little fires or flames with the most dangerous and explosive materials, such as coal gas, gasoline, oils, etc. These materials were constantly burning up their property, exploding and destroying their lives, escaping into their sleeping apartments at night and suffocating them. It was a common occurrence in those 'good old times' for hotel keepers to break open the doors of the rooms of some of their guests, owing to their non-appearance at breakfast and find them dead—the gas had 'gathered them in.' Some slight defect in the gas pipes or a draft of air had extinguished the little fire fed by the villainous stuff, with fatal result." These will be sweet sounding comments on the boasted intelligence of the present time, but they must occur to the thoughtful as strictly in keeping with present conditions and practices.

GOING OUT OF DATE.

The gas industry has but one source of revenue, viz., from light, while the central electric station, under the Edison system, has three—light, heat and power. Gas is used to a limited extent for cooking and power, but the cost is so excessive that it is quite prohibitory, and that gas is used at all for these purposes is conclusive evidence of a strong demand for a cheap distribution of power and heat. Such a system will net a liberal revenue if these ends are met economically.

One pound of ordinary coal develops 13,000 units of heat, which represents 12,000x772 (Joule's equivalent) or 9,264,000 foot pounds, or units of force, which is less than one-quarter pound of coal per horse-power per hour. As three pounds of coal per horse-power per hour are used, it is evident that engines give back in work only one-twelfth of the heat furnished them—eleven-twelfths are sent out the exhaust pipe. The combination of the electric-lighting engines with a system of heating mains, into which to pour these heat units from the exhaust pipes, and all this waste is at once made available for profit within a radius of enough territory contiguous to the lighting station to take up or employ this waste. The income from this source will pay for the coal used.

HOW POWER IS FURNISHED.

Power is furnished from an Edison central station precisely as light is—through a meter—where it registers the amount used. Power can be drawn from any lamp socket in quantities as desired, from one-tenth to one horse power, and can be placed on tap like water for larger quantities by placing a larger wire, as a larger water pipe would be placed to deliver large quantities of water.

Thus it is plainly seen how furnishing light, heat and power readily dovetails together in distributing economically these necessities from one central source of supply, where it can be produced cheaply. By the Edison system the demand for these commodities is met from moment to moment. An exact supply is produced to furnish existing demand and no more, so that nothing is wasted. Any changes in demand, though they be made with lightning rapidity, are as quickly met and instantly provided for. Nothing is stored up to condense, leak away, or rot; neither is a stock piled up to sell on a falling market. By thus keeping the supply and demand balanced nothing is produced unless sold at the time of production for cash each thirty days. This shows an adjustment for economy and profit impossible with any other industry. Sewing machines have been operated by electricity during the past two years for the manufacture of shoe uppers. The electro-motor is driven by a dynamo several blocks away, and may be seen in operation on Grand River avenue, just off of Woodward avenue.

GROWTH OF THE SYSTEM.

The central lighting district system is now in use in the following places, where Edison central stations are in perfect operation:

New York city, Brockton, Mass., Lawrence, Mass., Lowell, Mass., Fall River, Mass., Harrisburg, Pa., Shamokin, Pa., Hazleton, Pa., Bellefonte, Pa., Sunbury, Pa., Danville, Pa., Williamsport, Pa., Cumberland, Md., Hamilton, O., Piqua, O., Middletown, O., Tiffin, O., Circleville, O., Newburgh, N. Y., Roselle, N. J., Des Moines, Ia., Appleton, Wis., Lockport, N. Y., Mt. Carmel, Pa.

In addition to the foregoing 100 cities and towns are now under contract. There are at present nearly 500 Edison isolated plants now in operation lighting factories, stores, hotels, theaters and residences and about 100 steamships, steamboats and yachts are so lighted, using over 100,000 lamps.

For some time past the English admiralty have been making exhaustive tests at Portsmouth for economy in lighting war vessels, and find the cost of electricity to be one-half that of lighting them with oil. The same results have been determined in lighting the Iowa state prison at DesMoines, the Michigan school for the blind at Flint and numerous other places.

As regards the safety of the Edison incandescent light it need only be stated that the government powder works of both France and Germany are lighted by it. Insurance companies in Europe now refuse to insure exposition buildings unless lighted solely by electricity.

IMMENSITY OF THE BUSINESS.

The business of manufacturing gas, and the sale of gas for public and private illumination is, next to railroads, the greatest commercial and industrial enterprise in the world. In 1883 the United States and Canada had upwards of 900 gas companies and these companies had enlisted $300,000,000 of capital. In New York city alone, where there were six companies, there was employed an aggregate of $71,000,000, which yielded a gross annual revenue of $9,000,000 and a net revenue of $4,000,000. The public should now be prepared to accept a fact which is capable of demonstration, and that is the cheapness of electric incandescent lighting for commercial and private purposes as compared with gas.

To Thomas A. Edison the public is primarily indebted for the original development and introduction of the incandescent light system. Shortly after Mr. Edison's great discovery of a practical method of subdividing the electric light by means of a filament of carbon contained in a glass globe from which the air is exhausted, and which is rendered incandescent by an electric current, had been announced from Menlo Park, the Edison electric light company was organized for the purpose of utilizing it and placing the new light in the hands of the people of North and South America.

THE EDISON COMPANY.

The Edison electric light company has a capital of $1,080,000 and owns and controls all the fundamental and auxiliary patents of Mr. Edison and many others requisite to a comprehensive system of electric lighting, heat and power. The company was organized and established on a liberal basis, its functions as a parent company being simply to own and protect these patents, and to grant rights for their use.

It was the object of the Edison company to furnish its light in precisely the same manner that gas is supplied to the public, it having been demonstrated by experiment, in Mr. Edison's grounds at Menlo Park, that it was feasible, having distributed in this experiment upwards of 1,000 lights over an area of a mile square. As a result of this successful experiment there was organized in New York city the Edison Electric Illuminating company, which successfully lighted an area of upwards of a mile square. The result was a perfect demonstration of the practicability from every point of view of house to house lighting when the electricity is generated at a central station, distributed through conductors, under ground or overhead, and delivered to the consumer through a meter and used by him as desired, and with greater simplicity and more ready command than gas.

Many improvements have been effected since the first effort was made and today it is as economical to distribute over an area of several square miles as over one at the time of the inception of the first station, in New York city.

AS CHEAP AS GAS.

It is difficult for the public to understand or believe that electric lighting for private and commercial purposes can be furnished at the same cost to the consumer as gas. In illustration of the fact some points of comparison may be noted. The New York gas companies in 1883 disposed of an output of 4,267,050 measured cubic feet of gas, the cost of which was $5,000,000, or $1.16 per 1,000 cubic feet. These figures represent the cost of gas manufactured in the largest quantities. At Lawrence, Mass., there is an Edison station which furnishes light through 2,700 lamps, at a cost of 87½ cents for 3,000 candles of light, equivalent to 1,000 feet of gas. This represents the cost of production with coal at $5 per ton, and proves that the Edison light is cheaper, where produced in a small scale, than gas in a large scale. It is a conceded fact that it is impossible to make a gas plant of less than 1,000 standard jets yield adequate return on the investment unless an exorbitant price be charged to the consumer, whereas, with the Edison system a plant of only 800 lamps can be made to pay good dividends, even when sold in competition with gas when consumed on a large scale.

LYING GAS METERS.

The price charged by gas companies for their product is by no means a true indication of the real cost of illumination to the consumer. The gas meter itself is very unreliable. The registration may be so easily altered that, although nominally a consumer may be purchasing gas at $1 50 per 1,000 feet, yet, actually the cost to him may be triple that amount. Moreover, gas companies take credit to themselves for reducing their tariff. It generally happens that by the simple device of injecting a greater amount of air in their gas, thus reducing the illuminating power, they keep the bills of their customers the same as before the nominal reduction took place. Furthermore, gas burners deteriorate very rapidly and, although a consumer may be paying for gas having so-called standard illuminating power of sixteen candles, yet, from the defective state of his burners he may only be getting an illumination of ten or twelve candles. These sources of loss and annoyance to the consumers of gas do not accompany the Edison light, since the user of the latter does not, as in the case with gas, pay for a product which he himself must convert into light under conditions ofttimes unfavorable, but purchases and pays for light itself.

COMMERCIAL VALUE OF ELECTRIC LIGHTING.

The whole commercial success of electric lighting as a business depends very greatly in the multitude of cases upon the cost of turning a coal pile into light and the proportion of its latent energy which can be utilized. It is important, as well as interesting, to note the losses which are, in the light of progress thus far, inevitable. With the best steam boilers now manufactured there can be made available, in ordinary practice with the Edison system, an average of about 10 per cent. of the ultimate energy of the coal in effective steam. Allowing that 2 or 3 per cent. of this is lost between the boiler and the engine cylinder, it can deliver, perhaps, 85 per cent. through the mediumship of one of the larger sizes of Armington & Sims engines, as motive, at the pulley of a dynamo belted directly to the driving-wheel. The Edison 450-light dynamo, running 800 10-candle lamps, the standard electrical factor in the central station work, it is to be considered, converts 85 to 90 per cent. of the power supplied into electrical energy. A further loss of at least 12 per cent. takes place in consequence of the resistance of conductors between the terminals of the dynamo and the lamp on the system; and, lastly, the per cent. of the light actually developed by the incandescent carbons in the lamps is observed in its passage through the clearest white glass of which the bulbs can be made, leaving in available light from a 10-candle Edison lamp the equivalent of only about 6 per cent. of the latent energy of the coal required to produce it.

A STRIKING CONTRAST.

In contrast with the foregoing it may be said that by the gas process there can be obtained from a ton of coal twenty-four units of light for each thousand units of gas. This represents less than 3 per cent. of the actual energy in a ton of coal. As shown in the foregoing the electric process gives 6 per cent., a gain of 100 per cent. over the gas process.

These facts are of great interest to the Detroit public for reasons which are familiar to all consumers of gas. Perhaps in no city in the West has the disaffection with the gas service been so pronounced as in Detroit. The obstacles attending the introduction of incandescent lighting are fast disappearing before the enlightened researches of the practical scientist. Some of these obstacles still exist, but they are by no means as formidable as they were three years, or even one year, ago. Owing to the fact that gas is produced in very large quantities, the percentages of administration and general expense and depreciation are consequently proportionately very low, and, moreover, the business having been established for years, it can be conducted to the best possible advantage. With the electric light the case is very different, owing to its very recent development. The difficulties and consequent extraordinary expenses which naturally arise in connection with a new business are very considerable, and the general expenses are chargeable against a comparatively small output.

THE LIGHT FOR THE PEOPLE.

But notwithstanding it will be seen that incandescent lighting has been developed to a point where it can compete successfully with gas, even while the surrounding conditions are most favorable to the latter. It has been demonstrated that this new light, which lends itself in such a wondrous way to decorative and useful purposes, and which, from the fact that it conveys no noxious gases to the atmosphere of the house, nor takes from that atmosphere any of its vital properties, is so readily controlled, always at command and absolutely safe, and, in short, the perfection of artificial illumination, is attainable to all who wish to use it. To Mr. Edison alone belongs the credit of contributing this great boon to the world. This aside from all questions of dispute regarding inventions, for the reason that the Edison electric light company using his inventions is today absolutely unique in the industry of supplying electric light in the manner described.

ELECTRIC LIGHTING NOTES.

Underground Conductors for Greenock.

The Kinetic Engineering Company have received the order for the underground electric light cables for the lighting up of several of the streets in Greenock under the provisional order obtained by the Police Board. These cables will be of three types, namely, the main cable, consisting of 36 strands of copper wire, 1.5 millimetres in diameter; the branch main, consisting of 12 strands of 1.6 millimetres; and the leads for the lamp-posts, consisting of 1 strand of 1.2 millimetres diameter. These cables will be of the Berthoud-Borel type, insulated with Berthoud-Borel material and encased in a double sheathing of lead, the two sheathings being separated by a layer of gas-tar. A conductivity of 96 per cent. and an insulation of 1000 megohms per mile at the ordinary temperature are guaranteed. These cables will not be laid in any troughs or pipes. They will be tarred and then laid on a layer of fine sand placed in the bottom of the trench and covered with the same to a depth of about 4 in. A plank of wood or layer of bricks will be placed over the sand to indicate the presence of the cable to workmen afterwards taking up the street and save it from injury by their tools. Large quantities of these cables have thus been laid in many of the principal Continental towns and give complete satisfaction. By this method of laying the Berthoud-Borel cables effect a great saving in time and labour in placing mains underground.

THE ELECTRIC LIGHT ON SHIPBOARD.

At the first meeting of the present session of the Institution of Civil Engineers, on the 11th of November, Sir J. W. Bazalgette, C.B., President, in the chair, a paper was read on "Electric Lighting for Steamships," by Andrew Jamieson, Assoc. M. Inst. C.E., F.R.S.E.

The author commenced with the statement that, although it was not more than three years since the first application of incandescence electric lighting to the general illumination of steamships, the advantages accruing therefrom had been so universally recognised, that more one hundred and fifty ships had been fitted with it, and scarcely a man-of-war or a first-class passenger steamer now left the builder's hands without having it on board. This rapid success was mainly due to the following causes: 1. Electric lighting on the incandescence system, when properly fitted, was more healthful, cooler, more easily handled, and more artistic than other systems of lighting; there was no smell, and no products of combustion to tarnish giltwork; it was more agreeable in every way than any of the older methods of illumination. 2. The danger from fire was less, as neither matches nor lighted tapers were required. 3. The daily cleaning and replenishing of lamps, as well as the keeping in store of highly inflammable oil, paraffin, or candles, could to a greater extent be dispensed with. 4. The expense of maintenance was not much in excess of that of the other methods of illumination (in some cases less), whilst the space occupied by the plant was not great, and its position near to, or in, the engine-room caused no annoyance to passengers.

As the dynamo which furnished the electricity for feeding the incandescence lamps had to be driven at a uniform velocity, neither the ship's main engines, nor the donkey nor winch engines, were suitable for the purpose. The dynamo must have an engine for itself. It was, in most cases, necessary to place this special engine and the dynamo in such a position that the men on watch at the main engines could, with a minimum of trouble, also attend to the electric plant. This position, therefore, was naturally somewhere near the starting platform, and if possible on the ship's floors, so that undue vibration and noise might be avoided. Frequently a convenient recess could be provided, either immediately behind the main starting platform or opposite to the thrust-block, just outside the screwshaft-tunnel door. Only in large installations would it pay to have on board an electrician solely to attend to the dynamo, its engine, and lamps. In such cases a convenient and cool position was generally selected between decks, in the same compartment with, or in that next to, the refrigerating machinery, if such should be on board, so that one man might attend to both of these novel appliances.

Where practicable the axes of dynamos with large, heavy, armatures should be placed fore and aft, to obviate as much as possible the effects of gyrostatic action, since the angular velocity due to rolling was greatest athwartship. The author here gave Sir William Thomson's formula and examples, to show the pressure produced on the dynamo bearings, under different circumstances, by gyrostatic action.

In selecting a dynamo it was necessary to determine whether or not it fulfilled certain requirements: 1. It must develop electromotive force suitable for a certain lamp when driven at a certain definite speed. 2. It must be self-regulating; that was, the electromotive force generated at the given speed must remain constant to within 5 per cent., whether working one lamp or more, or the full number of lamps. It was preferable to have a slight fall in electromotive force as the number of lamps was reduced. 3. There must be no undue emission of sparks at the commutator brushes. 4. When running light, or with less than the full number of lamps, there must be no undue heating of any of the parts. 5. The conductivity of the copper wire with which it was wound must not be less than 96 per cent. of pure copper. 6. The insulation resistance of the armature and electro-magnets should not be less than 10,000 ohms per volt generated at the required speed. The dynamo should be tested mechanically and electrically before being put on board ship, and afterwards, when fixed in position, by a final trial of not less than six hours' duration, with its own engine, and with all the lamps in circuit. There was considerable diversity of opinion regarding the limit of speed of a dynamo on board ship. As a consequence of the general desire for low speeds, most of the best forms of dynamos, the Siemens, the Edison, the Edison-Hopkinson, the Victoria, the Ferranti-Thompson, and the Pilsen-Schuckert, had been specially modified for ship use, so as to produce the required electromotive force and current, at speeds varying from 400 to 650 revolutions per minute.

The success or failure of an installation on board ship depended as much upon the engine as upon the dynamo, and every care should be taken to procure one that needed the minimum of attention, and was not likely to break down. The engine should be capable of driving the dynamo during a voyage to Australia and back, without a hitch and without requiring overhauling. The demand for such engines, more especially for those driving direct, had led to the production of a great variety, many of them excellent in workmanship and in detail. It was frequently necessary that the engine should be capable of doing its work when supplied with steam either from the main or from the donkey boilers, so that the electric light might be available in port as well as at sea. This entailed capability for working under variable pressures, and thus the size of the engine must be adapted for the lower pressure. One of the most important adjuncts to the engine was its governor. It should be sufficiently sensitive and reliable in action to keep the engine within 5 per cent. of its normal speed, with a load varying 90 per cent., and a boiler pressure varying 10 lb. per square inch. No mechanical governor could do this, and consequently a good electrical governor, which would automatically open and close the throttle valve, in perfect synchronism with the load, or work to be done, and leave the valve in its last position until a change was made either in the load or in the steam pressure, was greatly to be desired. The author showed how this problem had been solved by means of his electrical governor.

Then were detailed the different methods of driving dynamos on board ship by belts, ropes, gearing, direct-driving fast-speed engines, such as Brotherhood's, the Westinghouse, Messrs. Siemens' frictional drive, &c. The author explained the methods of fitting leading wires into vessels, instancing certain well-known cases by plans of the s.s. Adelaide and the s.s. Arawa; and gave a practical rule which he had been in the habit of using for the dimensions of such wires. Insulation resistance was too often neglected by electric light engineers. Amongst submarine telegraph engineers it was considered of vital importance to watch the insulation resistance with the most rigid accuracy, not only during the manufacture of a cable, but during its submersion and after it had been laid; whereas, in the case of electric lighting, those charged with the fitting up of an installation very seldom thought of, or even knew how to take insulation tests, either of the dynamo or of the leading wires. It was far from right to allow leads to be run up like bell wires, without the slightest knowledge as to whether a flaw or a fault had crept in, and all engineers should insist upon rigid inspection, as well as thorough and searching tests, before an installation was passed. The insulation resistance standard need not be nearly so high as in the case of submarine cables; but nevertheless it did require to be several hundred times more than the copper resistance, otherwise a fault would soon develop, and short-circuiting occur, under the combined influences of the electromotive force, and damp or wet. The dielectric should, therefore, in addition to being a good insulator, be thoroughly water-tight, and as little liable as possible to be affected by atmospheric changes. The author then gave a description of what he had found to be the best form of switches, fusible plugs, lamp-holders, lanterns, and globes. Finally he directed attention to the powerful search-lights used on board men-of-war, and to the novel application of arc-lighting for salvage and fishing purposes.

The paper was illustrated by a large number of diagrams.

ELECTRIC LIGHTING NOTES.

The Edison and Swan United Electric Light Company have recently completed another very successful electric lighting installation on a Clyde-built vessel the ship in question being the paddle-steamer San Martin, built by Messrs. Napier, Shanks, and Bell, Yoker, near Glasgow, for the Lloyd Argentino Company, of Buenos Ayres, under the inspection of Senor Brugo, the president of the company. Current is obtained from a 200-light Edison-Hopkinson dynamo made by Messrs. Mather and Platt, Manchester. This machine is specially designed for withstanding the mal-influence of the moisture, dirt, and oil which are inseparable attendants of machinery on board steamships. It is actuated by a Tangye vertical engine of 10 horse-power. The conducting wires are led from the dynamo to all parts of the ship and are protected behind mouldings which are suitably combined with the general decorations of the vessel in the public rooms; but they are so arranged as to be everywhere accessible. There are in all 157 electric lights in the vessel. Each state room has a light wholly for itself, and a switch is provided for each lamp, so as to give the passenger absolute control over it. On each side of the drawing-room saloons there are plain but substantial plated brackets, while the dining saloon is fitted with eight handsome two-light pendants supplied by Messrs. M'Geoch and Co., Glasgow. In order to provide against any accident from short circuits the lamps are arranged in about twenty sections, each of which is protected by a lead safety fuse which can be renewed in an instant on the removal of a water-tight case with which each is fitted. In the alley ways, and throughout the several decks and engine-room, specially strong and water-tight fittings have been used.

During the past week the Lords of the Admiralty have been making their annual inspection at Portsmouth, and among other matters the electric lighting of the ships of the Navy occupied their attention, as great extensions have been made in this department during the last twelve months. The Edison system is now at work in four of the Indian troopships, and will be soon fitted to the Euphrates. The torpedo ram Polyphemus has been furnished with two Siemens dynamos and Swan lamps, the conductors being arranged on the single-wire system which utilises the metal of the ship for the return lead. The introduction of this system into the Navy is a novelty, but it has been universally employed by Messrs Siemens Brothers in the merchant marine, and presents many valuable advantages over the double-wire system, being exceedingly simple to understand and remarkably free from danger. In the engine and boiler rooms the leads are carried in iron pipes to defend them from wet and grease. The complete installation consists of two arc search lights, 220 incandescence lamps for internal lighting, and a yard-arm reflector fitted with eight 50-candle power incandescence lamps. Each dynamo, and the engine by which it is driven, is capable of feeding a search light of 25,000 candles, or 150 incandescence lamps, and can be applied to either purpose at will. The Bacchante and the Triumph have been fitted with D Gramme machines for search-light purposes, but it is not probable that more of this type will be employed, as they cannot stand continuous working without becoming dangerously hot. The Volage has the Wilde improved machine. The chief interest, however, was excited by the Colossus, in which the electric lighting has been carried out most extensively, every department of the ship having its own lamps and switches. The general arrangement comprises a day and night circuit for the mess, decks, citadel, passages, and working parts of the ship, while the stores and other smaller compartments have their own lights and switches. The night circuit includes sufficient lamps to enable the ship to be patrolled without lanterns. The whole of the lamps are fixed in spring holders, as described in our notice of the Brush system at the Health Exhibition, to prevent the filaments being broken by the concussion of the heavy guns. The switch-board in the dynamo room has six main circuits, two leading to the projectors, a third to the forward part of the ship, and supplying ninety 10-candle lamps and fifty 20-candle lamps, a fourth to the after portion, where there are fifty-five 10-candle power and forty-six 20-candle power lamps. The others light the citadel where there are thirty-one 10-candle power and thirteen 20-candle power lamps, and the engine-room, which has sixty-eight of smaller and fourteen of the large lamps. There are three Victoria dynamos, each driven by a Brotherhood engine, either of which can light the whole ship. The other two are available for the search lights. The installation includes two yardarm reflectors, each containing eight 40-candle power lamps, capable of being affixed to any part of the rigging for coaling and the like. The whole of the installation has been carried out by the Brush Company, who employ their slow-speed machines in all their ship-work, and have given the greatest satisfaction to the naval authorities by the excellent manner in which they have carried out their contract. The following Table, which we take from the *Times*, together with some of the above particulars, shows the size of the various floating installations at Portsmouth:

Ship's Name.	Dynamos.	Engine.	Lamps.		Candle-Power.
			Half.	Whole.	
Crocodile ..	Edison-Hopkinson	Brotherhood	288	96	10 and 16
Malabar ..	Edison ..	Ditto	204	115	16 „ 8
Serapis ..	„ ..	Gwynne	299	101	16 „ 10
Polyphemus	Siemens compound	Brotherhood	..	220	20
Colossus ..	Victoria ..	Ditto	250	230	20 and 10

N. Y. Building May 85.

The new custom house and post office building in St. Louis is lighted mainly by electricity, there being 672 incandescent and thirty arc lamps in use. In December, when gas and nothing but gas was used for lighting, the bill was $2,553. In February, when gas lighting had given way to the electric light on the first and second floors, the gas bill was $702, and the cost of electric lighting, including operating expenses, was about $1,300. Or in other words, the Government saved about $450 a month in changing from gas to electricity.

Harrisburg Independent May 2nd 1885

EDISON ELECTRIC LIGHT.

Successfully and Satisfactorily Introduced in Harrisburg Last Night.

BRILLIANT AND STEADY FLAME.

Illumination Soft and Diffusive in Effects.

FAVORABLE POPULAR ENDORSEMENT.

A large crowd congregated in Market, Third and Second streets last evening to witness the turning on of the Edison Incandescent Electric Light. It was about 7.30 when the dynamos and electrical machinery were connected. Notwithstanding unfavorable atmospheric conditions last evening and that an immense load was turned on for the first time the light was inaugurated under the most favorable auspices. It having been announced that the light would be turned on May 1 the careless of the house company would not allow the public to be disappointed. When it is considered that the light, so far as this city was concerned, is an experiment, that 2,000 lights had to be turned on without being able to test them, excepting with a battery, the success of the undertaking can be comprehended. The station starts with 2000 lights, a number of lights of any station previously started. It is due to the liberal policy of the company in the matter of free wiring, which will be continued until June 1st, after which time all the wiring will be at the expense of the consumer, as in other cities. For the above reasons it was not expected that the Electric Lights would be turned on without interruption or accident. The company however was most agreeably surprised to find that with but two or three exceptions the lights in every building burned. Owing to the absence of certain electrical machinery and want of time to connect the indicators, the system was in some cases unbalanced, the lights on one side of the system burning brighter than the lights from the other wire. All defects will be remedied in a day or two, when the lights will be in good working condition.

A large number of distinguished gentlemen connected with the present Edison Company, of New York, as well as many interested in the business from other cities were present. All expressed themselves as highly pleased and considered the starting a great success, especially under the circumstances. Mr. Edison was unable to be present last evening, but is expected soon.

The details of the plant have already been published in these columns. All the machinery, engines, boilers, etc., was furnished by the Foundry and Machine Department under the personal supervision of H. B. Hershey, Esq., Superintendent, assisted by Mr. Thomas Reese. The verdict of competent judges last evening was that they had seldom seen a more complete and thoroughly mechanical job. Mr. Ide, the inventor of the engines, was present to assist at the starting. Mr. W. S. Andrews, Chief Electrician of the Edison Company, assisted by Mr. Theron Byington, of Meriden, Conn., who put up the electrical work in the station, were in charge of the dynamos. Mr. Batchelor, of the Edison machine works, manufacturers of the dynamos, was also present.

The outside and inside wiring was under the immediate supervision of Mr. C. B. Story, of Johnson, Vt., as examination of which will convey an idea of the amount of work performed in three months. He was ably assisted in the inside wiring by Mr. W. H. Jacobs, an expert, of Circleville, Ohio.

The Auditor General's Department, the main building, as well as the House and Senate, are already wired, and the light will be turned on as soon as the outer line is built, about Monday evening.

The light will be all that was predicted for it—a beautiful mellow light, without glare or flicker, no heat or combustion of oxygen, to render the air impure, perfectly safe and instantaneously turned on or off by means of the key. If necessary, all the lights in a room can be controlled by a single key.

The Company was exceedingly fortunate in having the services of Messrs. Story and spencer, thorough and practical electricians, by whom the plant was erected.

The stock of the Company has all been taken, the stockholders working harmoniously together in their efforts to give the city a better light than gas. A vast amount of work had to be done in which they met with hearty co-operation from the citizens, with the exception of a few chronic fossilsize who are an impediment to any city and desire to obstruct all improvements, and who are mainly responsible for the slow growth of the city in the past.

It is the intention of the Company to run the plant as rapidly as possible. It is anticipated that another engine and set of dynamos will soon have to be placed in the station, as the capacity of the plant, 2,000 lights, is fully or altogether taken. Feeders will be run in different sections as the demand warrants. Foundations and bolts for two extra engines and four dynamos were built when the station was constructed. Surplus boiler power was also provided for. As soon as the plant has been working order the light will be on continuously day and night, as there are three engines.

The light is supplied on the contract basis, a rate for each for each lamp per month per year. The life of a lamp is 1,000 hundred burning hours, replaced at the expense of the company when burned out, when carelessly or accidentally destroyed at the expense of the consumer.

The company is purely a local one, composed of Harrisburg business men. The officers and directors are: President, E. S. Wallower; Treasurer and Secretary, John L. Begge; Directors, E. S. Wallower, Thomas B. Holst, Joseph Strouse, J. L. Paul, B. Cohen, H. J. Stewart, B. M. Neal, W. H. Eby, and H. A. Clark, who represents the Edison interests.

The entire plant, buildings, machinery and installation has been constructed in a first class manner and will reflect credit on the city. The investment approaches very close to $100,000 and is expected to pay a dividend the first year.

Harrisburg Independent May 9th 1885

The Electric Light.

Now that the electric light has come to Norwalk, possibly to stay, a few words of explanation may be timely.

It is proposed to establish a "station" where the latent heat of coal may be converted into electricity, which, after passing over wires, shall be reconverted into heat in the lamps in stores or elsewhere.

The essentials of such a station are steam boilers, steam engines, and dynamos, otherwise known as electric generators.

The consumption of coal is a chemical process, developing heat. This communicated to the water in the boilers converts a portion into steam which, conveyed to the cylinder, becomes the physical to move and the wheels to revolve. The belt from the driving pulley of the engine connects with the pulley of the dynamo, and revolves a cylindrical armature between the poles of a powerful horseshoe magnet.

The common horseshoe magnet, taken as a toy, is accompanied by a bar of iron which, when the magnet is not in use, is held across the two ends or poles of the magnet, and the boys call it a "keeper." Electricians call it an armature.

The armature of a dynamo is not a bar but a spool, wound with wire from end to end as the the boys wind a kite string or a fishing line. Now imagine the ends of the magnet until the arms are about half an inch in diameter and the arm correspondingly large, and place the spool wound armature between instead of across the ends of the horse shoe, and you have the generator complete, and electricity is generated. An armature depending on the speed with which the armature is caused to revolve.

One end of the shaft of the dynamo is bare, and on it rest the prongs, which collect the electricity. Those are joined to the copper distributing wires which convey the electricity wherever it is to be used.

The electric light wires are of copper because copper is the best available conductor of electricity, conveying it with the least waste or loss. Electricity in its passage produces friction in a greater or less degree according to the "conductivity" of the medium through or over which it passes. It passes freely over copper but carbon is almost a nonconductor, and often when resistance that it becomes of a white heat from friction when a current of electricity is forced over it, and the Edison electric light is produced by placing a carbon in electricity over a loop of carbonized lamicon.

The Edison "lamp" is a pear-shaped hollow globe from the interior of which the air has been exhausted, and the carbon loop within is protected from atmospheric oxygen which, if permitted to reach the carbon, would immediately consume it. Protected from oxygen, the delicate thread of carbon is not consumed at any heat. When you look at the "electric light" you see nothing but a thread or filament of charcoal heated to white heat within the bulb of a pear shaped glass.

There are numerous words used by electricians which will come into frequent use here if an Edison station is established in Norwalk. We give a few definitions. *Dynamo*: An electrical machine, composed of a horse-shoe magnet, an armature and a commutator. The armature has been defined above. *Commutator*: That part of the dynamo which collects the electricity from the armature and conveys it to the wires. *Incandescent*: heated to a white heat. *Carbon*: charcoal. *Ohm*: the unit of the measure of resistance to the passage of electricity, the same as a gallon is the unit of the measure of fluid capacity, or a pound the unit of the measure of weight. *Volt*: the unit of the measure of electric force or intensity. *Ampere*: the unit of the measure of the quantity of an electric current. *Indicator*: used are the Dynamometer, or force measurer; the Galvanometer, or load measurer, in some respects similar to a thermometer; the Galvanometer, or measurer of galvanic electricity, and the Electrometer, or measurer of Electricity.

The lamps are lighted or extinguished by means of "switches," which are turned by thumb pieces similar to those used to turn gas on or off. They simply connect or disconnect the outer wires when the current of electricity is passing. Turned "on," they complete the current to pass over the carbon; turned "off," the current passes easily over the copper wires.

Harrisburg Independent May 19, 1885

THE NEW ELECTRIC LIGHT.

Satisfactory Operation of the Edison Incandescent Illuminant.

ITS SUCCESS IN HARRISBURG.

Convenience, Safety and Comfort Combined With Steady Brilliance.

HOW, PRODUCED AND HOW SERVED.

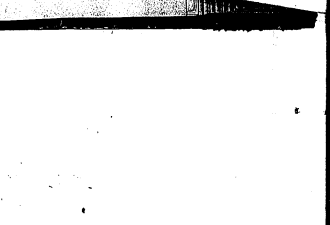
The new Edison Electric Light turned on May 1st has been running successfully and without interruption, excepting during the day to enable the force of wirers to make connections. The business of the Company is gradually assuming a system. The few consumers who had not been properly wired and those who had connected, for an insufficient number of lamps have been very patient, and the usual unavoidable and unforseen details incident to the starting of a new station, as well as all defects are being ailiminated. The light will be turned on during the day shortly, and the entire system is expected to run smoothly. The light has been received with admiration on all hands and notwithstanding the magnificent quality of gas, never surpassed in this city, the difference is plainly discerned. Already the absence of heat, cleanliness of show windows, the convenience, and the absence of the match nuisance, are being realized and appreciated.

At the station crowds of curious and interested people sit the windows watch the movements of the beautiful machinery. The perfectly regulating ide engines run like sewing machines. All the parts are in harmony. The speed indicators show no variation from no load to full load, running at a speed of 300 and 350 revolutions per minute. The dynamos work harmoniously and clean, displaying the machinery and electrical apparatus to advantage. The fluted wood finish on all sides and in the ceiling adds to harmony with the rest of the building. The Harrisburg station is considered the finest and best room in the country and reflects credit on Harrisburg mechanics. The dynamos, regulators, equalizers, switches, bars and rods, are all objects of great interest, and the room seems more like a wizard's shop than burning gas. By touching the bars of steel the full current of the system can be taken into the system. A shock will be experienced, never sufficient to injure but varying according to the intensity of the subject. The Governor' room, reception rooms, and store rooms are all lighted in yellow glass and correspond with the engine room.

On the second floor, rooms from the ceiling, are numerous beautiful chandeliers showing the adaptation of the light. On the side walls are samples of various styles of brackets. All are controlled by switches which flash the light instantaneously and as quickly extinguish it.

Admittance is secured by passes from the officers or in company with a Director. No one but employes is allowed in the engine room unless accompanied by a Director. The rules of the station are strictly enforced, and no talking to employes is allowed.

Several short circuits have been caused by persons tampering with the sockets of the lamps and wires, causing the lights to be extinguished but no harm where the lights have been tampered with. There are people in every city who know all about a new business, and after several inquiries occur it is expected the company will be the way of experimenting, or what would be more likely, it is impossible to be harmoniously with the current, the experiences of many experience very freely shock. Painters, carpenters and others are also reminded not to come in contact with the street wires as the current will be in the wires at all times.



Boston Globe
May 13, 1885

LIGHTING LIGHTING IN BOSTON

Successful New York Experiment Likely to be Tried in the Hub.

We hear excellent reports from New York regarding the newly-organized American Electric Manufacturing Company, which is already taking a very prominent position among the electrical companies, and the combination lately consummated between it and the Edison company is certain to give the allied companies very great prestige, which is certain to be materially benefited. It is said that steps are now under way to form a similar combination in Boston. The combination system created Holborn station in New York, in the vicinity of Madison square, for Edison incandescent lights and American arc lights on a scale far ahead of anything yet attempted in the way of electric lighting. For some time the Jamestown Edison station, better known as the "Pearl Street station," did not pay, but now that the mistakes in building have been overcome and the system perfected the station is found to be the most profitable of the kind in the country, earning 4 per cent. on the capital invested, viz., about $1,200,000. Now it is claimed that it can be duplicated for not more than one-quarter of that amount, so that a combined American-Edison plant is sure of a very prosperous business, with good dividends on the investment.

We learn that the subject of a large combined central station is also under consideration for Boston, and that an American-Edison company will most likely be organized to put in a plant somewhat similar to the Newport plant yet in. Another feature of this combination which is of particular interest to the people of Boston is the fact that underground conductors would be used, as before by the Edison company in New York, removing the objection to overhead wires. If the American company are successful, this reform in the business will find the people of Boston ready to lend their hearty support. Certainly, any movement which will relieve our streets of the unsightly mess of wires and poles ordinarily be commended by all citizens.

Troy, N.Y. Times
May 13/85

THE ELECTRIC LIGHT.

Different Ways of Constructing a Contract—Machinery on Hand.

The published statement that Comptroller Spicer will let electric light company forfeited fifty cents a night for each light not in operation at the expiration of ten days after the beginning of its contract, caused the persons interested in the electric light to procure a copy of the contract.

AN ATTORNEY WITH THE PURCHASE.

An attorney has examined the contract and specifications in the case of the Jackson Arc company and this warning: "There is nothing in the contract or specifications that can be construed as a penalty of forfeiture until the company shall have begun operations, and then only for that portion of poles and lights not in use. The company is to have a reasonable time to do this. The gentlemen who have purchased stock in the company are satisfied that there is no forfeiture on the part of the new company. Mr. Spicer caused the examination to be made, and he is satisfied with it. Parsons is a long pole purchase, and Mr. Parsons nothing in these lists to charge his company a little to the property at Liberty and River streets is being investigated, and I presume it will be found all right. The transfer of machinery and other details of the enterprises will be carried out in accordance with the statements already published in the Times."

THE OSTRANDER VIEWS.

The contract with the Troy Gaslight company was executed April 20, and is for one year. The company is required to furnish 100 arc electric lights, or as many as may be ordered, according to the specifications, each burning six hours per night. The coming campaign of the specifications provides that fifty cents shall be deducted from the contract price for each light not burning each night. This, the committee say, takes effect from the date the company began operating one light, or at the expiration of ten days after the execution of the contract.

THE CITY ENGINEER'S VIEWS.

City Engineer Fuller is required to locate the poles and lights, and see that the work is erected, and that everything is done in erect the poles. When asked to-day if the forfeiture provision in the specifications is now in operation against the company, Mr. Fuller said: "Not at all. The specifications provide that the forfeiture shall begin after the electric light company is entitled to a certain time in which to secure machinery and erect poles."

NEW MACHINERY.

The new machinery received consists of two dynamos with a capacity of 100 lights! As soon as the examination of poles is concluded the company will immediately carry out all the requirements necessary to fulfil the contract.

N.Y. Herald
May 16/85

The Electric Light and Plant Growth.

A correspondent of the *Scientific American* recently discussed in that journal some evidence showing that the electric light is productive of plant growth. One of the best known florists of New York states that plants grown for decorative purposes in rooms electrically lighted seem to have all the health and vigor of plants under the light of a conservatory. This opinion is fortified by the observation that the flowers of Camellias and roses develop better on the mantel at nights of winter than on those in which there is no moonlight.

Fortunately for the interests of florists the effect of the electric light on plants has been scientifically traced in some degree. In 1880 Dr. G. W. Siemens made a series of experiments, the general result of which was that plants kept entirely in the dark soon died; those exposed to the electric light only or to daylight only threve about equally, and those exposed both electric light and daylight threve far better than either. Dr. Siemens exhibited to the Royal Society the specimens of the several plants upon which he experimented, which fully demonstrated the correctness of his deductions, and before his audience placed a pot of budding tulips in the full brightness of an electric lamp, the buds in about forty minutes expanding into full bloom. The evidence subsequently offered by Dr. Schübler, of Christiania, that plants under the continuous light of the Norwegian "midnight sun" develop more brilliant flowers and larger and more aromatic fruit than under the alternating influence of light and darkness, greatly strengthens the theory that the electric light may be profitably employed in horticulture. Observation shows that diurnal repose is not necessary for the life of plants, for in the northern regions of Scandinavia, where the summer is so short and the sunlight almost uninterrupted, vegetation flourishes except when chilled by boreal blasts from the Arctic Ocean.

The public, as well as florists and horticulturists, would be deeply interested in experiments made by the Department of Agriculture to determine the conditions under which the electric light might be advantageously and economically employed in forcing the growth of garden and hothouse plants.

N.Y. Times
May 18/85

To Electric Light Williamsburgh.

Electric-light poles are being placed on Bedford avenue, from Division avenue to Grand street, by the Municipal Electric-Light Company, which are to have on the poles, each, 1,200-candle-power lamps. When a moonlight night is caused by the absence of gas, the contracts to the Municipal Company will be void. The poles are placed 150 feet apart, and the lights 17 feet above the pavement. The poles are placed on the curbstone next to the sidewalk, and the contract calls for 100 lights. It is the understanding that experimental lights will be put up on Bedford avenue, and if satisfactory the poles will be placed on the other avenues mentioned. If the lights are satisfactory the poles may be extended to the Boulevard, and to the following streets in the Eastern district: Fourth street, Fifth street, Bushwick avenue, Broadway, Franklin street, and Manhattan avenue.

Commercial Adv.
May 19/85

A RAILWAY RUNS BY ELECTRICITY AND IS NOT BLOWN UP.

The contractors for the Stanton and Barber railroad have decided to adopt electric motive power. The street car "accelerator" is the obstacle as to climate, etc., of which so much has been said. By this means they intend to construct the road during nighttime, when the temperature will be such as Europeans can withstand with tolerable ease, while during the heat of the day they can take their rest.

To carry out this arrangement a firm of Leeds, England, have already supplied two complete installations for electric lighting.

The engine, boiler and dynamo for each set, as well as the supports for the lamps when not in use, are all neatly fixed on a specially designed light railway truck. When in use the lamps will be hung from iron tripods 30 feet in height, and placed at intervals of 30 yards along the line of the proposed railway. These tripods are made of light iron tubing jointed at the top and made telescopic in the middle, so that they can be folded together, removed and united wherever required with the least possible trouble. The insulated cable to convey the electric current to the lamps is coiled on reels, two being supplied with each installation. On these reels the cable can be run off or wound up, as required. The lamps, which are of 2,000 candle-power each, can also be lowered forward, one at a time, from one end to the other as the work of reconstruction proceeds, a convenient arrangement being provided for the cutting off of the current from any particular lamp without interference with any of the others. The dynamo machines are of the Brush type and are driven by Parsons's patent high-speed engines. The boilers are of the locomotive type and are coupled by means of a feed pump with water from a tank fixed under the dynamo machine, which latter, by the means, is also kept cool during work. The cutters of the lamps are arranged to burn for a period of sixteen hours.—*Iron Age.*

Graphic - May 21/85

In a recent instructive essay on "Electric Lighting," Mr. Mattieu Williams, F. R. A. S., incidentally alluding to the cost and price of illuminating gas, says:

I refer more particularly to the practical and oriental question of economy. So far as economy, and consequently price, is concerned, the electric lighting interests have been developed with a power and skill furnished by the achievements of modern chemistry and engineering, which the gas-makers vainly try to meet by the utilization of the waste products of the gas itself as a volatile, magnificent coal-tar fuel. It would speedily and practically burn itself, and thanks to scientific bye-laws, is thus rendered harmless. Its value is so great that in less than nine months in London at one shilling per 1,000 cubic feet, if gas makers were compelled, as they ought to be compelled, to utilize it, it would be a considerable commodity and would subject us to a lucrative stimulating influence of free competition and private enterprise.

This is the language not of a dyspeptic but of a clear-headed, respected and dispassionate scientist. I therefore declare that the London companies merit confiscation for their extortion. New York solicits a much milder measure of protection against the tyranny of the meter.

Commercial Gazette (Cincinnati)
Sunday June 21st 1885.

GAS VS. ELECTRICITY.

[From Minneapolis Tribune.]

I was extremely obliged for the very excellent report of the interview which the Tribune printed upon the above subject. Mr. Herrick gave me a pleasant hour, and I only wish he might stay in town.

Mr. Herrick says—the interview was compiled in describing the process and progress in gas-making, the value of the residuals, and the various industries now dependent on gas products. I did not refer to another very important matter, however, well worth mention—the steadily increasing demand for gas in heating and cooking, and the gas engine. The day when gas-stoves will be in general use is not unnecessarily far good authority at the present. William Sinclair has affirmed that the day is not far distant when coal for domestic use, except cooking, heating and cooking will be entirely discontinued in our cities, and gaseous fuel will take its place. He argues that the expense and trouble consequent on the use of coal for household purposes is enormous, and that the cost of heating by gas on an at 1,000 cubic feet does not cost at per ton. Gas can be shut off after using it until it is continuous. Gas consumes itself to the point of consumption. Coal must be handled by the shovelful. There are over twenty thousand gas engines in operation. The electric light says nothing to gas in many ways, but the best power for running a dynamo. In a city like Minneapolis it is not a question of ability to light it, but it will be a necessity in it, at 3d dark and midnight. The curious is the use light are primarily made from the carbon which accumulates in gas-making retorts, gas-tar and the immediate by-products by burning the heavy oil of coal-tar. By the way, the here let me remark that no report of the last private lighting will ever be a success which does not include a description of the valid agent in illuminations, the electric light. Daily expenditures for carbon may be small, but were accounted annually it forms, with the manual labor of replacement, a formidable item. Incorporation of the electric light company for each are light.

Mr. Herrick advocates clubs; that where one-half dozen or more, the additional cost of lighting is not appreciable. Minneapolis has already tried it—has to get something better than has been accomplished. As to application of the Edison Incandescent Lighting System for a corner of Pearl and Third streets, No. 7, which I have frequently visited, suffices to say that I cause the Edison to be "successful and nothing" in the way of dividends. The "successful" is due to the steadiness of the generator, to the steam superintendence of various stations for eight years, and the economy has never paid one cent to the organization, four years ago, but sold. The Weil system (improvements and installations) was based than in 1882 a six-percent. dividend. Mr. Herrick says "original." As there is not an instance on record in this country or Europe, where an arc or incandescent company, paying a dividend for lighting such as is paid a dividend, it is fair to assume that, with the capital by increasing in price, the electric light stocks, before we will wait a long time to get "something for nothing."

The illumination is simply power, reduced to light, or, more simply still, under the same boiler-power in a gas engine, burned at the carbon point. The Otto Silent Gas Engine of the Centennial was run more economically, proportionately, than one burning coal, therefore saving an aggregate equivalent power. The subdivision of power always increases the proportionate cost. But in the subdivision of the electric current the light given by twenty arc lights of a thousand candle power is not so great as is represented in a single light, therefore, when the current is subdivided into the incandescent lamps or the largest, the 100-candle light (incandescent), the cost is increased by four times of 20 horse-power arc light, as seen in the streets of Minneapolis at seventy-five cents per night, is equivalent to paying for the same light from gas $5 per 1,000 cubic feet. Incandescent lights of the same power would, at the price charged for them here and elsewhere, be equivalent to gas at four 1,000 cubic feet.

Mr. Herrick says that Thomson-Houston people will, if asked, tell you that they can furnish that is given more light, a steadier light, a cooler light, &c. He will not tell you that it is arc-candle light, for however neat work, twelve the week after, ten in four weeks, and thousand hours, when the carbon expand on the interior of the lamp due to the oxygen which is never entirely eliminated. Neither does he tell you that these lamps cost you $1 each. Mr. Herrick says that the first current to burn incandescents was a larger one, and that now not tell you that these lamps cost you $1 each. He does not tell you that Mr. Edison himself —he of the "only original Aladdin lamp"—is often left to distance in his famous laboratory because the electric current won't do the incandescent burning. He never does thoroughly assert that. He will not tell you that nature's electricity, often, plays the deuce with Edison's, Brush's, Weston's, Thomson-Houston's, Fuller's, Swan's and Schuyler's currently. All who were present a year ago at the Coliseum on the occasion of the Thomson festival will never forget the terrible thunder storm—the lightning strokes—the extinguished lights—the almost frightful tumult—the total darkness—the shrieking women and trembling men. That very result is a commonplace in every city in the universe that is changing the mode of lighting its streets. To-day I interviewed the intelligent electrician of the West Hotel. He and an associate had charge of the Coliseum lighting. His colleague, who was near the dynamo, received a blistering stroke that left a mark down his shoulder, and one is crabbing and bent to this day. Since this party has retired from the electrical business, and is now engaged in what he added, "We always unharness the dynamo at the end of the day's run." But how about thunder-storms at night," I asked. He replied, "We still always executing an accident." In Chicago last week, during that terrific storm, the lightning destroyed an electric light, separated the wire, and left it in contact with wood work on a building in the center of the city, a fire resulted, and the whole block was in the ruins of the wires. The firemen were unable to get but not the same effect on the electric current of this sort, but it has an electric light stock; put until the manoeuvers were sent to the central station and the great dynamo shut off was the fire put out. At the same time by shutting down, it put out forty arc lights in hotels, saloons, restaurants and stores. During the great storm in New York, in 1882, never a light but that, except where the electric lights went out for a season less than a minute, are very unsteady, as are all arc and incandescent lights. It is the only unpleasant feature of this otherwise perfect establishment.

It is just as impossible to rent or write with, and steaming pitifully the eye sight, under an incandescent as an arc light. Since the introduction of the incandescent on the Fall River boats, reading is almost entirely ceased. It is unsteady as to flame, and trembles with the motion of the boat, and travelers complain bitterly. Even the Fall River railway depot in Cincinnati is ill, about with the incandescent, and complains of the same. I was there three weeks ago. It was quite table to read a newspaper anywhere except in the waiting-room and ticket offices, where the baggage and ticket offices, where all business is done.

The (so-called) 100 incandescent light, now abundant as sixteen-candle gaslights. Even in London recently the Duke of Sutherland installed the incandescent light in Stafford House, one of the great residences of the English aristocracy. The Edison Electric Company, and was placed on the best terms with the Duke, as a distributor. The experiment is over. He removed it after three months' trial, and soon he personally stated to me: "Too expensive cost. It's all he could have the electric light in my business." It is my opinion that the cost of three months' incandescent light is considerable's unreliability; it will set it at a good deal nearer hazard than any Detroit alderman will ever touch; but the people who pay the bills and who do not get any of the "dirt" would like to have it brought down to the street level for mortal use, leaving the stellar depths of space unlighted until the hard times are over, anyhow. In short, the electric light ought not to be stood at an altitude of more than twenty feet, and there ought to be at least two lights on each block. That is an improvement that will be worth something, and it must come.

THE DETROIT POST

O. L. STANDISH, Editor and Proprietor.

FRIDAY, JUNE 5, 1885.

THERE can be little or no question that electricity will give the light of the future, but the present method of lighting the streets of Detroit leaves the light altogether too far into the future. Detroit is well provided with the "contrivance of the dawn," it would like, just now, a little of the "dying" rose of Sharon." It may be important to squander nine-tenths of the light of good deal nearer heaven; than any Detroit alderman will ever touch; but the people who pay the bills and who do not get any of the "dirt" would like to have it brought down to the street level for mortal use, leaving the stellar depths of space unlighted until the hard times are over, anyhow. In short, the electric light ought not to be stood at an altitude of more than twenty feet, and there ought to be at least two lights on each block. That is an improvement that will be worth something, and it must come.

Why Capitol Lights Questions.

To the Editor of the Free Press:

There appeared a communication a piece of poor paper (Sept 26) on certain intended "electricity on Gas," which began the new series of a certain class of articles which will be found in the Free Press. Now, I am not going to say that the gas people will not from now right of date for their bills in particular upon their newspapers of the country, but I am sure that a certain number of them, if not a large number, will do what they have given the matter any thought. Now, I am not going to say that I am not a great lover of the electric light, but I am serious number of them, if not a large number, will do what they have given the matter any thought. Now, I am not going to say that I am not a great lover of the electric light, but I am serious enough to say that I am not a great lover of the electric light, but I am serious enough to say that I am not a great lover of the electric light, but I am serious enough

Character of article Ed.
From the Galignani's New Paris Edition
Published at
Date July 19, 1885

A RIVAL OF EDISON.

A very interesting séance took place on Friday last at the extensive workshops now in Paris of the well-known mechanical engineer and inventor, Bazin, who, in the opinion of the most competent electricians, has at last succeeded in rendering practically useful for domestic purposes, lighting by electricity, combined with small motive power.

The simplicity and completeness of this system puts it within the reach of all classes, and is calculated to produce results as remarkable as those which followed the accidental discovery of the power of steam by James Watt.

M. Bazin was highly complimented by all who witnessed his practical demonstrations and lucid explanations. Among those present we noticed M. Ferdinand de Lesseps; the Hon. L. P. Morton, ex-United States Minister to France; M. George Berger, the Director of the Foreign Sections of the Universal Exhibition of 1878 and President of the various International Electrical Exhibitions; M. Bapard, Chief Engineer of the Western Railway of France; M. Marcechal, Deputy; Mr. Walter W. Barker, of the U.S. Commission, and Member of the Jury of the Universal Exhibition of 1878; Baron de Gunhoung; Mr. H. E. Ellis, Mr. Morton's private secretary; and several professors of the École Polytechnique.

This invention is attracting the attention of electricians and others all over the world, and before long will be in practical operation.

Character of article Ed.
From the Mail & Express
Published at N.Y.
Date Aug 1885

* Temporary electric lighting is in use at the hotels in London, as it avoids the heat which even gas enables rooms. The loss of electric light is small, like concentrated sunlight, and its rural intensity is exerted by flooding trees and dewdrops with instruments that pick among the forms and leaves. In small glass globes of different colors, like thousands of jewelled flakes glancing among ferns and palms leave Aladdin's dream in the background.

Character of article Ed.
From the Republican
Published at
Date July 17, 1885.

Electric Light Notes.

Tuesday the Edison Electric Illuminating Company of West Chester submitted to the Borough Council a proposition, in which it was stated that they would light the town of West Chester every night in the year, and all night long, for the sum of $2,250 per annum. They would furnish 114 lights of 2,000 candle power each, and 25 extra lights. The proposition will be considered by the Council, and an answer given later. Last year it cost nearly $4000 to light the borough with gas for one night, and $14 a night to light the clock of the Court House. It is stated that the Edison Company will agree to use a test of the lights, and if they do not give as much light as represented, they will not be accepted.

Mr. Brookladay has rented a second-story room in Broughton's building, on High street, and has just moved from the Market House Station a number of electric lights, etc., to be used when the work of lighting the town is commenced. Orders for the lighting of residences would be judged that the light would be furnished by the Edison Company at the rate of $1.00 per month for the 64 candle power lights, and $1.50 per month for each 100 candle power light. The Edison Company is the invention of Thomas A. Edison, and is the largest electrical company in the world. The Edison Company is the invention of Thomas A. Edison, and is the largest electrical company in the world. The Edison Company is the invention of Thomas A. Edison, and is the largest electrical company in the world.

Character of article Ed.
From the Mechanical Engineer
Published at New York
Date Aug 19 85

Electricians in Convention.

The first annual meeting of the National Electric Light Association has brought together in this city representatives of more than sixty electric light and electric manufacturing companies, and yet it is only a few years since the first electric light was introduced. The rapid development in the utility of electricity provokes astonishment, and yet electricians are confident that the developments of the next twenty-five years will be greater than those of the past, and the transmission of electrical power is regarded by many as a more important enterprise than the production of electric light, although the business is yet in its earliest infancy. A few years ago Bell offered the British government the exclusive right to use his telephone patents in Great Britain and the offer was declined; he offered about $2,000,000 for the same right and the electricians had their revenge in declining the offer. The circumstance illustrates the rapidity of the expansion in the value of electrical enterprise. Although there are more than sixty companies represented in the convention of electricians to-day, it is said that the stock of one of them is worth more than $5,000,000. When it is remembered what has been achieved with electricity since the first telegraphic dispatch was sent, forty-one years ago, and then considered that electricians expect the future to bring forth greater electrical achievements than those of the past, the imagination, faltering at the task of portraying the ultimate development of the utility of the earth's most mysterious force.

Character of article Ref.
From the Inventive Age
Published at Washington, D.C.
Date July 15, 1885

THE ELECTRIC LIGHT.

NOW IN FULL OPERATION AND READY FOR USE THEY OF ITS MERITS.

Ottumwa's electric light is now running full blast, giving ample opportunity to subscribers for a test of its merits. The light in use here is the Sperry system, controlled by the Sperry Electric Light, Motor and Carbrake Company of Chicago. The company is a new one and has made quite rapid progress, bringing their light in use in Chicago, St. Louis, Omaha, Grand Island and North Platte, Nebraska, Ottumwa and other points. In this city the company have placed two twenty light dynamos, which were started up about ten days ago and have been kept in constant use since that time. The light is clear, white and comparatively steady, a very important feature in an electric light. The engine used is of 50 horse power, manufactured by the Ottumwa Iron Works and the electric light company express perfect satisfaction with it.

W. S. Weston is in charge of the plant here—or as it is known by the company, "Ottumwa station." He is a courteous, affable and obliging young gentleman, and will serve his company well in the position he fills.

Character of article
From the Herald
Published at Chicago Ill
Date May 30/86

ELECTRIC LIGHTS.

The Western Company's Claim to Precedence Disputed by the United States Company—Some Historical Facts and Figures.

Some days since an article appeared in one of the morning papers under the heading of the Associated Press account regarding suits brought by the Edison Electric Light company against other corporations using an incandescent light. As the United states Electric Light company is probably the only one making a specialty of incandescent lighting throughout the west, its actions was apparent. This class of fore advertising has been used by the Edison company for years in a very large way, and their agent, upon seeing the article, got a good deal of benefit of what would be done in the future.

In getting at the facts in the case, Mr. Warren, the western manager of the United States company, was called upon for information in regard to these claims. In reply to the interrogatory, he said:

"We claim that the incandescent light *per se* is old, and that Moses G. Farmer, a well-known eastern electrician, as far as the distribution and subdivision of the electric current is concerned, used incandescent lamps twelve and five years ago that is used to-day. He at that time lighted his residence at Salem, Mass., with incandescent lamps. Mr. Farmer's patents controlling this feature of the electric light are owned by the United States company. We claim that we can supply the Edison people enough an infringement of these patents.

"Edward Weston, one of the ablest workmen in all dynamo-electric machines. He invented and procured patents for inventions, many of which were fundamental and of great importance. In 1878 he severed his connection with Edison and Mr. Weston's patents. A great deal of very important work was done by Weston here at Chicago, and the United States company has a large list of electric lighting or devices patented for any purpose. All of these patents belong to our company.

"Mr. Weston also did a great deal of work on the arc system, including early in the history of the art. It is not generally known that the first incandescent lamp which Mr. Edison claimed to have perfected, was made by Weston. It was in the early days of the use of the process of electric lighting, was invented by Kosloff. Edison was granted a patent, but Kosloff's claim was disputed, and the matter was settled by Edison purchasing Kosloff's patent and issuing to him, thus making Edison's control valid. This was the Kosloff-Edison patent. Mr. Weston's connection with the Edison company was very pronounced, and he went to England. Sooner says that the capitalists who purchased Edison electric lights were at that time not very favorably impressed with the company's connection with Weston.

"In fact," continued Mr. Weston's private secretary, "Edison's connection with Weston was such that he was compelled to leave the country. After securing Weston to take Edison's company's worth 50,000 pounds, he was compelled to buy Weston's interest, however, before the deal was finished.

"Mr. Weston has been satisfied.

"I will say that the incandescent lamps was old when Edison claimed to have perfected it. Mr. Farmer, who I have spoken to, has in his possession a number of small pairs of an electric light. Mr. Farmer has also a very complete set of patents for electric lighting, and we are confident that we will easily supersede any infringement that may be made upon our rights. We are almost irresistible particularly in the matter of the Edison patents, as we have the control of nearly every patent that has been issued to Edison, Weston or Kosloff."

The capital of this company is 500 and its incorporators are: Nothing are required to make a contract lighting number or which cover the incandescent system.

"The United States Electric Light company has been in existence for the United States about eight years. It was organized by Edward Weston and Edward Weston. These suits are based upon the claims of Edward Weston. Weston is a practical electrician, inventor, dynamo-electric machines, regulators, incandescent lamps, safety devices, etc.

"In connection with the Weston patents they had a large number of the most experienced engineers and electricians, many of whom have made this business a specialty for years. They have also employed a corps of experts in every respect to maintain their rights in every respect.

Menlo Park Scrapbook, Cat. 1020

No. 12. "Induction (Magnetic)"

This scrapbook covers the years 1873-1883; there is also one item for 1885. The book contains clippings about electromagnetic induction, including several relating to a controversy between Edison and David E. Hughes over priority claims to the induction balance. There are 135 numbered pages.

Blank pages not filmed: 3-6, 59-60, 77-130, 133-134.

Inclination
Magnetic

1020

12

Telegraph

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Some recent researches undertaken under the direction of Prof. Charcot, in his laboratory at the Salpêtrière, have attracted attention anew to a therapeutical agent which has been known for a long time, but which at the present time has fallen into disuse. We refer to the application of the magnet in the treatment of certain diseases. It is admitted by the believers in the efficacy of this mode of treatment that magnetization has fallen into discredit on account of the absence of precise rules for the application of the remedy, and also because of the air of mystery which seems to be connected with it. To Prof. Magdonal, it is said, is due the credit of calling attention again, in 1860, to the value of magnetic medication, and of endeavoring to establish it on a rational and strictly scientific basis. The first experiments were made at the Salpêtrière in order to verify the facts collected together by M. Burq under the generic title of metalloscopy. After the results obtained by metallic applications, it was natural to endeavor to throw some light on these phenomena by varying the conditions of experimentation. It was found that patients (especially those afflicted with nervous diseases) were not only acted upon by plates of different kinds of metals, but that like results were obtained by the majority of physical agents, such as weak currents, static electricity, sonorous vibrations, differences of temperature, magnetized bars, etc. It was soon found that magnetized bars were remarkable for the consistency of their action and the facility with which they could be employed. It is not claimed that magnets are endowed with specific properties, but that they form part of a group of physical agents which, in varying degrees, possess the same power as the above-named of affecting the nervous system and giving rise to biological phenomena. The Salpêtrière researches have provoked a lively discussion. The facts announced have been confirmed in Germany, Italy, England, etc., but have been boldly attacked likewise in the last-named country.

A medical writer in *La Nature*, who has been a witness of Prof. Charcot's experiments, says that the action of the magnet is in some respects so surprising that it might *a priori* excite mistrust. The application is not direct. The magnet is not placed in contact with the skin of the subject experimented on, but its action takes place at a distance. To influence the organism and to produce the same effects as with metals it only suffices to place the poles of the magnetized bar at one or two centimeters' distance from that portion of the body upon which it is desired to act. It is thus that all the experiments have been made at the Salpêtrière. It is not necessary that the magnet should be a large one, but merely that the magnetic force should be appreciable. It is alleged by the writer in question that this mode of treating disease should be ranked of equal value with other methods now in use, such as that of electricity, etc.

Effect of Magnetization.

It has long been known that a rod of iron when magnetized is lengthened; but recent experiments of M. Adér, formerly professor, who has so ingeniously investigated the origin of sounds in the telephone, have shed additional light upon the subject. M. Adér's experiments have led him to the important generalization that all bars of a magnetic nature submitted to a mechanical action, be it compression, tension, or torsion, tend to recover their primitive molecular arrangement under the influence of the current which magnetizes them. According to this principle if a coil is pulled out by mechanical action, the action of a magnetizing current is not to lengthen but to shorten it.

Tel Journal Feb 1 1877

Tel Journal feb 1 77

The remarkable induction coil recently constructed for Mr. Spottiswoode for Mr. Appa, and which gives a spark 42 inches in length, is described in last month's number of the *Philosophical Magazine*. We note that it has two primaries, either of which can be used at pleasure (for long or for short sparks). The one is of .056-inch copper wire and 660 yards in length: it has 1,341 turns wound singly in 6 layers. The other primary is 504 yards long, wound in double strand, forming three pairs of layers. The secondary consists of no less than 280 miles of wire, wound in four sections, the wire used for the central sections being somewhat thinner than those for the external section (the diameters are .0095 in., .0115 in., and .0120 in. respectively). There are 341,850 turns in the secondary. The condenser required proves to be much smaller than might have been expected. It is thought that if the insulation of the ends of the secondary wire were carried further than at present, a still longer spark than 42 inches might be obtained. From effects with a 28-inch spark it is calculated that the 42-inch spark would be capable of piercing a block of flint glass 6 in. in thickness. When used for vacuum tubes the coil gives illumination of extreme brilliancy and very long duration.

INDUCTION.

From the Royal Institution we have the original apparatus with which Faraday obtained the magneto-electric spark in 1831. It consists of a ring of soft iron, six inches in diameter, with two coils of insulated copper wire wound round it, each coil occupying nearly half the ring. When the ring was converted into an electro-magnet by passing a current through one of the coils, an induced spark was seen at the carbon terminals of the other. The Royal Institution contributes also Faraday's rotating rectangle for illustrating the inductive action of the earth, and other apparatus used by Faraday

Tel journal June 15 1876

Tel Jour June 15, 1876.

ON MEASUREMENT OF THE ELECTRO-MOTIVE FORCE OF INDUCTION.

A session on the subject, by M. Donati, appears in a recent number of *Il Nuovo Cimento*. We have to note first the measuring apparatus, and next the experiments made with it.

The apparatus is a torsion balance, reminding one at once of that of Coulomb and of Thomson's electrometer; it appears to stand about midway between these two in point of sensibility. The points where there are differences of potential are put in communication with a condenser, which the author endeavoured to render as unvarying as possible; you then separate the plates, and put one of them in communication with the two balls of the torsion balance. From the impulsive deflection is deduced the charge, by means of a table of correspondence, obtained by examining previously to what initial deflections correspond the differences of potential (known by Ohm's law) of the different points of a conducting wire traversed by a constant current.

This apparatus then serves to verify, in open circuit and by electrostatic measurements, the already known laws of induction, viz., that the electromotive force of the induced current is proportional to the number of turns of the induced spiral (if all the turns may be considered as alike) to the velocity of the movement to which the induction is due, and to the intensity of the inducing current when the induction is electrodynamic. A pendulum carries, in its motion, the induced spiral; it is connected with an interrupter, constructed and used by M. Pellet, and meant to suppress, at a given moment, the communication between the induced spiral and the condenser. A particular arrangement serves at the same moment to measure the velocity of the movement. The charge of the condenser corresponds to the value of the electromotive force at the moment of the interruption. The author verifies, indeed, that with his condenser, and the circuit he employs, not more than $\frac{1}{1000}$ of a second is necessary for equilibrium to be established. In fact, the verification of the laws referred to is quite satisfactory.

M. Donati next studies the variation of the magnetism in a mass of soft iron serving as the core of an inducing bobbin. This core is not magnetized or demagnetized instantaneously; to the closure or opening of the circuit, and to the temporary variations of its magnetism, correspond proportional variations of electromotive force in the induced spiral. The latter is moved in the way mentioned above. The variation of the magnetism may be represented by an expression of the form—

$$K_1 a^{-ct} + K_2 a^{-c_1 t}$$

But this expression rather gives the sense of the phenomenon than shows its nature. The effect measured is, indeed, rather complex. Further,

over

Phil Summary, May 15 1873
Phil Soc May 15 73

ON THE INTENSITY OF AN INDUCED GALVANIC CURRENT.*

By HEINRICH LENZ[ETTE],
Professor of Natural Philosophy in the University of Helsingfors.

THE effects of an electrical current can be classed under two groups, one of which includes the galvanometrical and electrical results, and the other the electro-dynamical, thermal, magnetic, physiological, and purely mechanical. When a current of short duration passes through a galvanometer, it is well known that the effect is proportional to the quantity of electricity which is developed during the continuance of the current. If I is the intensity of the current—or the quantity of electricity developed in a unit of time, say a second—and t the time of duration of the current, then the effect, φ, is represented by the equation—

$$\varphi = k \int_0^t I dt$$

If, on the other hand, a similar current passes through an electro-dynamometer, the effect is expressed by—

$$\varphi = k' \int_0^t I^2 dt$$

These are the two characteristic formulæ of the above-mentioned groups; and if by means of them we seek to determine the intensity of an induced current, the total effect of which has been simultaneously measured both by the galvanometer and the electro-dynamometer, we obtain an expression for this which corresponds to the mean intensity of the whole current.

The case becomes different, however, if we interrupt the induced current for a short period of its continuance; we obtain then on the galvanometer an effect proportionate to the quantity of electricity which has been developed during the continuance of the current from the commencement to its interruption. If we continue in this way to interrupt the current repeatedly at unequal intervals, we obtain a succession of effects which represent the quantities of electricity corresponding to these different intervals. If i', i'', i''', i^{IV}, &c. denote the the mean intensity of the current, and t', t'', t''', &c., the corresponding intervals of time, then the effects are represented by the products $i't'$, $i''t''$, $i'''t'''$, &c. We arrive at this way at a means of determining and graphically representing the variations in the intensity. For if, taking co-ordinate axes, we set off the given intervals as abscissæ and the corresponding effects as ordinates, we obtain a row of points, the curve passing through which indicates the law of the quantities of electricity developed. Pursuing this train of investigation we obtain a series of values for the true intensity of the current, the variations in which can only be accurately represented by another curve, the abscissæ of which are the times t, and the ordinates the values of i.

Professor Lenzette has applied the above method to determine the course of the intensity of an induced current, his especial objects being to ascertain the influence which primary currents exercise upon an induced one, and the manner in which the latter behaves when the resistance of its circuit is increased, as is the case when a greenie of soft iron is placed in the induction coil. The following are some of the results of his experiments:—

1. *The opening or indirect induced current.* In the first half of the unit of time—that is to say in every second—the intensity indeed attains the maximum, but falls therefrom quite suddenly, so that at the beginning of the second unit it has sunk to a ninth of the maximum, whereupon the time-intensity curve runs asymptotically with reference to the axis.

2. *The closing or direct induction current.* The intensity of the current increases very slowly at first, but after about every second, a maximum is suddenly attained, whereupon just as suddenly—that is to say, within the same unit of time—it falls to about one-eighth or one-ninth of the maximum, in consequence of which the curve approaches the axis of x asymptotically.

When the resistance of the circuit of the inducing current is increased, the intensity is diminished, and the effect is at once perceived on the induced current.

When resistance is interposed in the circuit of the induced current, the opening current only indicates a marked decrease of intensity at the maximum, but the curve in other respects preserves its form. Under similar circumstances the intensity of the opening current increases somewhat, but with this exception, the curve remains as before. When the resistance is interposed in the form of a coil of wire, both currents show an equal intensity; the whole curve rises along the axis of x, and indicates a scarcely appreciable maximum for both currents.

When a greenie of soft iron is placed in the induction coil, the effect is somewhat increased on the power of the battery must be reduced, and then the intensity curve of the closing current is quite flattened away, but the opening current yields a curve which indicates the course of the intensity. It appears from this experiment that the induced current under certain circumstances develops an amount of electricity four times as great as that of the inducing current.

It is obvious that the results obtained by means of these experiments may be advantageously applied to elucidate the extraordinary electrical effects which have been lately produced with magneto-electric, electro-magnetic, and especially with electro-dynamical apparatus.

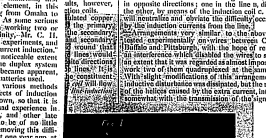
ON NEUTRALIZING THE EFFECTS OF INDUCTION BETWEEN TELEGRAPH LINES.

By CHARLES H. WILSON.

[Read before the American Electrical Society, Chicago, December 12, 1872.]

THE interference between well insulated telegraph wires, now universally known as induction, first manifested itself as a disturbing element, in this country, between wires extending from Omaha to Salt Lake, some few years ago. At some serious trouble had been experienced in working two or more parallel wires in that vicinity. Mr. C. H. Summers, electrician, made some experiments, and reported the interference to be "current induction." It did not manifest itself to any noticeable extent upon wires further east, until the duplex system was introduced, at which time it became apparent, probably on account of the large batteries used.

Since the introduction of the various methods of multiple transmission, the effects of induction have gradually become better known, so that it is now regarded by all who have had experience in working the quadruplex, duplex, and other late improved telegraphic apparatus, to be of no little importance. The possibility of removing this difficulty suggested itself to me about one year ago, at which time some complaints were made of difficulties in operating several Morse wires between Omaha and Sioux City. The ideas were carried out experimentally with good success; but, as it was possible to operate the above-named wires by having a "margin" over the induction currents, the arrangement was not considered of sufficient importance to be introduced. The theory by which the effects are produced, the conditions, however, which govern the action, and the manner in which the apparatus is applied to practical use, will be given in the following pages.



It was at once observed that having the two currents equal in strength was not the only essential condition requiring consideration. The *time* of the establishment of the two currents must be exactly the same in any section of the line where the neutralization is to be effected; otherwise, two currents, opposite in their direction, would be substituted for the single induction current, and they probably would not materially lessen the difficulty. After trying various devices to meet this condition of *time*, the most successful results were obtained by an application of electro-magnets. The artificially induced currents were made to pass through the coils of a series of electro-magnets, which, by their instantaneous magnetization of their cores, currents, and, by means of a rheostat, which formed a shunt around them, the proper adjustment was obtained. By increasing or diminishing the amount of resistance in the shunt, the prolonging effects of the electro-magnets can be adjusted at pleasure.

The application of this arrangement to "Morse lines" is shown in fig. 1: *c* represents an induction coil, constructed with two well insulated copper wires, with an adjustable core of soft iron; *a*, *a'*, *b*, and *b'* are electro-magnets placed in the path of the induced currents generated in the coil *c*, their function being to regulate the *time* of the neutralization of the two induction currents. The rheostats *n* and *n'* shunt the entire combination on either side. These shunts facilitate the essential adjustment of the opposing currents, and also lessen the effect of retardation, caused by the bullets, to the battery-currents.

Suppose the line *a* to have a battery at each terminus in the usual manner. On closing the circuit, two induced currents will be generated, flowing in opposite directions; one in the line *a*, directly; the other, by means of the induction coil *c*. These will neutralize and obviate the difficulty occasioned by the induction currents from the line.

Arrangements very similar to the above were tested experimentally on wires between Chicago, Dubuque, and Pittsburgh, with the hope of removing the interference which disabled the wires to so great an extent that it was regarded as almost impossible to work two of them quadruplexed at the same time. With slight modifications of this arrangement, the inductive disturbance was dissipated, but the reaction of the bullets caused by the extra current, interfered somewhat with the transmission of the signals. It

is well known that when an electro-magnet of any considerable size is worked in a line being worked quadruplex, serious difficulty is experienced in working through it.

In the quadruplex system at present used by the Western Union Telegraph Company, the condition of reversing the poles of the entire battery constantly occurs, and at each reversal there is an instant of no magnetism in the relays at the distant end of the line; and, as a consequence, the armature of the No. 2 relay has a tendency to yield to the force of the springs used to adjust over the "small end" of the battery. When the bullets are placed in the line, this neutral space becomes more apparent, and no longer would cause an interference if signals being transmitted in the same direction. The effects of retardation to reversals were less when the bullets were placed in the artificial line, than when in the actual line. This arrangement is clearly shown in Fig. 2.

It is evident that, with the "bridge" or differential principles, all that is required to affect the end in view is to cause the two artificial lines to act upon each other in a manner similar to the action of the actual lines. In the diagram, an induction coil is shown as a part of the artificial lines of the respective quadruplex arrangements, the two wires being well insulated, and wound side by side. The

11

Tel Jour Sept 1. 93

Journal de Physique. August, 1893.

Augmentation of the Induction Spark.—By M. C. M. Guillemin.—Everybody is acquainted with the experiment which consists in placing in the immediate vicinity of two coatings of a Leyden jar the extremities of the secondary wire of a Ruhmkorff induction coil. The length of the spark is reduced considerably, but the brilliancy and noise are, on the contrary, increased. I wished to see the effect of large insulated metallic surfaces, placed in contact with the two ends of the secondary wire, for the surfaces being separated from each other, so as not to produce the effect of a condenser. For metallic surfaces I took frames having each sheet eleven square feet covered with silk, and this with tinfoil. The coil there between two insulated points, which can be made to approach or recede from each other at will. So long as one or more plates of the commutateur with one of the poles only, the spark is in no way modified; but so soon as the other pole of the secondary wire is in contact with the plates of the other commutateur, the first, the brilliancy of the spark and the noise and its length diminishes. The increase of the surface produces a diminution in the brilliancy and the noise of the spark, and a new diminution in its length. If one of the metallic surfaces be greater than the other, the effect does not surpass that which two surfaces equal to the smallest produce. The effect of the plate becomes more sensible by the approximation of the points of the exciter, but if the distance of the points is reduced to a given minimum, the effect of the surfaces seems to disappear. When in place of the large metallic plates, metallic discs or rubbers of tinsel are employed, three-fourths to one inch in width, well insulated by means of glass supports or silk cords, we then obtain, by the use of equal surfaces, much more intense effects. Fifty-four yards of these metallic ribbons, placed in contact with each end of the secondary wire, making a total of 108 yards, greatly increase the length and the noise of the spark. The stronger the induction coil, the more marked the effect. In general the effects are the more intense when the insulated metallic surfaces are larger and separated from each other.

Tel Jour July 15. 93

Practical Notes on Resistance Coils.

Ten coils, to be accurate, must be so constructed that the connections or plugs do not give appreciable resistance. The plugs should not be handled, except by the double handle intended for the purpose, because the adherence of a film of dirt or grease to the plugs would increase resistance.

The temperature of the bobbins should be uniform—best maintained by making the bobbins nollow and of large diameter, placing them all in one box. For small resistances long lengths of large gauge wire are better than short lengths of fine wire, as the former are less liable to derangement from a powerful current, and may be more easily adjusted. When the equal arms of a Wheatstone bridge are required always accurately at the same temperature, it is convenient to wind them on one bobbin.

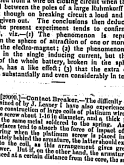
Prof. Fleeming Jenkin recommends that the wires should be insulated with two coatings of silk saturated with solid paraffin.

To avoid induction and magnetic effect the wire is doubled upon itself before being wound upon the bobbin, thus giving an equal number of turns in opposite directions.

There should not be any soldered joints inside the coils, owing to the danger of short-circuiting and break in continuity. Solderings with acid should never be employed.

Elect News July 8. 93

The Influence of Magnetism on the Extra Current. —A. Tolve.—Take an *electric egg* furnished with two small gold cups to the first a *thermometer* is fixed whose bulb penetrates to the centre of the egg, to the second an open-air manometer is soldered. The metal rod of the upper cup passes into a skin case, and is sided upon by a spiral spring that very rapidly returns it to its former position directly pressure is released. On applying the two poles of a large Ruhmkorff electro-magnet to the two cups of the egg, it was found—(1). That on producing the extra current *itself* the two poles of the electromagnet at the moment of breaking current, the thermometer regularly indicated 3° rise of temperature; so to the "mechanical" effect already noted by Rimsenley (in employing the *Sentenzie des Sciences de Paris*, last February. That paper explained how no noise nor spark is obtained from a wire on closing circuit when that wire is placed between the poles of a large Ruhmkorff electromagnet; though on breaking circuit a loud and violent noise is given out. The conclusions then deduced, and which the present experiments tends to confirm, were threefold, viz.—(1) The phenomenon is reproduced equally in the sphere of attraction of one or more of the poles of the electro-magnet; (2) the phenomenon is not inherent in the slight inducing current, but that the current of the whole battery, broken in the sphere of attraction, has a like effect; (3) that the extra current increases substantially and even considerably in tension.


Screw.
Contact Breaker.—The difficulty com-
plained of by J. Lower I have also experienced in
the working of platinum points of platinum wire for
the screw almost the same diameter, and a thick piece
of the same metal with the end of the spring. At first
surfaces tend to absorb the heavy deposit of the
mercury when the platinum screw is brought down
upon it, but by the slight vibration, the latter should extend
beyond, as this arrangement gives greater
power. Hard rubber, *Ebonit*, the armature is
placed at a certain distance from the core, the screw

should be about half-way up the spring (see sketch). It requires some experience to get the contacts perfect, however, and care should be taken to fix it firmly to the base-board. Foucault's mercury break is an improvement much in favour on the Continent for large coils. It can be worked either by the magnetism in the core itself or by a subsidiary battery and

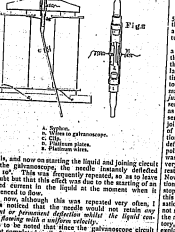
Decomposition of an Electrolyte.

battery was so Grove's cells, and the current through the magnet was led through a tangent galvanometer in the testing room in order to observe the constancy of the current.

The liquid used was dilute sulphuric acid, sp. gr. 1·24, temperature 18·2° C., and the resistance per cubic centimetre across opposed faces 1·7256 ohms at 20·2° C.

The tangent galvanometer used to detect the induced current was more delicate than that used in experiment 1. It was placed in an adjoining room far beyond the influence of the electro-magnet, insulated wires connected it with the platinum wires, sealed into the tube, and a current reverser, which served also as a contact breaker, and also a three out of circuit the electro-magnet's poles, and break the current under the same conditions as in (1). It was found that the rise of temperature accused by the thermometer does not ever exceed *one degree*; whilst the "mechanical" effect was never measured by a rise of the mercury column of more than 12 or 13 centimetres. Thus the interference of the magnetism manifests itself clearly both in a diminution of heat, and by a notable weakening of mechanical force.

Note.—This conclusion has been arrived at before by M. Tréve by a different method, as explained in a paper to the *Academie des Sciences de Paris*, last February. That paper explained how no noise nor spark is obtained from a wire on closing circuit when that wire is placed between the poles of a large Ruhmkorff electromagnet; though on breaking circuit a loud and violent noise is given out. The conclusions then deduced, and which the present experiments tends to confirm, were threefold, viz.—(1) The phenomenon is reproduced equally in the sphere of attraction of one or more of the poles of the electro-magnet; (2) the phenomenon is not inherent in the slight inducing current, but that the current of the whole battery, broken in the sphere of attraction, has a like effect; (3) that the extra current increases substantially and even considerably in tension.



20 cells, and now on starting the liquid and joining circuit with the galvanoscope, the needle instantly deflected about 20°. This was frequently repeated, so as to leave no doubt but that this effect was due to the starting of an induced current in the liquid at the moment when it commenced to flow.

But now, although this was repeated very often, I always noticed that the needle would not retain *any constant or permanent deflection whilst the liquid was found flowing with a uniform velocity.*

It has to be noted that since the galvanoscope circuit was not completed until after the magnet was made, this was not due to the mere induced current on making the magnet.

What was observed was this—after the first excursion the liquid, and shows that the decomposition by polarising the plates. But the rapid decrease of the liquid *carries away* the film of deposited gas on the plates almost as rapidly as it is formed, and so renders the polarisation but not great as it ought to be. The rate at which the polarisa-

swing continually approached nearer and nearer to the zero of the scale, so that within at first this point nearly 0 to the right, it dropped soon to 3°, 2°, 1°, and after a very short time, although the magnet's field remained constant and the flow uniform, the galvanometer needle was making nearly equal oscillations of diminishing amplitude on either side of zero. On stopping the liquid, the needle gave a very slight but sudden jerk in the opposite direction to that in which it first started. The full meaning of this will now be pointed out presently. This experiment, repeated many times without failure when once the difficulties had been overcome, gives an experimental proof that when an electrolyte flows in a magnetic field an induced current is set up, and that its direction is as follows the same law as is solid. The line or direction of the current is from one platinum plate to another, and this direction is at right angles to the line of flow or movement; the lines of magnetic force are at right angles to the plane containing the line of flow and line of current.

There are three things on which the success of this experiment depends:—

(a.) The plates must be *perfectly deposited* to begin with—so perfectly that when contact is made and broken, with the galvanometer in the breaks so as to fall in with the period of oscillation of the needle, still no movement occurs.

(b.) The platinum plates must be so fixed as to be incapable of making the slightest movement under the greatest velocity of liquid used, for even the otherwise tiny vibrations, by their movements, produce induced currents.

(c.) The velocity of the liquid should be rendered as uniform as possible, and the strength of the magnet's field also constant.

In the above experiment the velocity of the liquid was 56·9 c.c. per second; this was accurately by measuring the volume of liquid which flowed through in 35 seconds, and the velocity calculated from the dimensions of the tube.

Having thus obtained practically the induced current in a proving liquid, the next question was attacked, viz., is this electrolyte to be decomposed? To answer this, the platinum plates were again most perfectly deposited and the galvanometer disconnected, and the platinum plates short-circuited by joining the wires attached to them. The liquid was then allowed to flow down, the magnet being kept "made," and the circuit was opened *just before* the liquid stopped. It may here be observed that the liquid was never allowed to run out as far as to empty the syphon, but only drawn off from the reservoir down to a certain limit. The plates were then joined to the galvanometer, and there was no deflection of the needle of 2° or 3° to the right in the *opposite* direction to that in which the induced current would have deflected it when the magnet was made. This proved the polarisation of the electrodes to a certain degree, and this was confirmed by the fact that the liquid flowed down in very soon subsided; after a few moments it was again at rest at zero, and no further current could be detected. Now when I first tried this I obtained no opposite deflection on joining circuit with the galvanometer before stopping the flow. I was not altogether satisfied with this result, since sometimes I found no trace of polarisation, and at other times a very slight trace, which did not seem to increase with the length of time during which the acid was allowed to flow down. This was unsatisfactory, but a reflection this appeared to be capable of explanation, thus—as the liquid flows down in the field of the magnet, it is subject to induced current on cutting the lines of force. It can be worked either by the magnetism in the core itself or by a subsidiary battery and

On Electric Inductors.

The word induction, when used in connection with election electricity, refers to a peculiar mode of action of this agent, or which a vast number, indeed, we may say all electric phenomena depend. It is in fact only on account of the so-called inductive action that we do serve most electric manifestations, whether of attraction or repulsion, of charge and discharge, of positive and negative condition, etc. Therefore this subject is of the highest importance for the right understanding of the laws of electricity, and we will again devote a few experiments to it with the necessary to repeat practically, if one desires to possess a clear insight into the laws governing this most mysterious and interesting branch of physical science.

In order to make these experiments successfully, it is preferable to possess some form of electric machine, as described, page 232, however small, by means of which, on a suitable dry day, a sufficient electric charge may be obtained. The other instrument required is the electroscope, which every one may easily make for himself; this instrument is arranged in different forms, but all are based on this principle, that bodies charged with the same kind of electricity will repel one another. The most sensitive of these instruments is the electroscope of Bennet; it is represented in our fourth figure, and consists of two strips of gold leaf, suspended from the lower end of a metallic rod, terminating at its upper end in a ball of the same material; the gold leaves are enclosed in a glass cylinder, or bell jar, so as to be protected from air currents, and a metallic knob with two upright wires terminating in disks or balls, completes the apparatus. The latter serve to discharge the electricity from the gold leaves by contact, being so placed as to be touched by them, when the leaves diverge to their maximum extent. To enclose the gold leaves in a bottle, as is sometimes done, is very objectionable, as the inside of the bottle soon becomes dusty, and thus charged with electricity, and totally disturbs the indications of the instrument. Sometimes the two upright wires mentioned are replaced by two strips of tinfoil, pasted against the glass, and continued downward to the metallic base, so as to be touched by the gold leaves when they diverge far enough, and so discharge the electricity; this arrangement is equally good.

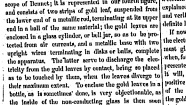


Fig. 1.

The first experiment to show the inductive action is represented, fig. 1. Let an insulated and positively charged conductor A be brought in the vicinity of another conductor, B, likewise insulated, but uncharged. If the latter be provided with two such ball electroscopes, suspended at each end, they will be seen to diverge more and more as the charged body approaches, and on examining the nature of the electricity which causes these balls to diverge, by means of a well rubbed rod of glass or sealing-wax, an explained page 232, it will be found that if the conductor A is charged with vitreous or positive electricity, the end of the uncharged conductor B, nearest to A, will have become resinous or negative, while the farthest end will be vitreous or positive. When the body A is discharged, the electricity in B disappears at once, and the inference is, that the proximity of the positive charge in A, destroys the natural or neutral state of B, and decomposing it, as it were, into the two opposite electricities, causes the same to become attracted to the two extremities of B, while the removal of A, or of the electric charge of A, restores these two electricities to their together, and neutralizes one another, or disappears.

It is even that also here the law prevails, which was mentioned on page 232, namely, that electricities of the same nature repel one another, while those of opposite nature attract. In this case it is not only the bodies charged with electricity that mutual repulsion, but the electric charges themselves: the portion of B farthest from A still above the same electricity as A, while the portion of B nearest to A will show the opposite electricity.

It is this clear that this body B is by no means charged with electricity by contact or communication of electricity from the body A, but that becomes electrified at a distance, by a kind of mysterious influence, which it has been agreed upon to call *inductive*. This word therefore offers no explanation, but is only the name for a certain class of phenomena, letting under the law just explained; all that we can do is to study these phenomenon, and verify that they always are manifested subject to the definite law of attraction and repulsion.

If now we apply this law of induction to the use of the electroscope, fig. 4, it is seen that this apparatus must give indications of electricity without contact; when, for instance, a rod of well rubbed sealing wax A is presented at a distance to the knob C of the electroscope, it will become in its condition, indeed, a positive electricity at the nearest upper portion C of the upright rod, while the lower end carrying the gold leaves will become negative like the wax, and the leaves will diverge by the negative charge. If the rod A is withdrawn, the gold leaves will again fall together and not a trace of electricity will remain; but if the knob C is touched by the wax A, then the whole rod from C to the gold leaves will be charged by communication with the negative electricity from the wax A, and retain the charge when A is removed. When the electroscope is in this condition, it is the best criterion to determine the nature of the charge of any electrified body; when it is charged negatively like the electroscope, it will, when brought in the neighborhood of C, cause the leaves to diverge more; if charged positively, it will, when brought in this neighborhood, cause the leaves to converge, as then the positive electricity leaves to converge, as then the positive electricity leaves to counteract or neutralize the negative charge of the instrument.

Fig. 2.

It is seen that by this peculiar action of electricity, bodies may be charged without that the body which causes this charge loses any of its own electricity. It simply induces the neutral body to manifest electric properties, and that only temporarily, as long as the influence lasts; therefore the term, electricity by induction is very appropriate and generally accepted.

If during this inducing action the body B, fig. 1, is momentarily touched with a conductor, so that the positive electricity which is repelled by the positive charge of A, has a channel to flow off. It will remain negative and this negative electricity will show itself as soon as A is removed from the vicinity.

THE ELECTROSCOPE.

We are now prepared to understand fully the action of the electrophorus and Leyden jar, represented in figures 2 and 3. AA, fig. 2, represents the section of a disk of sealing wax, or its equivalent, placed on an insulating stand, B; BB is a flat metallic cover or dish with an insulating handle C. When the wax disk AA is well rubbed and excited with negative electricity, the cover BB is placed on it, and the negative charge of AA will repel the negative electricity from the cover BB, and attract that of the positive kind, as indicated with the signs p or + and n or —. When now the disk BB, while laying on AA, is touched with the finger (which is a good conductor) this negative electricity escapes, and the positive kind is attracted in the cover BB; when then the cover is raised, by means of the insulating handle C, the positive electricity in BB will manifest itself by a small spark, when brought near a conductor, and by other manifestations of its presence, and this will verify that you always are manifested subject to the definite law of attraction and repulsion.

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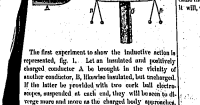

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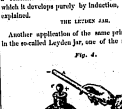


Fig. 4.

electric contrivances, named after the city of Leyden, Holland, where it was invented more than a century ago. It consists of a wide mouth glass bottle, covered with tinfoil, externally and internally, to within four or more inches from its opening on top. This top is closed with a stopper, through which a brass rod reaches to a metallic connection between the stopper and the interior coating; a perpendicular glass rod supports a brass ball, through which a stout brass wire also, reaching to two brass knobs, G K, with a curved brass wire, F, connects the outer and interior coating, or another brass rod, and by means of a chain, H, with the electric machine, which has to charge the jar with a sufficient quantity of the jar. The chain G connects it horizontal isolated wire with two knobs with the outer coating of the jar, as seen in H, which chain further is connected with the earth or any other large conductor; when now the inside coating of the jar is charged by an electric machine and the intervention of the chain F, with say positive electricity, the inductive agency will operate through the glass on the outside coating, and repel the positive electricity from there attracting the opposite kind or negative; this will flow then through the lower chain, from the conductor

Dingler's Polytechnisches Journal,
Band 208, Heft 5.

Historical Sketch of the Magneto-Induction Machines, with Uninterrupted Current of Invariable Direction.—Dr. E. Zetzsche.—This paper has been forwarded to us by the author; it will shortly appear in our columns.

Mayer's Caoutchouc Suspension for Compasses.

Deutsche Industrie Zeitung, 2/8/75

Inductrial Coal.

[2217.]—I find such a mass of queries on this subject, as yet less than five addressed personally to me, that I think it better to concentrate the replies in one article, than to scatter the information in several directions.

[2218.]—The first part of this question as to the relative merits of long and short coils, I replied to a number or two ago (222 ff), p. 230. It is purely a matter of pitting cost effective results from a given quantity of wire and battery. A bundle of wires is better than a bar, because in the latter the interior convex core forms in the core itself, and this reduces the magnetic effect. The bundle of wires has a curved outside form to the wire bundle, because there is no result of solid metal. The terms quantity and intensity, as regards a cell or battery, are not identical. The first means the amount of chemical action, the second the electromotive force, or power to produce that action against resistance; but this is not the only meaning for a cell, it involves a reference to constancy of action.

[2217.]—Charging Jar from Coil.—This is to be done by using a discharger in the circuit to one of the coatings of an insulated jar—that is to say, there must not be complete insulation between the wire coil to the coatings, but there must be a break across which the spark will pass, and the charge not be lost; that is the only way of getting the current past. If there is complete circuit, the current will flow, and make needless such attempt, and there can be no charge.

[2217.]—The instructions as to primary wire given as p. 467, Vol. XX. One end is connected to a binding screw, and the other to the spring of the break. The binding screw for the battery wires should be at the other end of the coil. The length of the primary wire would take about from pennies No. 14, and from three to five pounds of secondary could be put on advantageously. If No. 14 is used, there should be from 4lb. to 5lb. spark produced with moderate battery power. Eight pence a wire about 1s gross per foot. What might be bought for that sum I cannot say.

[2218.]—If Mr. Williams will turn to pp. 382 and 430 of Vol. XX., being in Nos. 467 and 475, or to p. 382 of my book, he will find the information he requires given fully. He gives some special references to it, and so do I, as he has not my whole figure to refer to, and it is not mine. I cannot answer for Mr. Williams's results, but they are not primary at once, rather than the reverse, I think. The stress of fall he names would be too wide for his coil, as he ought to have a good spark round them. Their number will depend on the battery power he uses, and that upon the quality of the insulation. From 30 to 60 yards of electric will be about the [illegible].

Signed,

The Western Union Telegraph Company and the Ruhmkorff Coil.

THE Ruhmkorff coil, like the electric telegraph, is the result of a series of investigations which would not have been going on for the last fifty years, and in which at least a score of investigators have taken part with more or less success, according to their knowledge, information, disposable time, pecuniary means, or other resources.

In our March number for 1873, we have given a condensed history of the electric telegraph, showing it to be the result of accumulated investigation, of which no one man can claim the whole. We showed how for the last one hundred years, various facts had been discovered and many ingenious matches invented, the sum of which aided in further inventions, and how of some fifty prominent investigators, the work of each was important in reaching the final result. This was nearest reached by Prof. Joseph Henry, of the Smithsonian Institution in Washington, who can lay a better claim to the invention of the electric telegraph than Prof. Morse, who obtained the patent, and who only made use of what others had invented before him. It was for this reason that the patent claims of Morse were very weak, and would not have stood the test of a vigorous opposition were it not that they had been bought by a company organized on the basis of plenty of capital, who wanted to obtain the monopoly of electric telegraphy in the United States, and who, in order to cut off possible competition, employed the most eminent legal counsel and scientific talent which money could command, in order to sustain the claims of Morse before the courts and have his patents recognized as valid.

The facts however are there, which show the truth, and posterity will award Prof. Henry, not as the sole inventor, but as the man by the results of whose investigations Prof. Morse was enabled to do what he did. We refer the reader to the above mentioned article above referred to, which appeared in our March number for 1873, in which the facts speak for themselves. No statement made there can be denied, being based as it is on printed records of the dates mentioned.

The company which held the patents of Prof. Morse, which have long since run out and become public property, has been fused into a great stock corporation under the name of the Western Union Telegraph Company, and have now commenced the same game which they so successfully pursued during the period of validity of the Morse patents, namely, with a patent for an induction coil, obtained in April, 1868, by Prof. C. G. Page, of Washington, and under which this stock corporation is now suing the makers of such medical electro-magnetic apparatus as have the least resemblance to the induction coil. The latter has only become famous since Ruhmkorff applied to it such important improvements that it became an entirely different instrument, which is now known under his name, and for which he received a well-deserved award of 50,000 francs from the French government.

When Prof. Page saw the great results obtained by the Ruhmkorff induction coil, and the fame the author received for it, he petitioned Congress in 1868 to enact a special law to authorize him to apply suits and obtain patents for some inventions which he had applied for twelve years before, and which at that time had been refused by the Commissioner of Patents, on the ground of want of novelty, and he requested Congress to authorize the Commissioner of Patents to grant the patent to C. G. Page, all laws in operation to the contrary notwithstanding.

The Ruhmkorff Coil.

One of the most remarkable pieces of apparatus belonging to a modern philosophical cabinet, and at the same time the most fertile in exhibiting startling experiments, is the combination of two nearly independent and isolated coils, surrounding an isolated soft iron core. It bears the name of Ruhmkorff, after the Paris instrument maker of that name, who has the credit of first having ensured its general introduction, by procuring it at very moderate prices, for experiments and as a product of manufacture and trade, while at the same time he succeeded, by several improvements, in multiplying its power more than tenfold.

The late Prof. Page, of Washington, claimed to be the inventor of some of the details applied in this coil, as well as of the small so-called torpedo electric machines, used for medical purposes, and which in fact are diminutive and simplified Ruhmkorff coils; however it is well known that the main principles on which the effects of this coil are based, are the discoveries made about the year 1830 by Faraday in England, and Ampère and Arago in France. They discovered the effect of a current in one coil on another coil surrounding the first, while Arago invented a machine essentially the same as the Ruhmkorff coil. Notwithstanding this, Prof. Page succeeded in inducing Congress to grant him a grant for an invention he claimed to have made more than 28 years before, and almighty slow and difficult they were, in the face of numerous precedents and the power to do under the existing patent laws, and granted a patent to Prof. Page for the invention of the Ruhmkorff coil, which in fact for the last 30 years had become public property, as well as the small electric machines based on the same principle; during all this time they were furnished by the instrument makers to numerous customers. It was at first said that this patent was to be extended as an acknowledgment of the merits of Prof. Page, and notwithstanding he could not be considered as the discoverer of the principle, nor as the first or sole inventor of the instrument, no scientific found fault with this acknowledgment, as Prof. Page labored well of electrical science in general, having been one of the foremost investigators, especially in regard to attempts of utilizing electro-magnetic attractions as a motive power; these however he abandoned on experience taught him the erroneous theory that the power thus derived is more than the fitness deserve than that derived from coal by the intervention of steam.

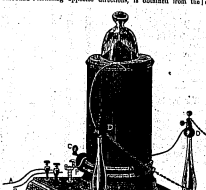
After Prof. Page's death, his widow sold the patent to the Western Union Telegraph Company, and they in their turn sold it to the Scientific American Company, who have since then commenced lawsuits against all the small and often struggling and poor manufacturers of small medical electric instruments, for damages for infringement of their patent, and a supply for the right to manufacture in the future.

We intend to contest this imposition to the utmost, and can do so easily by proving by official records, and the English Philosophical Transactions and the Memoirs of the French Academy, the utter invalidity of both patents of Prof. Page.

We believe this, even if Prof. Page were the first and inventor, the patent issued by Congress can have no legitimate power, and annul the right of public property obtained by more than twenty years undisputed possession, especially as no patent law guarantees the right of any invention longer than such a period of time.

The principle upon which this instrument is constructed is as follows: If two coils of copper wire, one over the other, are wound around the same hollow cylinder, and isolated from one another, and if then one of the coils, say the inner one, be made to discharge a voltaic current, another current of very short duration will be induced in the outer wire, both when making and when breaking the contact. This current is called a *secondary current*, and runs in the reverse direction when the contact is made, and in the same direction when the current is interrupted. The strength of this current is considerably increased when the hollow cylinder inside of the coils is filled with an iron bar, or better still, by a bundle of soft iron wire, as in this way the magnetism of the iron, by being alternately developed and destroyed, aids its influence to the development of the current in the outer coil, according to the principle explained on page 99 of our February number for 1873.

The closing and interruption of the current may be effected in different ways; in the machine here represented it is done by a contact-wheel, moved by a handle, and by a rapid motion of the arms a series of currents running to and fro, that is, in continually alternating opposite directions, is obtained from the



THE RUHMKORFF COIL.

shain attached to the glass insulators seen in front, and which are connected with the ends of the outer wire, while the ends of the inner wire are connected with the contact-wheel, and by the intervention of this wheel with the voltaic battery, (not shown in our engraving.)

So much for the principle of this remarkable apparatus, the further details of which we will explain in subsequent articles.

Cause of Cholera Infantum.

A practical physician of Berlin, Germany, has been investigating the causes of that horrible disease—cholera infantum—which yearly carries off thousands of beloved children, and one of the principal causes he finds in the patent nursing bottles, an American invention, which has reached Berlin, by reason of its convenient form. It consists of a glass bottle, which is filled with warm milk; through the cork of this bottle a glass tube passes to the bottom, and at the top of the glass tube is a rubber tube with a mouth-piece for the child. The physician referred to publishes the following remarks and advices: "The supposed advantages of these bottles consists in this, that they can be placed beside the infant in bed, while other bottles must be held in

ELECTRICAL STATIC REPULSION.

Present interest is from time to time being awakened in those grand celestial visitants of our system, shoals which there pass, month by month and year by year. The general phenomenon they present are familiarly known. Their enormous comets tails are apparent; but not less demonstrable is the extreme tenuity of the vapors or gases composing them; through which, in thick weather, small stars shine with almost undiminished brightness, and traversing rays of light suffer no perceptible refraction. It is further known that the sun has a powerful influence on this cometary matter; for the comets tend in a more condensed and globular form when at a distance from him; but, on coming nearer, the substance increases in lightness and volume, and alters in form, giving the phenomena of the tail, which is most extended in the perihelion, and, generally turned away from the sun, appears subject to a repulsive force exerted by him.

The question as to the nature of this force has not yet received a decisive answer from physicists, but there is strong probability that it is of electrical nature. This was the opinion of Olbers, and M. Faye's observation that the force diminishes with the square of the distance, and that it is proportional to the active surfaces, is in accordance with the hypothesis. M. Zollner's theory of electric repulsion between the sun and comets is based on the statical repulsion of two electricities of the same name. But there is an evident difficulty here, for the law of distance between two celestial bodies, like the sun and a comet, being too great for polar action to be possible, the action of the two electricities should neutralize each other.

The subject appears to have important new light cast upon it from a series of researches by two Austrian observers, MM. Holtlinger and Dibenfurt, described recently to the Vienna Academy. If a flagon or any conductor be brought near the luminous cushions in a Geissler tube, an attraction is observed, which has been explained by the known laws of electrical influence. But these observers, experimenting with a number of tubes, found some which gave a pronounced repulsion instead of an attraction. These cursy tional tubes contained, one bromine, the other perchloride of tin. Besides repulsion, the tubes showed a peculiar green light on the side towards which the column was forced; a kind of electric phosphorescence.

Examined spectroscopically, both tubes gave like spectra, and the most visible parts presented the three bands which are generally attributed to the spectrum of carbon, and which are not well in chemistry species. The identity of carbon is accounted for by supposing the that the light was not furnished by the gases that had been introduced, which may have been absorbed by the electrodes, or precipitated on the glass; but by a trace of some surface dust of another kind.

The authors then prepared a number of tubes with cyanogen gas, oxygen, hydrogen, carbonic acid, and other gases, examining the light in the manner used in all these cases for spectral attraction. But, on pursuing the rarefaction further, the effect was reversed; they obtained repulsion. This became more and more pronounced, so long as the rebulous light was not replaced by a simpler and stable sort of stratification, which appeared unfavorable to the effect. The light of the negative theophore shows neither attraction nor repulsion. The rarefaction was continued down to 0·2mm.

When one pole of the induction coil is connected to one of the electrodes of a Geissler tube, and the other pole connected to earth, the interior of the tube may be rendered luminous in three battery of eight elements was used. In this case there is marked attraction in gas having a tension of 6 to 8mm. Continuing the rarefaction, you come to a neutral point: thereafter the same gases give a repulsion quite as pronounced as the previous attraction; and it may even be observed at a distance of three to six centimetres. This repulsion always increased with the rarefaction, and it was the greatest possible with the greatest degree of rarefaction.

INDUCTION COILS. 1877

The largest induction coil yet made is that of the Royal Polytechnic Institute, of London. The length of this coil is 9 feet 10 inches, diameter 2 feet, weight 16 cwt., including 177 lbs. of best rubber. The core is 6 feet long, and four inches in diameter, of No. 16 iron wire. The primary coil consists of 145 lbs. of No. 20 wire. The secondary coil consists of 150 miles of wire, weighing 660 lbs., and having a resistance of 31,500 ohms. The condenser is in six parts, each containing 125 square feet of 12 inches in length, and with 20 coils this has been increased to 29 inches.

The induction coil constructed by Ritchie for the Royal Institute of Technology, at Stockholm, N. J., has a primary coil consisting of 125 feet of No. 8 wire. The secondary coil is over 20 miles in length, of No. 36 iron wire. The core is composed of a bundle of No. 26 iron wires, wrapped in oil silk and shellac. With these large dimensions coils, this coil has given sparks 21 inches in length, capable of piercing through solid glass three inches in thickness.

9 15 16

O.A.

Specific Volume.

[E]very one knows that various metals have different [weights], that means, for the same size a piece of [one kind] of metal has a different weight from a piece [of anoth]er kind of metal; thus a gold spoon is about [double t]he weight of one of tin or Britannia metal of [the same] size, and a key of aluminum is much lighter [than one] of iron of the same size. The comparative [weight o]f masses of the same size is called the specific [gravity, a]nd it has been adopted to take water as unity; [an]d it has been found that, in round numbers, [Iridium,] the heaviest of all metals, is 23¼ times heav[ier than] water; Platinum is 22 times heavier; Gold, [19; Merc]ury, 13½; Lead, 11½; Silver, 10½; Bismuth, [9¾; Copper,] 8¾; Nickel, 8¼; Tin, 7¼; Iron, 7¼; Zinc, [6¾; Al]uminum, 2½; Magnesium, 1½; Sodium, 1, or rather [0.97; L]ithium, about ½, or rather 0.59. The latter is [the ligh]test of all metals.

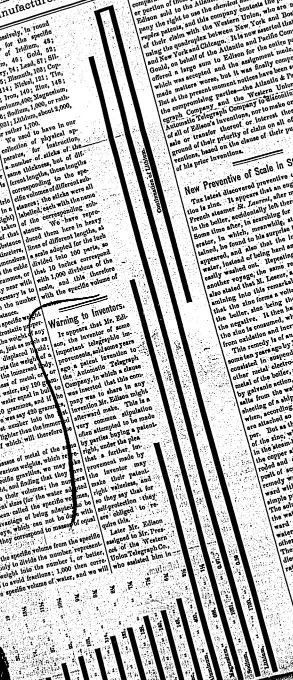
[One] of the many advantages of the beautiful metric [syste]m is, that (as the weight of water contained in a [cubic c]entimeter has been adopted as the unit of weight) [the we]ight of a cubic centimeter of any substance, taken [in gr]ammes, will express the specific weight of that [subst]ance; therefore the dimensions of any substance [(as a] block of stone) expressed in cubic centimeters, [give] at once its weight in grammes, or its dimensions [in cu]bic meters gives the weight in tons; (as the cubic [meter] of water has a weight of 1,000,000 grammes, or ...responding tolerably near with ... calculation necessary is to ... substance with the number ... [we]ight of the substance.

...[w]ay to find the specific weight ... [u]se of the hydrostatic proper... [bodies immersed in water] diminish the weight of any ... [immerse]d into them, just as much as ... [weig]ht of the displaced liquid; ... [als]o represents the weight of a ... [vo]lume to the immersed body. ... [irre]gular mass of metal, ore, or ... [imme]rsed in water, say 120 gram. ... [quan]tity of water equal in bulk to ... [wei]ghs 120 grammes, and if the ... the ore was say 420 grammes, ... the first number into the last ... [3½] times lighter than the immersed ... [the] specific gravity of which will therefore be [st]ated by 3½.

[Inst]ead of comparing masses of metal of the same [size], and comparing their various weights, which repre[sent] their respective specific gravities, we may take [masses] of the same weight, and finding that they have [different s]izes, compare their volumes; the numbers [expressing] their different sizes (for the water adopted [as u]nit) have been called the specific volumes, [and h]ave the advantage of being adapted to be [presente]d to the eye, which can not be done with [the we]ights, as they correspond to masses of equal ...

... to find the specific volume from the specific [weight w]e have only to divide the number, represent[ing the s]pecific weight into the number 1, or better, [into 1,000], so as to avoid fractions; 1,000 then corre[sponds wi]th the specific volume of water, and we will find successively, in round numbers, for the specific volume of Iridium, 43; Platinum, 46; Gold, 52; Mercury, 74; Lead, 87; Silver, 95; Bismuth, 103; Copper, 114; Nickel, 121; Tin, 138; Iron, 140; Zinc, 148; Aluminum, 400; Magnesium, 666; Sodium, 1,000, or rather 1,031; Lithium, about 2,000, or rather 1,700.

We used to have in our collection of physical apparatus, for instruction, a number of sticks of the same thickness, but of different lengths, these lengths corresponding to the specific volumes of different substances; the sticks were all labelled, each with the name of the corresponding substance. We have reproduced them here in heavy lines of different lengths, at a scale adopted for the inch divided into 100 parts, so that 10 inches correspond with 1,000 divisions of the scale, and this therefore with the specific volume of ...



Warning to Inventors.

It appears that Mr. Edison, the inventor of some important telegraphic improvements, sold some years ago a patent invention to the Automatic Telegraph Company, in which a clause was inserted that this company was to share in any invention Mr. Edison might afterward make. This is a very common stipulation often attempted to be made by parties buying a patent-right, under the plea that a further improvement made by the inventor may make their patent-right valueless, and so they say that for self-protection they are obliged to require this.

Later Mr. Edison assigned to Mr. Prescot of the Western Union Telegraph Co., who assisted him in the development of the quadruplex telegraph, for a comparatively small compensation it is said, the greater portion of these patents. It also appears that Mr. Edison sold to the Atlantic & Pacific Telegraph Company the right to use the *chemical automatic* and *quadruplex* patents, and this company contests the priority of their claim with the Western Union, who are now using the quadruplex between New York and Boston, and New York and Chicago. It is now asserted that Jay Gould, on behalf of the Atlantic and Pacific Company, offered a large sum to Edison for the entire patents, which was accepted and the assignment made. This made matters worse, but it was finally compromised. But at the present moment notices have been served on the compromising parties—the Atlantic & Pacific Telegraph Company and the Western Union—by the Automatic Telegraph Company to discontinue the use of all of Edison's inventions, nor to make or accept any sale or transfer thereof or interest therein, on the ground of their priority of claim on all of Edison's inventions, based on the clause of their purchase of one of his prior inventions.

New Preventive of Scale in Steam-Boile[rs.]

The latest discovered preventive of boiler incr[usta]tion is zinc. It appears that an engineer on bo[ard the] French steamer *St. Laurent*, after making some [trips, put] in the boiler, accidentally left therein an ingot [of zinc.] Some time after, in searching for the bar in t[he gen]erator, in which, meanwhile, steam had bee[n main]tained, he found to his surprise that the metal [had dis]appeared, and also that the incrustation left [by the] water, instead of being hard and firm, was a m[ud,] easily washed out. Repeating the experime[nt on] another voyage, the same result was reache[d. It is] also stated that M. Leseur, a French chemist, [on ex]amining into this remarkable circumstance, [found] that the zinc forms a voltaic couple with th[e iron of] the boiler, zinc being the positive pole an[d,] the negative. It then happens, as in all bat[teries, that] the zinc is consumed, while the iron is pro[tected] from oxidation and incrustation.

This remedy is of an opposite nature to th[at proposed] some ten years ago by Messrs. Webster & Y[...], [which] consisted in suspending a rod or plate [of an]other metal electro-negative in compari[son with the] metal of the boiler, and it was intended t[hat this,] by galvanic action, should receive all th[e] salts from the water, in the same way [as the copper] sheeting of a ship receives deposits fro[m sea water] when, according to Humphrey Davy's [plan, zinc plates] are attached so as to prevent the corro[sion of the cop]per. But as these deposits are formed [at the expense] of the zinc, which is soon corroded a[way, so] in the steam-boilers the deposits were [formed on] the copper at the expense of the boile[r, which was cor]roded and destroyed, and instead [of a de]posit of scale it became perforated[; the] remedy was worse than the disease[. Looking for]ward with special interest for addi[tional experience with this] simple preventive with the zinc as [...]. The solution of the zinc of cour[se] ... the water, which may also contri[bute to]ward preventing scale deposits ... water the remedy may be more ... others; this is a fact which should ... There is no doubt that the effecti[veness of such reme]dies has, for this very reason, be[en over]rated in some special localities.

Improved Fire-Escape.—A ... has been adopted in Chicago, S... is called the Jenks-Richards f[ire-escape] ... manent fixture to the building ... cornice of the house, and com... is sounded, giving the inmate[s] ... other exits are cut off; but ... a plan to ascend with the ho... greatest possible advantage ...

...increased to 29 inches ... The induction coil ... Stevens Institute of ... has a primary coil ... wire. The secondary ... of No. 36 wire. The co[re] ... of No. 20 iron wires, wr... With three large Bichr[omate] ... given sparks 21 inches in ... through solid glass three f...

[illegible] Induction Coil.—If "A. R." has not yet constructed a coil giving say, 3in. or 4in. sparks, should strongly recommend him to do so, as he will find no difficulty in the method of winding and insulation, the one described by "Induction," in my estimation, is decidedly the best. Having made many coils on various plans, I can speak with knowledge of each. One just completed, giving over 6in. sparks, has the primary wire wound in four sections, as described on his plan. I have, since making the above, altered one I had previously made on Ferguson's plan to "Induction's," which is very considerably improved. The horizontal or old plan is perhaps the easiest to wind, but the other is the best when it is once made a success. Ferguson's is better still. The secondary wire being divided into two halves, the tension is necessarily half of some, leading to strike to leaves below. Still the outer layer of secondary wire is under great tension, as in the single coils. The middle line is also a source of danger should it get moved, as in the case of the one I have referred to, when the wire was broken, as it passes under or through the disc. In large coils of this description, I should prefer the middle line to be dead. The second paper (that of "Induction," which is well understood) offers advantages which none of the others possess. The absolute certainty of insulating every inch of wire, as "Induction" says, eliminates all danger and responsibility of breaking down insulation, and consequently of waste, the greatest care, possible, and certainly of economy, and, I believe, from 25 to 50 per cent. longer wand, should recommend it. If I had to make twenty coils instead of only the same plan, believing it to be in the end the most economical, I am certainly cheaper of all I have tried. The effects of the condenser in the case of "sets" construction, of dividing secondary into four, five, or six divisions or concentricals, I have not yet tried, but will say no more about it than that it is still determined to try a large coil I shall be glad to hear the experience of any practical researcher in electric theories, as I think there exists no more difficulty in construction of a coil to give 20in. or 30in. spark than one of 6in., except perhaps a very large increased size, &c. Too much cannot be said in favour of the Ruhmkorff coil, and some system may be resorted if an actual shock occur, which would not be the case when wire is varnished or insulated with such mixture, as recommended by some.—OBLIQ. C.H.

[illegible] Record 76

INCREASING THE SPARK OF THE INDUCTION-COIL.

To the Editor of the Scientific American:

Reading over the very interesting article of Prof. Houston in the Scientific American Supplement No. 41[illegible], 1876), I smile an experiment in which I put to a practical use the lengthening of the spark of the Ruhmkorff by connecting up of the poles of the secondary wire with a large surface, although it must be known to many of your readers, I have described it below as it is of interest just now in connection with the question of "electric force."

Desiring, during the winter of 1874, in a lecture on electricity at St. Francis Xavier's College, New York, where I have professor of physics at that time, to show the application of the inductive coil to lighting, I made the same arrangement with a dozen large Bunsen cells of the same pattern as those used at Niblo's Garden Theatre. The spark, however, would not pass when all were connected; but if only three or four were connected it passed quite readily between the platinum points and illuminated the gas. I had no difficulty in switching—as the coil was small, giving, as the most, a 1inch spark—the spark was too weak. On the following day, however, on repeating the trial, by accident one of the secondary wires leading to the burners came in contact with the iron work of the chandelier, and as the wire was uninsulated, communication was established with the gas-pipe. Immediately the spark, which previously had refused to pass between the platinum points of the burners, was so much strengthened that it lit the twelve burners without difficulty. I then connected one of the secondary wires permanently with the chandelier, and the spark never failed to pass even with less battery power. As you will readily see, this was nothing but another instance of Prof. Houston's discovery of increasing the spark of the induction-coil by connecting with a large surface, and is readily explained in the same way.

It may not be out of place to state in conclusion that both of your valuable journals, the Scientific American and the Supplement, are a real wonder to all the Belgians to whom I have shown them, being far superior to any similar journal on the Continent.

Samuel H. Pushee,
11 Rue des Recollets, Louvain, Belgium.

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13. L'application du courant électrique pour l'extinction des incendies, par A. Tolhausen. (Telegraphic Journal, vol. III, page 285).

Un thermomètre forme par l'augmentation de la température le courant d'une pile qui met un électro-aimant en mouvement. Celui-ci ouvre le robinet d'un tuyau qui est en communication avec une chaudière à vapeur. La vapeur remplit tout tout l'appartement où l'incendie s'est déclaré et éteint le feu. De que cette application présente de nouveau est la combinaison de l'électro-aimant avec le robinet. Quant au principe de reconnaître à l'électricité pour signaler un incendie, il est depuis longtemps connu et employé sous différentes formes. Nous mentionnerons ici spécialement le système ingénieux de découvrir au moyen de l'électricité une fuite de gaz dont les conséquences, on le sait, peuvent être très-graves. L'on place dans l'appartement une capsule fermée par un couvercle de grès poreux. S'il y a fuite de gaz, la pression du gaz dans l'intérieur de cette capsule sera bientôt plus forte que celle d'une atmosphère, une colonne de mercure monte et ferme le circuit d'une pile et le signal d'alarme est donné par une sonnerie.

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through which the sun's heat is conveyed to and from the earth; the lower and denser strata absorb the greatest amount, and are necessarily the warmer;" a sentence of which a tenth could scarce atone every word. Again, "Gases, &c., which *rapidly* lose their own heat and *slowly* acquire that of others are susceptible of being copiously wafted." The italics are ours. And once more, "when the temperature of the air is reduced below that of the invisible vapour it contains, the moisture becomes visible." These sentences could be multiplied till we might wonder if it is really a book on *Physical* Geography we are reading. But these are serious defects, and we wish they could be altered. By the side of them it is of the merest importance that while we read in the Preface that "this every" yet on turning to the temperature of the sea, where the most important changes have taken place in our knowledge, we are still referred to Sir James Clarke Ross, and told that the present mean sea-temperature of the Antarctic temperature of 39°, for which at the equator we must descend deeper than anywhere else. We can scarcely imagine that any amount of clearness will atone for these things; let us hope they will be seen to before the edition in the ninth is required.

The Flora of South Australia. By R. Schomburgk, Ph.D., Director of the Botanic Gardens, Adelaide. (W. C. Cox, 1875.)

We have here a complete list of the indigenous flora of South Australia, both tropical and extra-tropical, with some general remarks prefixed. The most predominant natural orders in the colony are Leguminosæ, Myrtaceæ, Compositæ, Proteaceæ, Cruciferæ, Rubiaceæ, and Graminaceæ. The genera and species are remarkably circumscribed in area; many are found in one spot alone. The colony is singularly devoid of native edible fruits and roots; on the other hand it produces abundance of valuable timber-trees and of plants suitable for the manufacture of paper and other fibres, and for the production of dyes; but most of the valuable crops are naturalised plants, introduced from Europe or other parts of the world.

A. W. B.

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

Theory of Electrical Induction

In NATURE, vol. xiii. pp. 457, 475, Prof. Paul Volpicelli gives an exposition of the two theories of electric induction, containing copious references to the writings of electricians, and numerous experiments of his own. It is remarkable, however, that he has not referred to any of the articles on the works of Poisson, Green, Thomson, Beer, Betti, &c., who have studied the mathematical theory of electric action, but he has not even introduced the subject into his exposition, unless we are to take the word action in the sense of potential, where he says that a certain portion of electricity possesses tension while another portion does not.

The result of this mode of treating the subject without calling in the aid of those ideas and phrases which the progress of science has developed, is to convey the impression that the whole theory of inductrical action consists in the surface of conductors and in very imperfect and vague conditions, whereas there is a part of electrical action in which we can trace more distinctly the correspondence, quantitative as well as qualitative, of the phenomena with the laws of electricity. It appears, however, from what M. Volpicelli says, that an erroneous theory of what it ought to be superseded by a more correct theory first proposed by Helmholtz.

Both theories admit that if an insulated conductor, without charge, is acted on by a charged inductor, the surface becomes electrified, oppositely to the charge of the inductor on the parts near the inductor, and similarly to the charge of the inductor over, and that both these electricities are produced with equal intensity. Across the second, that of Melloni, assumes that the "endowed with tension," while the other kind of electricity is entirely "latent or disdissimulated."

The only sense in which we can attach to the word "tension" or potential function, in the which modern writers mean by "potential," is often used in a vague manner, whereas potential is strictly defined.

Then a point is spoken to and to have a certain electric potential, and since all points of a conductor in electrical equilibrium have the same potential, we speak of the electric potential of the conductor, but we do not speak of the potential of a charge of electricity, or of electricity being endowed with potential.

Such language would only lead us into error.

Let us suppose the inductor to be charged positively and the insulated body to be insulated and charged without charging it, then, since its insulation prevents any electric communication with other bodies, its total electrification must remain zero, or there must be as much positive electrification as there is negative.

Hence for every flux of electric force which terminates on the surface of the insulated body and falls on the inductor, there must be a flux from the inductor to the body, there by either which passes from the inductor body and falls on the surface of the insulated body must therefore be equal to the sum. The between that of the inductor and that of the walls of the room, which is generally taken as zero. The potential of the insulated body is therefore positive.

There is no portion of the surface of the induced body a region nearer the inductor which is negatively electrified, and a region farther from the inductor which is positively electrified. These regions are divided by a neutral line on the surface, which is the surface of the section by an equipotential surface in space which has the same potential as the insulated body. The total charges on these two regions are exactly equal but of opposite signs.

If a small insulated conductor is placed in contact with any part of the surface and removed, it will be found to be electrified in the same way as the part of the surface with which it was in contact. A fine stout needle point, or a burning paraffin, placed on any part of the surface will dissipate the kind of electricity which exists on that part of the surface. See Riess, "Reibungs Elektricität," Art. 247.

If any part of the induced body is placed in electrical connection with the earth by touching it with a fine wire or by native electricity will be discharged, and the potential of the induced body will be reduced to zero. This will be the case whether the part touched be positively or negatively electrified. The quantity of electricity discharged will be the product of the potential of the induced body into its electric capacity.

After this discharge every part of the surface of the induced body will be negatively electrified, but the parts nearer the inductor more than those which are further from it.

In mathematical treatment of the subject Sir Thomson has found it convenient to divide the electrification into two parts, each distributed over the induced body according to its own law.

(*a*) The induced electrification when the induced body is connected to earth, and the charge of the inductor is zero. This is found to be negative on every part of the surface, but the density is greatest where it is nearest.

(*b*) The electrification when the induced body has a potential 1, and the inductor, still in the same place, has no charge. The electrification is positive on every part of the surface.

From a knowledge of these two distributions it is easy to determine a third, in which the total electrification is the algebraical sum of (*a*) and (*b*), and is such that the total electrification is zero.

We might then assert that the electrification (*b*) is free, because it will be discharged if the body is connected to earth, but that the electrification (*a*) is latent or disdissimulated, because it will not be discharged to earth.

The only danger of this mode of exposition is that it may suggest to a beginner the notion that electricity, like water and other substances, may exist in different physical states, in some of which it is more mobile than in others.

This idea of variation of quality once introduced into the

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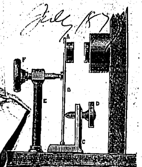
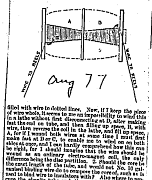
[29744.]—Induction Coil.—*The Contact Breaker.*—Having constructed the reel and wound on the wire to our satisfaction, the next thing that must be done is to construct the contact-breaking apparatus. It will be seen that the spark between the terminals of the secondary wire only occurs when the current, passing through the primary, is suddenly broken and re-made; as it would be impossible to do this by hand sufficiently rapidly to obtain a continuous spark, we must have resort to automatic machinery. There are several descriptions of these pieces of apparatus, but the one generally used is the one which I shall here describe, it being the



simplest and best for small coil. A is a disc of soft iron, carried on a stout steel spring; B, the spring is fixed to a piece of brass, which serves as a support; D is a screw which presses against the spring with more or less force, accordingly as it is tightened or unscrewed. This piece of apparatus is screwed to the base-board of the instrument in such a position that the soft iron disc (which should be 1in. in diameter, and tolerably heavy) is exactly opposite to and about ¾in. distance from the end of the core. E is a brass support, carrying a brass screw, tipped with platinum, F, which presses against the steel spring, which latter is provided with a little square of platinum foil, and in the place where the screw presses against. The way in which this apparatus is connected is as follows:—You will remember that one end of the primary is loose, as also is one end of the battery wire; the loose end of the battery-wire is to be attached to the support of the steel spring, the end of the battery wire to the support, D. When the battery current is flowing through the instrument, the core will be rendered magnetic, and attract the soft iron disc—technically termed the "armature"—which will move towards it, bending the steel spring, and breaking contact with the platinum-tipped screw, when, of course, the current will cease, and the core will lose its magnetism, and the "armature" will again fall back and restore the circuit by allowing the spring to touch the platinum screw. The other screw at D is for the purpose of tightening or loosening the steel spring, as occasion may require. But I have forgotten an important piece of apparatus called *The Condenser*:—By the omission of this in my last letter a grave mistake was committed. No coil will give its full power till this is connected to it; therefore, the trial described in my last was unjust, and would give misleading results. I will do my best to remedy this when I have described this adjunct to all induction coils. It consists of 50 sheets of tissue paper soaked in paraffin. Each sheet is double—that is, contains two thicknesses of the paper, coated with tinfoil. The way these are arranged is as follows:—A thin mahogany board, soaked and baked in paraffin, is procured, and laid on the table; this board must be 8in. square. One sheet of the paper, which is slightly smaller, is laid on this, over that a sheet of tinfoil 7in. wide, and 8in. long is laid on so that 1in. overlaps on one side; over the tinfoil is laid another sheet of prepared paper, exactly over the last. On this is laid a sheet of tinfoil, which overlaps on the other side, and so on alternately, allowing the tinfoil sheets to overlap on either side, and keeping the paraffined paper in the centre till the whole 50 sheets are used. Another board is laid on the whole, and the whole pressed together by an indiarubber band. 25 sheets of tinfoil will be found overlapping on either side; these are all clamped together by brass clamps. The condenser, when complete, is fixed in the base-board of the machine. The two brass clamps are connected one with the steel spring, the other with the support, carrying the platinum screw. In the trial described in my last letter the condenser should have been described as connected—one clamp with the loose wire from the primary, the other with the loose battery wire. I have now finished the description, and hope it is quite plain. Any one wishing further details may have them by applying to—THE CLUB BEARER.

[30330.]—Induction Coil.—"Club Bearer," in reply to query 29744, Vol. XXV., No. 640, of the MECHANIC, gives a descriptive account of the construction of an induction coil. As I am thinking of constructing one on the same principle, I should be glad if "C. B.," or some other of your correspondents, would enlighten me on one or two points I do not clearly understand in "C. B.'s" instructions. 1. As to the secondary wire, "C. B." says: "Divide this into two equal lengths, still keeping the piece whole, and wind one layer of wire on the tube." This I understand to mean that instead of winding the wire, beginning with one of the ends, you wind on the first layer from the middle of the secondary, and I presume on the whole length of the tube. The next thing to be done, "C. B." says, is to place on the guttapercha band, and slide on the disc partition. Now comes the point I fail to follow, for I now find I have the two ends loose, or in other words two wires to wind on, one for the right, and the other for the left, division of the coil, as per inclosed rough sketch, A B being the divisions to be

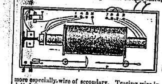


filled with wire to dotted lines. Now, if I keep the piece of wire whole, it seems to me an impossibility to wind this in a lathe without first disconnecting at D, after making fast the end on tube, and then filling up space, B, with wire, then reverse the coil in the lathe, and fill up space, A, for if I wound both wires at same time I must first make fast at D or C, to enable me to wind on on both sides at once, and I can hardly comprehend how this can be right, for I should imagine that the wire should be wound as an ordinary electro-magnet coil, the only difference being the disc partition. 2. Should the core be the exact length of the tube, and would not No. 16 galvanised binding wire do to compose the core of, such as is used to bind wire to insulators with? Also where to procure the ebonite tube and discs, and the probable cost of same for coil 12in. by 6in.?—NORFOLK.

[31090.]—Induction Coil.—Such connection between primary and secondary as "Warrington" speaks of would be ruinous to the performance of a spark coil. The aim and purpose of the ebonite tube is to keep them separate. To insulate them as perfectly as possible from each other, at the same time keeping the tube as thin and the insulating generally as light as possible, is the very acme of coil making. The secondary wire works purely by induction, and for this agency to act no connection is necessary between the primary and secondary wires. Hard Spanish mahogany, baked and saturated with paraffin, has been recommended by some as a cheap and efficient substitute for ebonite, but I have never tried it; also paraffined paper for the division, which I have used as an insulator in experiments with frictional electricity and found a reliable material. You speak as if you thought ebonite was a wood, which perhaps accounts for the difficulty you experienced in obtaining it. It is a compound of indiarubber and sulphur, therefore the best place you could try would be an indiarubber dealer's. Do not be afraid to ask again if all is not plain to you.—CLUB BEARER.

[32146.]—Galvanic Coil.—There is no reason that any one can explain, without actual examination, why the coil should not act now as it did formerly. But as No. 24 cotton-covered wire is utterly unfit for anything but a shocking or medical coil, the paper interposed is worse than useless, as it increases the distance of the wire from the core. But it is pretty certain that in the second making up some mistake has been made, which only actual examination can discover.—SIGMA.

[30610.]—Coil.—To OMEGA.—I find I have made a mistake. If you allow one inch of wire in winding discs you will require to have your paper discs 6¾in. in diameter. In same reply are one or two printer's errors. In giving thickness of wire for core should be 22 or 20, and 18. I omitted diameter of core, which may be 1¾in. in diameter, and still leave just room for four layers of secondary. To reduce resistance and accommodate to varying battery power I send a sketch showing general arrangements on base board,



more especially wire of secondary. Tracing wire in dotted lines from commutator to No. 1, it enters core at the break end to No. 2, from 2 to 3 back on core to No. 4, 4 to 5 to 6, 6 to 7, back to 8, where it is of course connected to support of hammer, through break screw to commutator to battery. The curved lines show connections when arranged for batteries with large surfaces, shorter and thicker sparks. Nos. 2, 3, 6, 7 are all coupled by passing wire through each binding-screw; No. 1 and 5 coupled; 4 and 8 coupled to hammer support. This may puzzle you at first, but if you make a plan to work to I think you will have no difficulty. The break is generally a trouble to all amateur coil-makers. I know no better plan than one shown: a large heavy piece of soft iron, a strong steel spring, with tension screw half way up spring at the back to press hammer to screw; in my own coil, hammer weighs 9oz.; spring a piece of table saw nearly ⅛in. thick, ¾in. wide. Screw should be 5-16th inch thick, shod with platinum. Let it be the best you can get, flat on face, ¼in. diameter, 1-16th inch thick, same on hammer. Condenser should have 30ft. of tinfoil insulated with two layers of paraffined or waxed paper between on each side of break. Have it large enough. No. 9 and 10 show binding screws and switch for turning off all or half condenser. When all off, the secondary may be used for giving shocks. Secondary terminal supports of ebonite or glass-ebonite I prefer, as you can turn, screw, and otherwise handle, as you cannot use glass. Directors of brass wire to slide, and having some universal joint. You will see represented one director having a disc attached. Longer sparks are obtained with its use when positive current is discharged against it. You had better get the *Philosophical Magazine* for January this year, for description of coil having 280 miles of wire, or giving 42in. sparks. Your secondary must be wound (if in lathe), commencing at the left-hand, winding from you to right end, leaving enough wire to make connection; wind still from you back to left hand, leaving enough for connection, and repeat; or you may have opposing currents.—OMEGA.

The experiments with the telephone, in which tones are transmitted by means of magnetic induction currents, have anew drawn attention to the employment of such currents for telegraphic purposes. M. Christiani, telegraph secretary in Berlin, has been experimenting as to whether the magneto-induction currents which occur in working the Hughes apparatus (and which are essentially similar to the telephone currents) are capable of putting into action a second Hughes apparatus at any great distance. He used for the purpose two Hughes apparatus furnished with mechanical liberation. The results obtained so far are thought highly encouraging—thus, *e.g.*, it was found possible to work with certainty through a cable 120 kilometres in length. Should it be practicable to telegraph to greater distances in this way, it will be a very important progress, especially with reference to [illegible]

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[31558.]—Induction Coil.—"Warrington" gives a correct description of the paraffin used for insulation; I sometimes use paraffin candles for temporary purposes, but I believe they frequently contain stearine, which might act on the wire, so that I get it as pure as possible for insulating coils. Guttapercha is used for tubes and ends, but it is objectionable, because it softens at a slight increase of temperature, so that it must either be used very thick or you run the risk of the ends giving way from the pressure, and make your core difficult to remove, should you wish to do so for any reason. The primary wire must be brought out at one of the large holes in the end, thence to the base board. To bring the wires down the inside of the coil end would cause the spark to pass between them and the secondary, and make your coil useless.—COILER.

[31558.]—Induction Coil.—Do not use the ebony: it would not be at all suitable. There is another name for ebonite, which, if you will quote to the dealers, they may be able to understand—vulcanite. The substance is called promiscuously by the two, but having adopted the one, I resolved, as much as possible, to keep to it to avoid confusion. It is the same stuff as combs are made of. Ebonite is very far superior in practical use to guttapercha. It is hard, like wood, whilst guttapercha is "flabby," which is an advantage from a mechanic's point of view. Its value as an insulator also transcends that of guttapercha. Moreover, I am informed by people skilled in the subject that the latter substance is liable to a deterient action, which finally puts an end to the working of the coil in which it is employed. The reason why I employed the gutta-

percha ring in my coil to fix the partition on was because I could not find a substitute, but upon thinking over the matter, I see that I could have employed ebonite for this also. In this way, ebonite, at a temperature of about 180° or 200° Fahr., has the property of becoming soft and pliable, while on cooling it again resumes its normal properties. If, therefore, a strip of the required width be cut and softened by heat, it can easily be bent over the tube, and on cooling will remain firmly in its place. I would recommend this hint to any one who is constructing a coil on my plan. And allow me here to remark that I don't say this is the best or easiest plan for fixing the partition. I adopted it because I did not know of any other, having had no other help save my own ingenuity, such as it is, and a description of the general principles of a Ferguson coil. I have attained tolerably good results, and believe any one following my plan with a reasonable degree of intelligence will obtain the same. The paraffin is just such a substance as you describe. For mine I give 1s. 8d. a pound, but believe it may be bought cheaper. I have not, however, given myself much trouble on that score. The ends of my primary are brought out at the ends of my tube, coiled so as to look neat, and passed through a hole in the base to their respective connections. The wire covering being green coloured has a neat effect.—THE C. B.

[31559.]—Induction Coil.—I do not see how you could get more wire on such a core, even if it were necessary; the difficulty of making would not, I think, repay you, but as the question might be answered by an outlay of a few shillings, you might try it.—OMEGA.

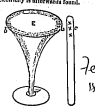
[31789.]—Medical Coil and Galvanometer.—"Uncas" has certainly not altered the connections according to my instructions. He had better look over them again, and find out where his failure is. The induced current will magnetise needles, and act on a galvanometer; but, as its quantity is extremely small, it will not act in place of a series of cells for these purposes.—SIGMA.

[31987.]—Galvanic Coil.—For the benefit of Mr. Ranger and others, I can inform them that there is a kind of tape to be had at the milliner's which has three or four thin cotton-covered soft iron-wires worked into its substance. Tearing, cutting, and joining this wire, I used it for the secondary in a medical coil machine. It answered perfectly. The machine was quite powerful enough to "double up" a careless experimenter, and, indeed, was very near rendering its maker hors de combat. In winding I used no insulation beyond the cotton covering of the wire. Possibly, the wire being of iron, it was not so essential as it would be with a finer copper wire.—E. B. FENNESSY.

[31987.]—Galvanic Coil.—Let the querist take off the brass tube which he says covers all. No coil contained in a metallic tube will give any shock or generate a secondary current of any appreciable amount.—SIGMA.

INDUCTION.

[13593.]—In Collin's work on "Electricity and Magnetism," by Fred. Guthrie, it is stated, at p. 111, that when an isolated conductor is suffering induction, the quantity of electricity by π, say, repelled over the surface, the end nearest to the inducer is accompanied by a quantity π of the opposite kind, and the inducer then with the earth, is found charged with quantity π of similar electricity whereas, if the other end be momentarily touched, no excess of positive electricity is afterwards found.

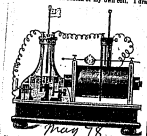


Let us now turn to p. 69 of Tyndall's "Lessons in Electricity," and see what he there tells us. Using his own words, he says:—"While the ball, A, is near the cap, inside the cask, B, with your finger touch the cask, and remove the inducer by touching it; you remove at the same time the positive electricity has disappeared. Has the negative disappeared also? No. Remove the glass tube, and as soon as you touch the cap at b by the inducer. It is charged negatively, and gives a spark with negative electricity. The mutual neutrality of the cap is first disappeared into negative electricity. By the contact between the inducer repelled by the cask and the fibres. The repelled electricity is free to escape, and the inducer and on your touching them with your finger; but the attracted electricity cannot escape as long as the inducer remains there. On removing the tube which divided the negative fluid in boulogne, that fluid immediately rushes to the whole cask, the whole cap." Now, according to Guthrie, the charge on the insulated body will depend on whether it is connected with the earth, and therefore it can no longer believe that the electricity collected on the end of the insulated inducer is as far as it goes to find collected on the most remote part of it; but Tyndall tells us that the electricity collected on the end of the insulated inducer cannot pass off until the earthing rod is removed, and hence that my brother-inductors may favour me with their opinion as to its above.

Newton, 2, O'Connor Terrace.

New Dielectric Constant. Be M. Neyreneuf.—On examining the comparison of different insulating substances employed as the dielectric plates of a condenser, the author has established that for glasses of the same nature that the ratio $\frac{e}{a}$ of the thickness e to the number a of sparks corresponding to a given quantity of electricity was constant. He has, almost determined the value of this ratio for the varieties of glass met with in commerce. For substances much more insulating—such as ebonite, caoutchouc, and paraffin—the above ratio, which may be called the condensing constant, goes on increasing in a marked manner with the thickness. Consequently, only results obtained with plates differing respectively little in thickness are comparable.—*Compt. Rend.*

[13594.]—Induction Coil.—As this query seems to call directly on its way in the U.Q. column, I am suggesting a query addressed to correspondents, so send the inclosed sketch of my own coil. I drew



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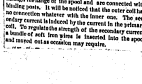
it as it stands on the table before me ready for action. The primary coil is No. 1 wire, the secondary one No. 36, diameter. The cells I use are three Nos. 20 secondary, with salt and water. In fact nothing. I just give the hands of the current, and the length between the terminals. The secondary is 1 inch long, between the terminals. The secondary is several millimetres, but I have filled up the space with a thin electric tube. I think I have described it. Will some correspondent please say whether I have arranged paper and an adequate amount of tinfoil. I have no means of testing.

J. P.—I have no means of testing my coil, however, so don't know to what extent it is reliable. However, send this in hope it may be useful.—Cuthbertson.

(10) F. P. C., W. A., and others: An ordinary induction coil may be made in the following manner: Turn a spool, A, of wood or hard rubber, 4 inches long with flanges, about 2½ inches in diameter. The spool should be ¾ inch internal diameter and quite thin. Upon this spool wind two layers of No. 18 insulated copper wire, as shown at B. Then around the coil thus formed two or three thicknesses of paper which has been soaked in melted paraffin. Upon the paraffin paper wind from 300 to 400 feet of No. 40 silk insulated copper wire, placing under each layer a thick piece of paraffin paper. The ends of the wire of the inner or primary coil extend outward through the flange of the spool, and one of them is connected with a post, B, to which is also attached a screw binding spring, supporting an armature in front of a short soft iron plug in the end of the spool. The current breaking spring has the form

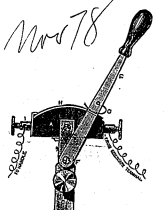


attached in it a small disc of platinum, which rests against the adjusting screw in the post, B. This post is connected with the battery, P, and the latter connects also with the terminal of the primary coil. The ends of the wires of the outer or secondary coil extend through the flange of the spool and are connected with binding posts. It will be noticed that the outer coil has no connection whatever with the inner one. The secondary current is induced by the current in the primary coil. To regulate the strength of the secondary current a bundle of soft iron plugs is inserted into the spool and moved out as occasion may require.

REGULATOR FOR INDUCTION COIL.

By J. E. Floyd.

A A is a block of ebony, of the shape shown, and about ¾ an inch thick. It is supported by means of the pillar, B, which fits into a socket, C, secured to the base board of the coil. This socket is situate between the secondary terminals, and is also used to support a small ebonite table for spark experiments, etc. The screw, D, secures either attachment at pleasure. The lever, E, turns on a screw at F, and carries a spring, G, which presses on a strip of soft leather, H, glued over the top of the block. The leather is well impregnated with plumbago, and a small portion of electrical amalgam is rubbed into the surface. The binding screw, I, is in connection with the leather at one end, while the other is connected with the lever support by means of a wire through the



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block. The instrument is placed in the secondary circuit, as indicated in the sketch.

When the lever is in the position shown, the current has to pass through the resistance of the impaired leather—the block is therefore reduced; but when it is turned over on to the other side, so that the spring is in contact with the brass at F, the full benefit of the coil is felt. The best proportion of amalgam can be determined by experiment. This regulator is much better adapted than the water regulator for singular other parts of the coil.—*English Mechanic.*

Effect of Induction Currents on the Spinal Cord.—Dr. William Miller Ord, Physician to St. Thomas's Hospital, has been investigating the effects of Faraday's induction currents on the spinal cord of dogs. The dogs were killed by chloroform; and the cords being quickly exposed, were subjected to the currents for different periods and in different directions. Dr. Ord observed that the cord broadened under these, through which the currents passed longitudinally, and narrowed when transverse currents were applied. The following are the conclusions as communicated to the Royal Society:—1. That, in young dogs, the protoplasmic constituent of the gray matter contracts *ex vacuo* under the influence of strong faradaic currents. 2. That it expands unequally and irregularly by reason of its unequal and limited sectional area, causing thereby condensations at certain points—notably in the anterior horns and around the central canal—and rarefaction at others—notably in the middle of each crescent; such rarefaction going sometimes to rupture of tissues. 3. That nerve-vesicles contract in various degrees according to the strength and duration of current, and that while they tend to contraction to become spherical they also tend to become uncoulated. 4. That the vessels are in some places strongly constricted and empty; in others dilated and filled with blood clot, with the appearances of oedema. 5. That the appearances correspond so decidedly with the conclusions in cases and seizures to give ground for the supposition that contractions, such as are produced by electricity, do actually occur during life under the effect of nervous shock, and may be phenomena causal or associate of disease.

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The Voss Induction Machine.

[13595.]—I was much interested in the article of "W. W.," which appeared in your last issue, as this difficulty so nearly resembles my own. Two or three of the earliest my practice in the query column of this paper. I am myself still a novice in the subject of electricity, and when I saw the description and illustration, I felt that I could understand it in the reply of "H. S. A." I was very obliging, I immediately set about making one, and it is now at work. I have used Mr. Sutton's "Electrical Manipulation" as my guide. The condition I made has a moving plate of vulcanite, which is glass by the coating of shellac, the varnished glass. I have modified the form of the sectors, the tinfoil being adhered to the parts which would influence the principle. My machine starts without priming; but to do this, the sectors to be revolved a few seconds smartly. The velocity is from 15 to 20 revolutions per second.

At its inception, certainly influenced by the state of the weather, as on some occasions it will take a force to set it till slightly covered. I find that the heat of the hand held behind the stationary plate for a few seconds will start it readily. The disturbance of temperature gives the initial charge.

I have not yet tried the effect of the form "G. A. A.," though the pencil is not exactly shown in the sectors. They are 10 in number, and from the description. They are to be placed 60° from the vertical or 30° from the horizontal centre. The direction of revolution is not given by "G. A. A.;" this should be from the brushes to the collecting combs, and not up to the right in the machine. Has this been attended to this? The use of the vertical comb is to increase the electricity, or does it act as a guard to the — electricity to convince when the discharging terminals are formed strikes at distance, and this arrangement prevents the over-strain? Although I have not yet tried the form "G. A. A." a difficulty I have many Holtz machines, and it is also from the experience of many of course that the brushes need not touch the — commencing to work. Some years ago I made Holtz machine of the form represented at page 241 of Bartlemann's "Electricity"—viz., with two plates and four opposing directions; but I brought the sectors to each other and added another pole, which took from each alternately the part of the sector which it could use. This machine acted admirably, but, of course, had to be glassed. I have been staying my question to prevent the cause of my failure; but have yet only had time to look at the principle of the action of the machine. I would be glad to view my other information I can on "S. W. W." if he will communicate with me.

A. B. Molison.

HOW TO MAKE AN INDUCTION COIL.

By Gen. M. Hoxsie.

Faraday discovered in 1832 that a galvanic current was capable of inducing other currents in wires near but not in contact with the conductor of the primary galvanic current; those he named *currents of induction*, or *induced currents*.

Since the discovery of Faraday, the phenomena of induction have been exhibited by many forms of apparatus; but the most striking example of inductive action is afforded by the induction coil. Prominent among makers of this instrument are Ritchie, Buhmkorff, and Ladd. The performance of the induction coil is familiar to many of the readers of this journal; but its construction is not so well understood.

There are two methods of making an induction coil; the simpler, cheaper, and perhaps the best will be described in connection with the accompanying engravings, which, with the exception of figure 4, are exactly one half size, and may be used as working drawings from which to construct the instrument. Figure 1 is a plan view. Figure 2 is a central, vertical longitudinal section. Figure 3 is a vertical transverse section, taken through A, B, and C. A, A, wood base, B, B, wood ends, and C, C, wood sides, supporting the condenser. Figure 4 represents the under side of the base, in plan, and the condenser, in perspective, and shows the connections.

The coil consists of two portions, the inner or primary, and the outer or secondary. The primary coil, D, consists of two layers of No. 16 cotton covered copper wire, which are wound upon a spool composed of the thin brass ends, D, D, and the wooden tube, A, and the handle, HH, which are of vulcanite, or hard vulcanized hard wood. The tube is $\frac{3}{4}$ inch internal diameter, and the heads have each a central hole of the same size. The holes are enlarged or countersunk to receive the ends of the tube, A, which are glued or cemented therein. In the head, D, there are two small holes near the tube's central hole, for the terminals, *e d*, of the primary coil. One of these terminals is put through the head before the winding operation is begun; the other, after the winding is finished.

The primary coil must now receive four coats of moderately thick alcoholic shellac varnish; each coat being allowed to become dry before another is applied. When the primary coil has become thoroughly dry and hard, it is covered with three or four layers, D, of stout cartridge paper, which is fastened by a little gum along its outer edge. This paper is covering must fit between the heads, HH, perfectly, and must be well smoothed and rounded, and varnished with shellac, taking care to cover the joints at the ends, and also to varnish the inner face of the heads. The secondary coil, E, is wound in two sections separated by an insulating medium, G, which is applied in the manner presently to be described. The coil, E, is of No. 36 naked copper wire; the two sections being connected at H.

The winding is best done in an engine lathe, the wire being allowed to pass through a fine girdle in the tool post, and the lathe being set as for cutting a fine screw. The coil, E, should be about three quarters of an inch in depth, and its width must be the same as that of the primary coil.

The different convolutions of the wire should be as near together as possible without touching. To accomplish the same thing in an ordinary foot lathe, a piece of quite thin brass should be bent together in a U form, and the wire should be allowed to pass between the two sides thus formed; the thickness of the metal will regulate the space between the adjacent coils of wire. The winding begins at the middle, leaving the terminal, H. When one of the heads is reached, the coil or layer, formed in the manner described, is covered with three thicknesses of common white tea paper or quite thin writing paper, the edge of which is fastened with a little gum. The winding of the fine wire is now continued toward the center of the coil; when the second layer is complete, it is covered as in the case of the first coil, when the third is wound on, and so on until it is about $\frac{3}{16}$ inches in diameter. The secondary wire should not be wound close to the head, a space of about $\frac{1}{4}$ inch should be left. After winding one of the sections of the secondary coil, the other may be proceeded with after changing the coil with the spool in the lathe, so that one section may be wound as a continuation of the other. The inner terminals are connected at H, and soldered; the outer terminals are connected with the binding posts, F, which are screwed into the upper edges of the heads, BB'. For the sake of strength the ends of the secondary wire may be four or six times larger than that of the coil. The outer layers of fine wire are separated from the primary coil by several thicknesses of tea paper, which is while enough to reach from the head to about two-thirds of the coil section; the whole is then covered by a wrapper of stout paper, having a hole directly in the middle of the top, through which is poured melted resin in which has been added a very small quantity of beeswax.

This forms the insulating medium, G, which prevents the spark from leaping from one section of the coil to the other. After the resin cools, the thick paper is removed and a covering of smooth heavy paper is neatly put around the coil, and upon it is wound as closely and as neatly as possible common smooth fastened thick thread. This latter is not essential, of course, but it gives the coil an excellent appearance and forms a really good covering.

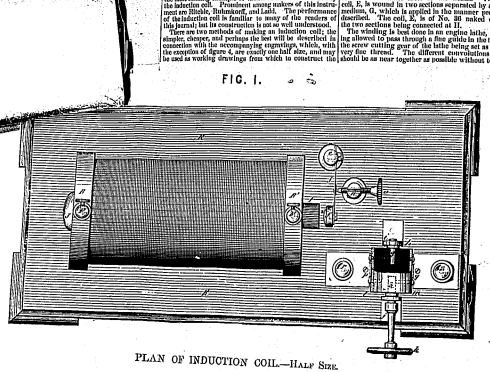


FIG. 1.

PLAN OF INDUCTION COIL.—Half Size.

This color is printed upon cloth prepared with a fatty acid, an essential condition of success. About one part of salicylic acid should be used with 20 to 30 parts of water.

Steam one and a half to two hours. Wash and soap 20 minutes at 122° F. Take through boiling lime water 15 grains of quicklime per 20 fluid ounces of water. This gives a greenish blue shade, owing to the formation of a lime soap.

Wash well and soap at a boil, which restores the blue to its original purity.

Barium and zinc salts produce upon blue alizarine an effect similar to that of alum. Dilute soda and potash turn the violet shade to a decided blue. Certain oxides almost insoluble, such as magnesia and oxide of zinc, act in a permanent manner upon alizarine blue when already fixed so as to modify its tone.

The alizarine blue fixed by our process bears chloride of lime and light. It turns certainly more gray on exposure to the sun, but its fastness is considerable; so that of a vat blue.—*Bulletin de la Société Industrielle de Mulhouse.*

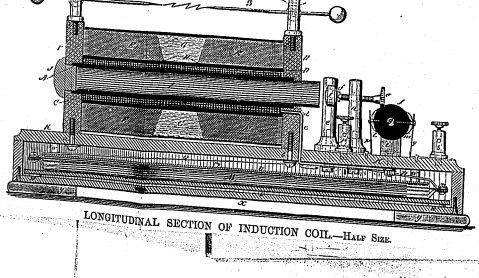


FIG. 2.

LONGITUDINAL SECTION OF INDUCTION COIL.—Half Size.

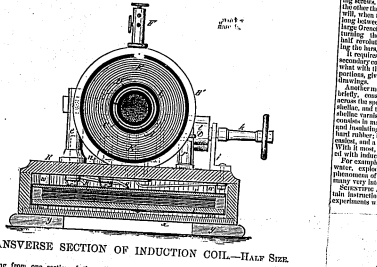


FIG. 3.

TRANSVERSE SECTION OF INDUCTION COIL.—Half Size.

In the base of the instrument is placed the condenser, M, which is composed of sheets of thin tin foil alternating in position as shown in Fig. 4. The ends of the sheets, O, project beyond the sheets, P, to the right, the ends of the sheets, P, projecting beyond the sheets, O, to the left. The sheets, O, are insulated from the sheets, P, by sheets of paper, N, which have been coated with white vulcanite varnish and well-dried. All connected together at one end, and are electrical connected with the wire, B. Similarly the sheets, O, are connected with the wire, H.

A piece of pasteboard, *r*, is placed upon each side of the condenser thus formed, and the whole is fastened together with tape running around it in two directions, and the condenser is held in place by bits of cork, *s*, which are pressed by the bottom, N, when it is in its place. The condenser has 40 square feet of tin foil surface.

The battery wires are connected with the binding posts, *r r*, the former passes through the springs, *g g*, bars, *f f*, pivots, *h h*, to the posts, *i j*. The post, *j*, is connected directly with the terminal, *c*, of the primary coil. The post, *i*, is connected by the wire, *k*, with the post, *n*, and the terminal, *d*, of the primary coil, is connected with the post. The battery current passing through the primary coil renders the wire bundle, *l*, magnetic; the hammer, *f*, attracted toward it, breaking the electrical connection at the end of the screw, *s*, when the iron wire bundle loses its magnetism, and the hammer flies back until the spring, *f*, again touches the screw. When the current is broken at the end of the screw, *s*, the secondary current is discharged from the primary coil; but when the primary current is discharged by the wire, B, with the condenser, *e e*, the spark is very much increased in intensity, as the extra current is diffused in the condenser, and the strength of the secondary current is very much increased.

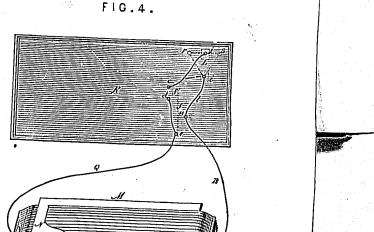


FIG. 4.

DIAGRAM OF CONNECTIONS, INDUCTION COIL.

The engravings. The coil is secured to the top of the box, *a*, a little nearer one end than the other, by two screws, *a b*, which pass upward into the heads, BB'. Near the head, B', there is a brass standard, *c*, to which is secured one end of the spring, *f*, that supports the hammer, *f*, exactly opposite the center of the wire head, I, and about $\frac{1}{16}$ inch distant from it. Opposite the middle of the spring, *f*, and $\frac{1}{16}$ inch from it, there is a post, *g*, through which passes the platinum pointed screw, *s*, which touches a small plate, *f*, attached to the center of the spring, *f*. The post, *s*, is split longitudinally, and clamps the screw, *s*, with

some little pressure to prevent it from jarring loose by the vibrations of the spring, *f*.

The commutator, L, consists of a vulcanite cylinder on the bar, *l*, coming in contact with the pivot, *k*, and one of the screws of the bar, *m*, coming into contact with the pivot, *h*, and one pivot, *h*. The pivots, *k h*, are kept in posts, *j j*, which spring against the shoulders of the pivots to insure a perfect contact. The pivot, *h*, is elongated and provided with a wire thumb handle, *h*. The binding posts, *r r*, are connected by copper springs, *p q*, with the copper bars on the vulcanite cylinder.

Concluded from Supplement, No. 159.

briefly, consists in winding with covered wire entirely across the spool, and insulating each layer by a coating of shellac varnish or melted paraffin. Or another method consists in making the secondary coil of very thin sections, and insulating the sections one from the other by disks of hard rubber; but the plan here given is said entirely the best, and a coil made in this manner gives good results. With a coil of not all, of the experiments usually performed with induction coils may be accomplished.

For example, a small charge a Leyden battery, decomposes water, explodes detonating cartridges, light gas, exhibits the phenomena of electric light in vacuo, and may be used in many very interesting experiments.

Scientific American Supplement, No. 106, will contain instructions for performing a number of interesting experiments with the induction coil.

INDUCTION ON AIR-TELEGRAPH LINES.

Every well-versed electrician knows that when two neighbouring telegraph wires are working, the signal currents in one induce feebler but corresponding currents in the other. The effect of these induced currents on a very sensitive receiving instrument, such as the speaking telephone, is, to certain extent, causing a confused chemour of sounds which quite smothers up the small voice of that instrument. Now the tendency in telegraphy is, of course, to obtain greater speed of working on lines, and in order to do this more sensitive instruments are required. For the retarding effect also of earth induction on current signals, which causes them, as it were, to plough their way up against an influence tending to hold them back, and the wave-like form which the signals assume under this influence, render it necessary to make the receiving instruments more sensitive so as to appreciate smaller fluctuations of current strength, if greater speed be aimed at. It is evident, however, that there must be a limit to this sensitising of the receiver if the induction of neighbouring currents is to be left uncorrected, for the receiver may be made so sensitive that, like the telephone, it will be perturbed in its action by these induction currents. There is no mechanical obstacle to making receiving instruments which will record 1000 words per minute, could these induced currents be prevented from influencing them. Until the researches which Professor Hughes brought before the Society of Telegraph Engineers last Wednesday (March 12), very little, if anything, had been done by electricians to neutralise the evil. It has hitherto been evaded by them in employing powerful currents to work insensitive instruments, and in having recourse to multiple methods of telegraphy. The time is come, however, in which this question will have to be seriously grappled with by telegraph administrations, and as the sensitive telephone has been the means of bringing back the wandering attention of electricians to the subject, so has it been, in the hands of Professor Hughes, the means of enabling him to give us the first contribution towards a solution of the difficulty.

FIG. 1.

One of the cures for current induction suggested by Professor Hughes can be explained by help of fig. 1, where a and b are two neighbouring telegraph lines, one being longer than the other for the sake of generalising the case. Between each line and its receiving instrument a, a coil of wire a for line a, and b for line b, is inserted. Now the length of the wire in coil a is proportioned to the length of the wire in line a in the same ratio as the length of wire in the coil b is proportioned to the wire in line b, supposing the kinds of wire for each to be similar. The coils themselves are of the same diameter, only a will have more turns than b, the line a being longer than b. The distance d, between these two coils, also bears a relation to the distance between the lines, a relation found by experiment; and if the line a is directly above b the coil a should be supported directly above b and parallel with it. On the other hand, if a be not in a vertical line above b on the telegraph posts but displaced sideways, as on the French lines, then the coil a must be displaced laterally to a proportionate extent, while being above b. The coils a and b then posed form a compensating arrangement to the mutual induction of the two lines. This induction compensator, as Professor Hughes calls it, can be easily made by causing the coils to slide up and down a vertical stem in the case of wires vertically over each other, and giving them also a lateral motion in the case of wires placed otherwise. It is in fact an artificial bad line, just as Muirhead's inductive resistances are an artificial cable.

We have yet to see how it operates in neutralising the induction. Let us suppose that a signal current is passing in the direction of the arrow, along the line a and the coil a, to earth through the receiver R. Now if the coil a be wound in the same direction as the coil A, this current will evoke an induction current in the reverse direction in the line b and the coil b, as shown by the arrows. This induction current will make a false signal on R if it is, like the telephone, sufficiently sensitive. If, however, the position of the coil a be reversed with respect to b so that the current circulates round its turns in an opposite direction to what it did in the case we have just considered, the induction of the coil a on b will be such that an induction current will be set up in b in the same direction to the primary current through a, as shown by the arrow F. At the same time the induction current in a will remain, as before, in an opposite direction to the primary current in a. But the coils a, b have been so proportioned and placed with respect to the lines a, b, that the inductive effects in them are equal to those in the lines themselves. Hence the equal but contrary induction currents in a and in coil b neutralise each other and no false signal can be made on the receiving instrument a in circuit with a. In this way the two lines are screened from each other's dynamic induction. The adjustment of the compensating coils is best effected by means of a telephone in circuit, and Prof. Hughes employs a microphone placed near a ticking clock to give the sonorous currents. The adjustment is made by shifting the coils with respect to each other till no induction sound is heard on the telephone. The insertion of soft iron rods into the hollow of the coils also affects the balance very sensibly; and Professor Hughes finds that according as one or more of these rods are inserted the mutual induction of the coils is more and more lengthened out. By these rods the arrangement can be made to compensate for the length of the induced signal as well as for its intensity.

The plan of using a return wire for telephone circuits in order to overcome the induction clamour is a well-known one; but of working the wire in a disdiacting envelope in connection with earth, though efficacious in the case of ordinary electricity, is worthless for dynamic electricity. It occurred to Professor Hughes that the going and returning wire should be twisted round each other; but as was pointed out in a note of our last issue, this plan has been already patented by Professor Bell, and also by Mr. David Brooks, the American electrician. The

FIG. 2.

modification of this plan, shewn in fig. 2, is, however, due to Professor Hughes. Here A and B are the going and returning wires twisted round each other. The battery is earthed in the middle and the poles are connected to a double pointed reversing key K, so that when the key is worked by the sender, the signal consists of simultaneously applying the positive and negative poles to the two wires A and B. The receiving instrument is wound differentially, and the signal currents flowing along A and B in the direction of the outer arrows, work the receiver conjointly. The effect of the equal and contrary induction currents produced by primary currents in a neighbouring circuit, being in the same direction in both wires, as shewn by the inner arrows, pass in opposite directions through the receiver and are neutralise each other.

[illegible] JONES'S INDUCTION BALANCE. 77

[illegible] reading resembles into the [illegible] induction, especially as [illegible] has been lately made [illegible] important discoveries [illegible] Society of Telegraph [illegible] with an instrument to which [illegible] Induction Balance has been [illegible] known words, several of [illegible] by Prof. Hughes.

[illegible] consist of 100yds. of [illegible] each, and [illegible] are placed at a distance of 10 centimetres from [illegible] coils, and between them, at the distance of five centimetres, is a single coil. We have here two long lines and one intermediate short one. The induction of these coils on each other ensures the reduction on similar long circuit; the effects, however, are much [illegible] with coils them on straight wires, and [illegible] allows us to reproduce with a hundred [illegible] of a battery the full amount of inducting [illegible] on a line a hundred miles or more. The [illegible] of having a neutralising coil on a line [illegible] that it represents, as we have found, the most difficult portion of the problem. The [illegible] for the induction on these lines, we have three small No. 32 copper (covered) coils; three of these [illegible] together so as to form a compact bundle are gradually approached until the exact balance for each line is found; and this is found very rapidly, for we have only to slide it until [illegible] silence is obtained in the induced currents passing other wires. Those coils have a large or unequal lengths, the coils should be in ratio to the length of the line, say 100 yards of coil to 100 miles of line; but, from the practical effects obtained with the coils experimented with, Professor Hughes believes that 100 metres per 500 miles of line would be amply sufficient.

Each coil should be reversed by the key of the instrument at the instant of putting on the battery, and with these the compensation is most perfect, and lines that were full of powerful induced currents all become perfectly free from it; whilst it is no way millimites against the transmission of the battery current on its own line.

The invention is not only regarded as a great advance in telegraphy, for by its means the telegraph engineer will be enabled to meet electrical induction with its own weapons, and remove the cost of working his lines on expensive and troublesome items.

of a wire of pure copper, 1 knot (6,087 feet) long, and weighing 1lb. avoirdupois. (7,000 grs.)}

A. R_t at 32° Fahr., $= \frac{P}{W \times 4\cdot6} = 1089{\cdot}38$ ohms.

R_t at 75° „ $= 1089{\cdot}38 \times [1 + (\cdot00215 \times \frac{75-32}{1})] = 1100$ ohms.

Q. 6. How would you arrange twelve cells, each having an internal resistance of 4 ohms, so as to obtain the maximum current through an external resistance of 12 ohms.

A. Since the external resistance equals 12 ohms, and we require to make the battery resistance equal to this, if we put two rows of 6 cells each, and join them up in multiple arc, we shall have the internal resistance halved, because we have half the number of cells, and then halved again, because each cell is (virtually) twice the size. Therefore, $\frac{48}{4} = 12$, which is the external resistance exactly.

Q. 7. Demonstrate, by means of a diagram, the theory of the tangent galvanometer.—*(Not answered.)*

Q. 8. What work will be done in one hour by the current of five Daniells circuited through a total resistance of 100 ohms?—*(Not answered.)*

Q. 9. A mirror galvanometer, in circuit with a Latimer Clark standard cell (*E* = 1·457) and a resistance of 3,800 ohms, gives a deflection of 120 divisions of the scale. Through what resistance would the E.M.F. of one volt give a deflection of one division?—*(Not answered.)*

Q. 10. Required the constant for microvolter current, with values in last problem.

$$A.\ \phi = \frac{D\,H}{2\,G} = \frac{100 \times 3800}{2 \times 1\cdot457} = 131.$$

Q. 11. A reflecting galvanometer, placed with its mirror at a distance of 36 ins. from the scale, is shunted with a shunt of mult. power 100, and is then circuited with a single Daniell cell through a resistance of 8,000 ohms. Under these conditions it gives a deflection of 3·25 *inches* on the scale. What is the *figure of merit* of the instrument, or the resistance through which one Daniell cell will deflect the *needle* through 1° of arc?

A. In this case $\phi = 2{\cdot}6$, and since (by)

$$R_1 = \frac{\phi \times 31{,}607{,}000}{I} = \frac{2{\cdot}6 \times 31{,}607{,}000}{32} = 2{,}287{,}861.$$

(The correct answer would be 2,049,161 ohms.)

Q. 12. A galvanometer having a resistance of 180 ohms is placed in a telegraphic circuit of high resistance, and is then traversed by a current of 200 microvolters. The instrument is afterwards shunted with a shunt of resistance 20 ohms. What will now be the current traversing the galvanometer?

A. The mult. power of the shunt is $n = \frac{200}{20} = 10$. Therefore, the current in the galvanometer equals $\frac{200}{10} = 20$.

(No note book used.)

W. KINGSLAND (Student).
DESMOND G. FITZGERALD (Examiner).

ELECTRICAL INDUCTION.

EXPERIMENTAL RESEARCHES [INTO MEANS OF PREVENTING INDUCTION UPON LATERAL WIRES.*

BY PROF. D. E. HUGHES.

The induction upon lateral wires has of late years been a serious question upon telegraph lines—the constantly increasing number of wires upon the same poles, added to the adoption of high speed and consequent sensitive apparatus, renders the study of these effects of the first importance.

The disturbing effects have become each year more and more remarked, and in 1868, by the desire of the French Telegraph Administration, I undertook a series of practical experiments with the view of finding a remedy. I soon perceived that we had to deal with a question of a more complicated nature than was at first supposed. We found, then, that we had to deal with the static charge of the own line and the dynamic induction of the lateral wires; that the effects of each were very different; and whilst it was easy to deal with the comparative feeble static charge, the more powerful and rapid effects of dynamic induction could hardly be suppressed. By introducing extra resistance coils we could reduce the induced current, but at the same time we should reduce the current with which the line was working. The remedy was in most cases (particularly during faulty insulation) worse than the disease. Condensers and polarisation batteries would allow the momentary ind currents to act, whilst they prevented the more prolo currents of the distant stations. The only remedy we then k was by the introduction of an electro-magnet, with an arma fixed upon its poles—thus being a closed magnetic conduc This practically absorbed or destroyed all the short moment currents; but then if on this line the apparatus was worked high speed, with consequent short currents, we practically ca the best part of the current needful.

In this case, whilst the remedy was practically perfect, t apparatus at low speed with comparative long currents, fa useless for those working at high speed requiring shorter curre and, consequently, more sensitive organs of response.

Other duties prevented me at that date from following up t line of research. The disturbances on the lines from this ca have been on a constant increase from the adoption of ra rapid, and consequently more sensitive, organs; and, in t *telephone*, we have at last arrived at an organ of rapidity a sensitiveness which reveals the constant induction which a s main reason why the telephone has not been more largely adop upon telegraph lines.

In a late paper upon *inductor* we brought to notice t powerful organs of research in this field that we possess in t telephone and microphone; and we thought that by the aid these we might investigate, theoretically, the cause and remed for lateral voltaic induction.

The following experiments are a *résumé* of the results t gained :—

We made use of three separate and distinct means of resear The first consisted of two or more parallel wires, 25ft. long; one being used as a primary was connected to battery and tele phone, with clock as source of sound (both ends of wire being earth). The secondary wire, upon which the induced cur was observed, was connected to telephone—both ends of t line also being to earth.

The second arrangement was made in order to study effects upon a much shorter length, and with more accuracy tha could easily be obtained on the longer line.

Two parallel—1 millimetre—copper wires were strung upon board, 15in. by 12in.; these wires were placed 16in. apart, both united at one end with one Daniell element, placed near The free ends of these wires could be put alternately in connection with battery; and thus, if we surrounded one of these wi with tinfoil, or other means of protecting wires, we could ascer the degree of protection obtained, by comparing it with the unprotected wire. A difficulty was at once felt in obtaining sufficient induction upon a parallel wire of such a short length. We obviated this, however, by the construction of a flat rectangular coil 100 turns, having 6in. side exterior. Now, by placing either of the sides of this coil near primary wire, we had 100 parallel induced wires, of a few inches—the influence, therefore, was multiplied greatly; we had also in this coil, on the opposite side, 100 parallel layers running in a contrary direction, so the resultant strength of current was simply that due to the different distances; and it was a rule to diminish this, as far as practicable, that we made the coil square. The sound obtained by this means was amply sufficient for all the researches needed.

The third means was that usually employed, namely, the use of coils either superposed or wound together in the same helix by this means powerful effects could be easily obtained; and as the results were identical and verified by the three systems, we will not relate the experiments with coils.

I. If we construct two flat coils of 100 yards of No. 36 copper wire each, and join one as primary to battery and microphone, the second coil as secondary, joined to telephone alone, we find that by placing one of these coils near, or within a few inches, distance from the other, we hear distinctly the sounds of the clock on the microphone. Our object now being to screen the secondary coil, so as to reduce the induced current, and consequently sound obtained on telephone, we joined both coils to the same earth plate, without effect. We then took a sheet of copper, one millimetre thick, 12in. square, and placed it between the coils, without effect; joined both coils to this plate, as if it were an earth plate between the coils, but no perceptible reduction of the induced current was thus obtained. We then put 10 thicknesses of iron plates, 12in. square, between the coils, again joining them as earth, but still no perceptible reduction.

II. The two coils were surrounded with several layers of tinfoil, thus enclosing each separately in a continuous metallic sheath. This, however had no effect, and sounds were quite as loud, even when the sheaths were joined to earth. Placing both these metallic covered coils in a vase of salt water, and all to earth, had not the slightest effect, even when the copper plate was also interposed between the coils. Theoretically, these ex-

* Paper read before the Society of Telegraph Engineers.

† "Comptes Rendus de l'Académie des Sciences," Paris, December 2, 1878, and January 20, 1879.

wire. If we can send into the wires B and C an opposing current of exactly equal strength and duration to that of the induced current, we evidently reduce the induced current to zero, and have consequently no disturbing effects on those wires.

After numerous experiments, I have found that if coils of wire be so placed in relation to each other, that their relative distance represents the relative distance of the wires from each other, and if each line at its transmitting station be joined to earth through these coils, then in passing the battery current through one of these coils to its line, it would induce a current whose direction would be contrary to itself; and as this would be exactly what takes place on the line itself, we should (supposing the coils to have equal inductive force to the lines) simply double the induced current, and the disturbing effects would be twice as much as what they were before the use of the coils; but if at the same instant that we send battery on line we reverse the terminals of the coil in relation with it, then the induced current sent by coil will be in the same direction as battery on primary, and this would neutralise the contrary direction of the induced current, reducing it to an absolute zero.

I have embodied this idea in the instrument which I present this evening, consisting of a series of coils of insulated iron wire. There are two of such coils, 10 centimetres diameter, 100 metres long, connected together so as to form a single line; these are placed at a distance of 10 centimetres from two similar coils, and between them, at the distance of five centimetres, is a single coil. We have these two long lines and one intermediate short one. The induction of these coils on each other represents the induction on similar iron aerial wires; the effects, however, are much greater with coils than on straight wires, and this fact allows us to reproduce with a hundred metres of wire only the full amount of induction of a line of hundred miles or more. The reason of having a shorter intermediary coil is, that it represents, as we have found, the most difficult of the problem.

To compensate for the induction on these lines, we have three small No. 22 copper (covered) coils; these are so arranged on a graduating scale that they can be gradually approached until the exact balance for each line is found; and this is found very rapidly, for we have only to slide it until complete silence is obtained from the induced currents passing other wires. These coils have no necessary absolute relation as to length or power to that of line, as we can increase the force by approaching them; but in the case of intermediary wires, and also several wires of same or unequal length, the coils should bear a definite ratio to the length of the line, say 100 metres of copper coil to 100 miles of line; but, from the powerful effects I obtain with the coils I have experimented with, I believe that 100 metres per 200 miles of line would be amply sufficient.

Each coil should be reversed by the key of the instrument at the instant of putting on the battery, and with these conditions the compensation is most perfect, and lines that were full of powerful induced currents all become perfectly free from it, whilst it in no way militates against the transmission of the battery current on its own line. But as our object this evening is not to bring forward new instruments but to discuss the question generally, we will at once sum up our conclusions.

There are three points on ordinary telegraph line or lines where we may attempt a solution of the difficulty by compensation or other neutralising effects, namely—receiving, intermediate, and transmitting stations.

At the receiving station, ordinary induction coils, or the compensating coils I have described, would be injurious, as they would not be reversed in relation to each other, and would thus increase the induction.

Voltaic currents, direct or by derivations from primary line, would answer only where the signal consisted of a dot or a short signal exactly equal in duration and force to that of the induced current.

Polarisation batteries, direct on line, would allow the induced current to pass, and if used as a derivation would require a very great resistance, and would allow the extra current from the working electro-magnet to affect all the coil.

Condensers would be similar to the polarisation or secondary batteries. Resistance coils would reduce the induction, but also in equal proportion reduce the voltaic current needed. Magnetic condensers would absorb the induction, but also absorb the first part or the part most needed of the voltaic current.

At the intermediate station all these would give contrary effects to those desired, except secondary batteries and condensers in derivation; but these would weaken the primary current, and for a line of ten wires would, from a calculation we have made, require 45 such condensers, and even then it would be impossible to fulfil all the necessary requirements.

At the transmitting station ordinary induction coils could not be used except for a line of two wires only.

Derivations from sending battery would require that a great resistance between line and earth should be introduced, and, moreover, the current would be prolonged beyond the induced current.

Polarisation batteries and condensers would also, if in derivation, require great earth resistance, and would require for a 10 wire line the same number of condensers as the intermediate station with like results.

Compensating coils, on arranged in the instrument we have submitted, fully meet the difficulty, giving perfect compensation for any number of wires, with but one coil to each wire, provided that the lines are used for transmission in one direction only for stated periods, and that they are arranged as in France, as already explained.

The perfect line, however, itself quite free from induction, and not inducing on other wires, and therefore requiring no compensating arrangement, is the double wire we have already mentioned, where both ends are to earth, and its electro-magnets wound differentially.

I have studied this subject with much interest because I believe that the future improvement in telegraphy depends in a great measure on its entire solution, and I hope that by a discussion on this subject new facts may be brought to light.

COMPANHIA TELEGRAPHICA PLATINO BRASILEIRA.

The adjourned general meeting of the above Company was held on Friday, the 18th inst., at the offices, No. 66, Old Broad-street, under the presidency of Mr. John Pender, M.P.

Mr. W. Payton, the Secretary, having read the notice calling the meeting, read the minutes of the last meeting, which were approved by the present meeting, and signed as correct by the Chairman.

The Chairman then reminded the meeting that the object of the adjournment was to receive the report of the directors, and to receive a report from the Committee appointed to report upon the transfer of the Company's property and business, effected with Brazilian law, and the constitution and Articles of Association of the Company. It was most difficult to work the Company as it was now constituted.

The Secretary then read the report of the final committee—Sir James Anderson, and Messrs. J. Reuben and C. Burt—who stated inter alia, that the Committee had examined the accounts of the Company, and had had several meetings with Messrs Gwynn, Hicks, and Co., and to the latter firm was due the compiling between them and Messrs. Hicks, Herman and Co., as agents for the Company, was carried out by an order of the court in the action, by which the accounts were referred to the arbitration of Mr. Turquand, and the investigation before him was still pending when the failure of Mr. Ernest took place, and had not since been continued. They were informed by the accountants that all expenses previous to the 31st of March, 1869, were charged to capital account, and that all expenses since were charged to revenue, except such as were clearly chargeable to capital. They approved this arrangement. When the statutes were originally framed the issue of part of the capital in the form of debentures did not appear to have been contemplated, and it was doubtless anticipated that the profits of the Company would enable the directors to pay them off. The directors had, however, very wisely kept their profits at a level much more than sufficient for the reserve fund, and, therefore, it appeared to them that the course adopted by the present directors in setting aside for the reserve fund 10 per cent. of the net earnings of the Company from its foundation, before declaring interest on the debentures, was right and prudent. They had asked the accountants for the details of the large item of £10,238 for general expenses and the £5,000 for law charges, and had been informed by the accountants that the £5,000 only of this amount had been incurred by the present directors of the Company (when acting as the committee of shareholders) and during the last six months, the charge of the remainder having been incurred during the management of the Company in Brazil. They learned from a circular issued by the Western and Brazilian Telegraph Company to its shareholders that the telegraph line from Para to Santa Catharina, including the Amazon branch, and the line from Rio Janeiro to Montevideo under the original, also that during the last twelve months 833 miles of new cable, nearly all sheathed, had been added to shallow waters, having just a moderate length in those waters which it would be necessary hereafter to renew, and that the old cable laid in deep water was in excellent condition. Having regard to the position of the Company in the gross receipts of the Western and Brazilian Company, this information was satisfactory, and they had, therefore, no hesitation in recommending the adoption of the future profits of the Company, based on the income of the last year, showing a probable net income of £7,500, after setting aside the reserve required by the articles and paying the interest on debentures. This estimate appeared to them to be a very moderate one. They recommended that the Directors' report should be adopted, and that the dividend proposed by them should be declared and paid.

Mr. Bradge then entered the meeting, and in reply to the Chairman stated that the Brazilian law required that the report of the final committee should be read by one of its members) and he considered the report as having been read by himself.

The Chairman then moved—"That the report of the final committee be approved, and that a dividend of 5s. per share, free of income tax, be declared and paid."

Captain Patt having seconded the motion, it was carried unanimously.

"lanternists" are of all men the most exacting as regards artificial light. So much being premised, it is not difficult to see how a large hall might be lighted. Let us take, for example, the Leeds Town Hall. The wind is supplied to the great organ in the hall by seven water-pressure blowers. These are worked by the pressure in the town mains, and such a blower could be readily adapted to supply a sufficient quantity of air at a uniform pressure of, say, 3 lb. on the square inch. This air could be led in a suitable tube to a small furnace containing a coil of piping. In passing through this pipe the air might be raised to a temperature of 1,000 deg. to 1,200 degrees. Thence it would be led through pipes suitably cased in non-conductors, to a series of modified pyro-hydrogen lamps, placed in suitable positions. The cost of producing the resulting light should, it will be seen, be comparatively moderate. Of what the pyro-hydrogen lamp is capable it is impossible to say without further experiments than have yet been made; but it would appear that it can be adapted to the illumination of large public buildings, and possibly of streets and even private houses. At any place within the metropolis it should be possible to obtain a moderate quantity of air under pressure, which is the first thing needed. There are various ways in which this air may be heated; and given hot air under pressure, and coal gas, it would seem that any required temperature may be obtained, and with heat enough comes the lime light —the true rival of the electric light. It may be worth while to add that experiments which have been going on for some months in Staffordshire go to show that large volumes of super-oxygenated air may be obtained for a very small cost, and if this be true then the work of the gas companies would be much facilitated.—*The Engineer*.

A FEW EXPERIMENTS WITH THE INDUCTION COIL.

By GEO. M. HOPKINS.

IN a former article* explicit directions were given for making an induction coil capable of yielding a $1\frac{1}{8}$ in. spark. A few experiments will now be described which exhibit phenomena peculiar to the secondary current. The spark

of the secondary coil—as shown in Fig. 1—the spark leaps downward to the mica surface, and then travels in a tortuous route to the vicinity of the point of the other rod and leaps upward. These sparks follow each other in such rapid succession that the mica appears to have several sparks traveling across it at once; but such is not the case, only a single spark traverses the mica at a time, the impressions of the successive sparks being retained on the retina a sufficient length of time to cause the several sparks to appear as if simultaneous. By placing the mica plate in contact with the two rods, the spark may be made to travel further than it would otherwise. By separating the rods somewhat more

FIG. 4.—EXPERIMENTS WITH LEYDEN JAR.

than the length of the spark and placing the mica from $\frac{1}{8}$ to $\frac{1}{4}$ inch below it, the current will be diffused over the mica surface in radial, purple streams. When one of the rods is *allowed to project considerably over the silvered portion of the mica, and the other is allowed to project over it but very little, as shown in Fig. 2, the current escapes to the mica surface in purple streams and is diffused in all directions.*

When a piece of glass is placed between the points, the spark will be deflected and pass around the edge of the glass;

By increasing the speed of the disk, or reducing the rate of vibration of the interrupter, the disk appears to set up a slow retrograde motion; by decreasing the speed of the disk it appears to move slowly forward.

A Leyden jar being placed on an insulated table, K (Fig. 4), and having its inner and outer coatings connected with the poles of the coils by wires, *p*, *q*, adds greatly to the intensity of the spark between the pointed rods connected with the coil. The jar may be charged by insulating it and connecting one of the poles of the induction coil with the ball of the jar, and placing a wire connected with the other pole a little distance from the outer coating. The jar may be discharged with the ordinary discharging rod.

The fulminating pane, Fig. 5, consists of a glass plate

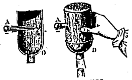


FIG. 6.—GAS PISTOL.

fixed in wooden supports, and having on opposite sides pieces of tin foil, leaving a free space all around the foil. The glass should be coated with shellac varnish; the varnish may be used in sticking the foil to the glass. The space between the tin foil and the edges of the glass should be about ¾ in. the tin foil surfaces with [illegible] *By connecting one of the* [illegible] *secondary wires, and bringing the other wire near enough* to allow the spark to pass to the foil, the plate soon becomes charged with contrary electricities, and discharges spontaneously over the edge of the glass, producing a loud report. By placing between the secondary wires in the path of the spark any highly inflammable substance, like

FIG. 1.—PATH OF ELECTRIC SPARK OVER MICA.

FIG. 7.—STATEHAM'S FUSE.

between the points of the wires that extend from opposite ends of the coil toward its center is of itself interesting and beautiful. It is in fact a miniature discharge of lightning of which we have control; but woe to us if we interpose a part of our body between these two points: we shall then experience in a small way the effect of a stroke of lightning.

When the points referred to are as wide apart as allowable within the limits of the length of the spark, the sparks leap

when a candle flame is placed near the path of the spark, the spark diverges toward the flame. The current will travel in all directions over a surface sprinkled with any finely divided metal, and will deflagrate some of the particles of the metal. By connecting a wire with one terminal of the secondary coil, and allowing its free end to dip in a glass of water, and placing a wire connected with the other terminal near the surface of the water, a spark will be obtained from

gun cotton or common cotton sprinkled with lycopodium, it is readily exploded. Ether and the light hydrocarbons may be ignited in a similar way. A mixture of illuminating gas and air may be exploded by the spark by employing the gas pistol shown in Fig. 6. This consists of a small tin can, D, having a mouth fitted with a cork, and an insulated rod passing through one side and nearly touching the other. When this contrivance is filled with a mixture of gas and air, and the knob, A, is presented to one pole of the coil while the can is in communication with the other pole, an explosion follows.

Stateham's fuse, shown in Fig. 7, is employed in electric blasting. It is simply a gutta percha covered conductor, twisted together and interrupted; it is buried in gunpowder, which is ignited when the spark from the induction coil passes the break in the conductor.

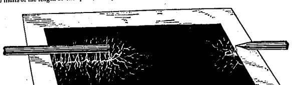


FIG. 2.—ELECTRIC DISCHARGE OVER MICA.

rapidly from the one point to the other, giving a vivid light, and appearing altogether spiteful. A piece of paper or cardboard placed between the points is readily punctured, and the current finds its way through mica, the surface of which it will follow in various directions toward the hole through which it passes, at which point the spark is very bright.

A sheet of mica, about 4×6 inches, having upon one side a sheet of silver leaf 2×3 inches, may be used in some very

the water. By incasing each of the terminal wires in a glass tube—leaving only the end exposed—and dipping the two wires thus incased in a glass of water, with their exposed ends near together, a vivid spark will be seen to pass from one wire to the other, showing that the spark is not extinguished by water.

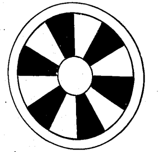


FIG. 3.—ROTATING DISK.

pretty experiments. To apply the silver leaf to the surface of the mica it is only necessary to moisten the latter with the tongue and then lay on the leaf. When the sheet of mica, thus prepared, is placed, silvered side down, from $\frac{1}{8}$ to $\frac{1}{4}$ inch from the rods, which are connected with the terminals

* SCIENTIFIC AMERICAN SUPPLEMENT, No. 160.

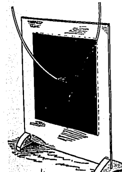


FIG. 5.—FULMINATING PANE.

A rapidly whirling disk, Fig. 3, as viewed by the discharges of the induction coil, appears stationary when the passage of the sparks and the passing of the radial bars of the disk by a fixed point occur simultaneously. This experiment exhibits the great velocity of the electric spark.

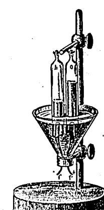


FIG. 8.—APPARATUS FOR DECOMPOSING WATER.

When the discharging points of the induction coil are placed quite near together a calorific spark is produced which will ignite wood, paper, etc.

In Fig. 8 is shown an apparatus for decomposing water; it consists of a vessel having two platinum poles connected with the secondary wires, and covered by two glass tubes suspended over them. The vessel and the tubes are filled with water acidulated with sulphuric acid. Oxygen is disengaged at the positive electrode, and hydrogen appears at the negative. These gases may be reunited by placing them in the gas pistol and exploding them by a spark, as before mentioned.

The experiments already described, although very interesting and instructive, do not compare in splendor with the class of experiments in which the electric discharge passes through a rarefied medium.

The remarkable beauty and brilliancy of the discharge is,

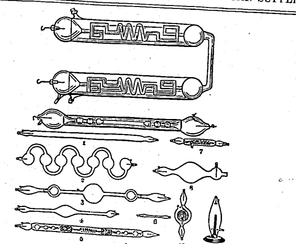


FIG. 9.—GEISSLER'S TUBES.

perhaps, best exhibited by the well known Geissler's tubes, several forms of which are shown in Fig. 9. In these the color of the discharge varies with the vapor contained by the tube, and it is also modified by the quality of the glass composing the tube.

In Fig. 10 the magnificent striæ which are produced in these tubes are represented. These striæ vary in shape, color, and luster, with the degree of vacuum, the dimensions of the tube, and the nature of the gas or vapor through which

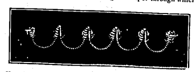


FIG. 10.—GEISSLER'S TUBES SHOWING STRATIFICATIONS.

the discharge takes place. In this figure the striæ given by hydrogen are represented.

In Fig. 11 is shown a bell glass adapted to the plate of an air pump, and provided with a packed sliding rod, which has at its lower end curved radial pointed arms, the ends of which point downward; at the bottom of the bell there is a similar series of arms pointing upward. When the air is rarefied in the bell, and the upper and lower series of points

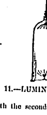


FIG. 11.—LUMINOUS POINTS.

are connected with the secondary the wires, points become luminous.

The electric egg, shown in Fig. 14, is simply a large egg-shaped glass vessel, having a stop cock for attaching it to an air pump, and provided with a sliding rod at the top, and a metal rod at the bottom, which terminates in a ball and is in metallic connection with the base. The air being exhausted, and the upper and lower rods being connected with the poles of the induction coil, the light tuft between the two rods will assume an ovoidal form, and will become more nearly spherical as the air becomes more rare. When a piece of metal is presented to the side of the egg the current will be diverted from its path and flow toward the side of the egg, as seen in Fig. 12. When the glass globe contains a small portion of the vapor of alcohol, naphtha, or any light hydrocarbon, the character of the light is changed, being stratified, as shown in Fig. 13.

The experiment known as Gassiot's cascade (Fig. 15) is very beautiful. A goblet coated with tin foil, after the manner of a Leyden jar, is placed in a vacuum. The induction

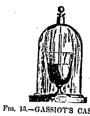


FIG. 15.—GASSIOT'S CASCADE.

current is carried to its bottom by the wire passing through the cap of the air bell. The other electrode being in communication with the air pump plate on which the apparatus stands, when the current is established, "the goblet overflows like a fountain, with a gentle cascade of light, wavy and gauze-like, falling like an auroral vapor on the metallic base."

There are many other experiments which may be readily performed with an induction coil, and many of those described may be modified so as to present other interesting features.

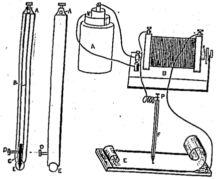
A SIMPLE ELECTRIC PEN.

WE give, as supplemental to the foregoing article on induction coil experiments, a description of a simple electric pen, which we extract from an article by Professor Wentworth Lascelles Scott in the *Electrician*.

The little contrivance which is shown in the accompanying engraving could be sold at a good profit for from 25*s*. to 30*s*. complete, or can be put together by any one possessing a very moderate amount of electro-mechanical skill at even less cost than the former sum, while the "pen" *per se* is as convenient and as light to hold as an ordinary pencil, and can be actuated by a comparatively very small single cell battery.

The accompanying rough sketch needs but little explanation, and shows fairly well the arrangement devised and actually used by me.

A is a Daniell's cell of medium size, which is all the battery power required; indeed, a very small bichromate or "Marié-Davy" couple may often be substituted here, where the pen is not required for very hard and continuous use. The battery is connected in the usual way to the primary ter-



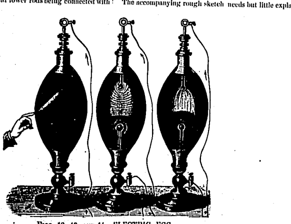
A SIMPLE ELECTRIC PEN.

minals of a small induction coil, B, and for this purpose one of the little coils generally accompanying the cheap French sets of apparatus for "vacuum tube experiments," answers very well if certain simple improvements be applied thereto. As a rule these tiny "Ruhmkorffs" give a secondary spark of from one-eighth to three-sixteenths of an inch in length, but would give a much longer one, only that the vibrating armature is not sufficiently delicate, while the condenser is often only a delusion and a snare. The former should be more delicately adjusted, a really elastic bit of spring being added if necessary, and the latter should be taken out and replaced by a sound and practical condenser, containing 300 or 350 square inches of tin foil, carefully insulated with paraffin paper. When these alterations are completed, it will be found that the spark is increased in length to some five-sixteenths of an inch, or even more. The desk or writing slab consists of a plate of glass or vulcanite of suitable dimensions, upon which has been evenly laid a perfectly smooth, but rather smaller sheet of silver or tin foil, D, the whole being protected from damp by a coat of thin amber varnish; at one corner of the slab is fixed a binding screw, E, in contact with the metallic surface, and connected by a wire with one terminal of the secondary coil.

The writing stylus or "pen," F, consists of an ivory or vulcanite tube, pointed at its lower extremity, and provided at the other end with a small brass terminal; from the latter a stiff wire, furnished with an extremely fine platinum point (*p*), proceeds in the interior of the tube, and is capable of adjustment by a small set screw. In practice this platinum point should be (when the stylus is turned up) very slightly below the level of the aperture in the ivory. The "pen" being then connected to the free terminal of the secondary, and the little coil set so that the primary sparks appear almost continuous by reason of their very rapid succession, a sheet of paper laid upon the slab, C, will be quickly perforated in a series of minute holes if the point of the stylus be gently drawn over it. Any writing, plan, or outline drawing may be traced in this way upon the paper, although in a somewhat slower manner than with an ordinary pen. When removed from the slab the paper is found to be a kind of stencil plate, from which, by laying in succession upon a number of sheets of paper, and applying the ink roller or "dubber," many hundred *fac-simile* copies may easily and quickly be obtained.

If an "electro-stencil" of a large architectural or other plan or of a map be wanted, a slightly modified stylus will facilitate the work. Fig. 2 shows such an instrument drawn to scale (half the original size), Fig. 3 being a section of the same.

A represents the terminal for the reception of wire from coil. B is a brass tube extending to within an inch of the "writing," or lower end of the stylus, where it receives a pointed platinum wire, C, which can be fixed at any required height by means of the set screw, D. A small ivory wheel, E, enables the stylus to travel easily and evenly over any long continuous lines, either with or without the aid of a ruler.



FIGS. 12, 13, AND 14.—ELECTRIC EGG.

AUTOGRAPHIC TELEGRAPHY.

AUTOGRAPHIC telegraphy, or the process of transmitting messages in the actual handwriting of the sender, has occasionally, during the past thirty years, constituted the special study of scientific minds. So long since as 1850 Mr. F. C. Bakewell invented a copying telegraph by means of which autographic telegraphy was effected, and this was probably the first time it was effectually accomplished. In this instance the message was written by the sender with a gummy ink or varnish on metallic paper or tin foil, and this writing was by the aid of mechanism used to actuate electric currents in such a way as to produce a record at the distant station by the chemical decomposition of a solution with which the receiving paper was damped. Both the written message and the paper were fixed around cylinders of similar form and dimensions, one being placed in the transmitting and the other in the recording instrument, and the cylinders were caused to revolve with corresponding velocities. Each time the gummy, and, consequently, raised lines of the writing were crossed by a pointer under which the metallic paper was traversed in the transmitter, a mark corresponding in position was made on the prepared paper at the receiving end. It therefore followed that the sum of all the marks reproduced the writing itself. Mr. Bakewell successfully reproduced the writing in white on a blue ground, but the process failed to become one of public utility owing to the extreme slowness with which the apparatus worked and the difficulty that was experienced in maintaining uniform the synchronous motion in the instruments. In 1856 the Abbé Caselli, in Italy, endeavored to solve the problem of autographic telegraphy in a similar manner. His apparatus was exhibited in England, and it was used practically between

PROFESSOR HUGHES ON INDUCTION.

From the criticisms which we have heard, there appears to be an impression amongst electricians that Professor Hughes' paper on Induction on Air Telegraph Lines, read before the Society of Telegraph Engineers on March 12th, and treated by us in our last number, does not bring forward any new solution of the induction problem; his pointed out that reversed induction coils inserted at the beginning of two lines have been employed by Mr. Wilson of Chicago, and Mr. Little of New York, as well as by other electricians. But there is an important essential difference between these earlier methods and that of Professor Hughes, which a fuller study of his paper than we had time to give it before our last issue, has made clear to us. Professor Hughes' researches were of that kind which are not grasped at once from merely hearing them read over; and it is matter for regret that a special night was not set apart by the Society for the full discussion of them after members had had time to study the printed paper thoroughly. As it is, we fear that many of those present at the meeting did not understand the results submitted to them, and not understanding them, did not, of course, appreciate them. Hence it has come to pass that one of the most important and original contributions of the winter has been hurried over in neglect.

The plan of connecting reversed coils in circuit with the wires of the line, and adjusting their mutual induction so as to balance the mutual induction of the wires, as used by Mr. Wilson, is sufficient for a two wire line; but when three or more wires have to be balanced it fails. To apply it to ten wires, for example, as many as forty-five coils would be required, and even then the balance would be imperfect. This is due to the necessity of making the balance at one, any number of the ten wires may, in actual working, become primaries to the others as secondaries; in short, that all sorts of combinations of the inductive influence may take place.

Now, Professor Hughes dispenses with the need of so many coils; 1, by making the length of each coil proportionate to the length (and consequently the actual wire it stands for, and 2, by distance from each of the other coils proportionate to the distance of that wire from each of the other wires of the line; 3, by making the the other wires of the closes each circuit, also by the same act, reverse the adjusted coil which represents that wire in the arrangement of induction coils forming the artificial line. To explain this, let us consider one end of the three wires, a, b, c, in order. The first case we have is when all the three are silent or merely receiving at the end in question. Here the three corresponding coils are all in circuit in one way, some being reversed with respect to the other. If, however, a begins to signal from one end, it is necessary that the key should reverse a's coil with respect to those of b and c. Again, if both a and b begin to work it is necessary that their keys should reverse both of their coils with respect to that of c, which remains as it was. But, it may be objected that we have now the coils of a and b both in one direction, and not reversed to each other. The answer to this, given by Professor Hughes, is, that it does not matter, there need be no mutual induction between them, since, as pointed out by Faraday in 1832, but forgotten since, current induction is due to change in the magnetic field surrounding the current. If, then, the simultaneous currents of a and b were made of equal strength; they will rise and fall together when the circuits are closed without any shock to the magnetic field generating induction. We should add, that the same results may be secured by keeping the coils of the artificial line permanently in circuit and connecting up the key between the line wire and the coil, so that the current should divide, part flowing through the wire to the distant station and part flowing in the reverse direction through the coil to earth.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents.]

EDISON'S INDUCTION EXPERIMENTS.

SIR,—My attention has been drawn to a telegram from Mr. Edison, contained in your last number, in which he says:—"In my paper on induction, lately read before the Society of Telegraph Engineers, the object of that paper was, as there stated, not long and complicated, but to discuss the question generally, with a view of showing that my personal researches were there stated not to be new, and that patents myself, or belonging out patents of others; the discussion was then invited, and which will take place next week, amply sufficed for my associates to bring forth his own solution of the difficulty. Still, as I stated in my paper, I was anxious to give credit where due, and I therefore, before the reading of the paper that Mr. David Brooks, of Philadelphia, had already proposed the use of double-twisted wires, and I at once assumed credit for the idea. I learned immediately after the lecture, that Professor T. Wilson, of Chicago, had very beautifully resolved the difficulty as regards two wires by the use of coils and counter currents." Now, I have before me Mr. Edison's telegram that he also, as well as Mr. Wilson, used inductionless coils and counter currents, and that his claim would be found in patent No. 186,787, 1877. If this I was unaware, as it was not patented in England. Of the "Telephone" or "Inductive" line under the title of "Telephone," Still, if I had been aware of this claim in his telephone patent, I should have at once, as I have always done, called the date of his patent. If the question was simply limited to his patent of 1877, I should at once freely and very willingly admit that Mr. Edison might have a perfect claim to priority of invention of a single line, as proposed in his patent. But Mr. Edison has not, as I understand that his patent is exactly the same thing as my instrument I showed, amongst many others, and that this instrument I showed, and which I used for some months at his request, before Mr. Edison spoke to the compression of one line, then I freely accord to Mr. Edison the priority, and I have balanced all the fees on some relays as I supposed to do, I must beg to differ from him, and show the essential difference.

In describing the bifilar instrument in my paper, I described the line with coils at relative distances, and showed that the further the coils were from the induction, and do more harm than good. Now I also described exactly the theoretical conditions as shown in Ellis' mathematical paper showing what would not do, I therefore stated how, by fulfilling certain conditions—not one of which are mentioned in Edison's patent—a perfect electric balance could be obtained for all lines. Those conditions were too technical to fully describe here, but they may be summarized to the effect that must be reversed as instead of putting on battery or by Quintin Coils must all have a certain definite length of wire in exact proportion to that of the used upon. (2) Battery power must also be proportionate to length, so as to have equal force on each line.

There are many other details, such as question for extra cords, static change, &c. The main difficulties, however, are overcome and Mr. Edison's is, in reality, nothing more than the question of practicability and utility, that, as a simple laboratory experiment, Edison's instrument is described in English and American patents, and which I have not, but not for the rest of the many adjacent wires. Mr. Clos. I am sure you are very beautiful and superior arrangement will perfectly answer for any two lines. The arrangement I proposed compensates for all, and any other wires being all perfectly free from induction.

London, March 31st. D. E. HUGHES.

[For the present we refrain from offering any comment upon the controversy between Mr. Edison and Mr. Hughes.—ED. E.]

PROFESSOR HUGHES' INDUCTION BALANCE.

We condense from *Engineering* of March 14, 1879, the following description of Professor Hughes' induction balance:

The invention of the telephone by Professor Bell has placed in the hands of the physicist a detecting instrument of greater delicacy and sensitiveness than the most delicate galvanometer, and one which is besides to be active and convenient in use; and the invention of the microphone by Prof Hughes has supplemented the telephone for electrical research, and has largely extended its field of usefulness. So sensitive is the telephone, or perhaps we may say, so sensitive is the human ear, aided by the telephone, that vestigations of electric currents so small as to be far beyond the powers of the most sensitive galvanometer to detect, are instantly made apparent by its use, and it is found next to impossible to work the instrument for business purposes in many places during business hours by reason of the induced currents produced in its conductors by the influence of neighboring lines conveying telegraphic messages.

The elimination of the effects of induction for telegraphic working has hitherto been one of the great unsolved problems of the telegraph engineer, and several plans have been adopted whereby the evils resulting from it have been lessened, but all are far from satisfactory.

It has remained for Professor D. E. Hughes, the eminent inventor of the type printer, as well as of that still wonderful instrument the microphone, to solve the problem by which inductive currents in telegraph lines may be absolutely neutralized, and his solution of this problem is as simple as it is scientifically accurate. The whole apparatus, part of which we illustrate, consists of a few coils of wire, a telephone, a microphone, a small three-cell Daniell's battery, and a galvanometer.

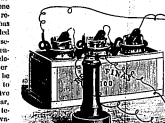


Fig. 1.

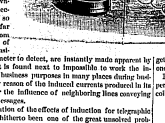
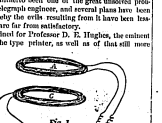


Fig. 2.

The diagram, Fig. 1, represents an experiment arranged by Professor Hughes, which demonstrates a simple case of ordinary electrical induction. A and C are two circular coils of insulated wire, of which one, C, is placed in circuit with a battery, B, and microphone, M, upon which a small clock is placed, and the other coil, A, is joined up in circuit with a telephone. Upon placing the ear to the telephone the ticking of the clock is loudly heard by the inductive currents produced in A, by the influence of the neighboring microphone currents passing through C. When the two coils are placed one against the other the sound is nearly as loud as when the telephone was included in the primary circuit, and as the distance between the two coils is gradually increased, the ticking becomes fainter and fainter, but at several inches distance the ticking was louder than the original sound emitted by the clock, and with several feet between them it remained distinctly audible. The demonstration of induction currents by means of two such rings does clock and microphone in conjunction with a battery as a simple automatic source of sound, or rather of electrical impulses, and of a telephone as the detecting instrument, forms together an exceedingly convenient arrangement, and we mention it here because it forms the groundwork of the system upon which Professor Hughes' recent experiments have been carried on. We may mention here, in passing, that this arrangement forms a beautiful way of illustrating the diminution of induction influence by destroying the parallelism between the planes of the two rings, for if either of them be slowly turned about one of its diameters, the sound heard in the telephone gradually diminishes as the angle between the planes of the two rings, for if either of them be slowly turned about one of its diameters, the sound heard in the telephone gradually diminishes as the angle between the planes of the two rings is increased, disappearing altogether at the moment that they become perpendicular to one another.


CLOCK AND MICROPHONE.

Professor Hughes placed between the coils a sheet of copper 12 inches square and one millimeter thick between the coils (gluing both coils and plate to the same earth plate), without disturbing the induction effects, in next tried the effect of introducing between the coils lumion of sheet iron; but no perceptible reduction of the induction currents could be detected. Covering each of the coils with several layers of the foil and immersing both in a vessel of ash water, with a plate of copper between them, did not diminish the induction as far as the ear could detect.

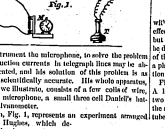


Fig. 3.

Fig. 3 represents a modification of the same experiment. A is a Daniell cell of wire having a hundred turns, its two ends being joined to the terminals of a telephone, and the wire-lengths, portion of the coil is inclosed in a heavy brass tube, H, one eighth of an inch thick. C C is a primary wire in connection with a clock microphone and battery. Upon placing the slide, B, of this coil near and parallel to the wire, C, the sounds of the clock are distinctly audible, and hardly any difference of induction influence can be directed between the influence of the currents in C on the portion of the coil surrounded by the tube and on the unprotected parts of the secondary circuit.

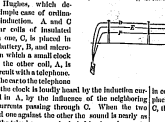


Fig. 4.

Having demonstrated that a metallic shielding or screen is altogether ineffectual for the protection of telegraph lines from the effects of lateral induction, Professor Hughes turned his attention to the question whether, although induction cannot be destroyed, it may not be neutralized or compensated. With this object in view he constructed a set of four separate insulated wires, which could be joined up at their free ends in several combinations. Joining one wire to the telephone, and one of the others to the telegraph, so powerful induction, as might be expected, took place, the ticking of the clock being heard loud and clear, but no apparent increase or diminution of the sound was produced when three of the wires were in circuit with the microphone, in the same direction, and the fourth was connected with the telephone. By joining two of the wires to the microphone circuit in such a manner that the current through one returns by the other, the inductive influence is completely neutralized, and absolute silence is the result. From this it follows that it is perfectly possible to protect a telegraph line from disturbance by the induction of its correspondents.

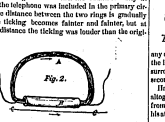


Fig. 5.

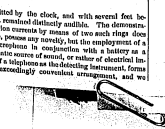


Fig. 6.

In Fig. 5, A and B represent the two coils respectively of two Professor Hughes electro-magnet, of a telegraph instrument at the receiving station, but it differs from the ordinary electro-magnets in the fact that the coil surrounding each core is connected with its own separate battery as in the usual way. An improved application of the same principle is shown in Fig. 6. The bobbin of the electro-magnet is wound with two coils of equal length and thickness. Each of these coils is connected with the battery, one through the contact-breaker at the transmitting station and the other through the line and a sympathetic relay. The current through the line and a sympathetic relay. The current through one line and a sympathetic current through the other, but the coils of the magnet are so connected to the line at the receiving station, that the positive currents traverse in coil in the opposite direction as regards the magnet core, and the negative current passes in the opposite direction, so that, by the influence of double reversal, the effect is the same as that of a single current of double the strength traversing the magnet in the usual way.

It will be seen that portion of Professor Hughes' researches which constitute the important contribution to the science of telegraphy. We have but little doubt that Hughes' induction balance, by which term we would include all instruments based upon its essential principles—will ultimately take its place side by side with Wheatstone's bridge in the history of the electric telegraph, for by its means the telegraph engineer will be enabled to eradicate from his lines the disturbing and cost-entailing effects of electrical induction. In Fig. 7, let D, E, and F represent three lines of telegraph, supported on poles and running parallel to one another; if a current of electricity be transmitted along the line D, it will induce in each of the lines E and F a current in the opposite direction, whose relative strength will be determined by the distance of its corresponding wire from the inducing or primary wire, D. Now, if at the moment of sending a current through the latter, it were possible to transmit through each of the lines, E and F, a current in the same direction as that of D, and exactly the same strength as the currents produced in the opposite direction by induction, the two, being equal and opposite, would completely neutralize one another, and although, as a matter of fact, the latter line would be exactly the same, its effects would be completely eliminated and destroyed.

Fig. 7.

At the transmitting end each of the lines is connected to a small induction coil or ring, X, Y, or Z, similar to those figured in Fig. 1, and placed one in front of the other, so as to exercise an inductive effect, the one upon the other. Now, from what has been said, it is obvious that if the coils were all similarly connected to their respective wires the effects of induction between one circuit and the other would be increased by the addition of the inductive effects of the coils being superposed upon and added to the inductive effect of the lines; but if at the moment of transmitting a current through the primary wire the two ends of its corresponding coil were reversed, then the inductive effects of the line and of its coil would be equal on the lines and coils of the other circuits and in opposite directions, and the aggregate influence would be reduced by the sum of the effects between the two inductances. By making the length of wire contained in each coil, however, proportional to the length of its corresponding line, and the number of turns proportional to the coils proportional to the mean distances of the lines from one another, the inductive effects of the coils are exactly equal to the inductive effects of the lines, and if their direction of the coils, then the problem is solved and all effects of induction are eradicated.

For the purpose of practically demonstrating the system of compensation, Professor Hughes constructed the apparatus shown to the right of the general perspective view. The five rings of insulated line wire attached to the board represent three lines of telegraph running parallel. The two coils of each of the outside pair are joined so as to form one circuit, consisting of one block coil, and the other coil, each pair representing one line of a certain length, and between them is a single coil representing a similar telegraph line of a shorter length; this difference of length in order to represent a somewhat complicated case, and to show that no matter what the relative lengths and distances apart of telegraph lines, their mutual induction may be compensated by suitably constructed and adjusted compensating coils. The compensation portion of the apparatus consists of three rings whose distances apart can be adjusted by sliding in or out the cylinder to which each of the outer coils is attached. On the front corner of the board is the commutator, consisting of six stiff elastic wires, which can be sprung against twelve brass nails, and the connections are so arranged that the battery circuit may be sent through any one of the lines, with or without the balance in the circuit, and each line can be made either a primary inductorial circuit, or a secondary line in connection with a telephone, by simply placing the commutator wires against their proper contact pins. The microphone and clock, which is the source of sound, and which is shown below, was placed in a distant room, and the direction of the currents through out the whole apparatus was under perfect control by means of the commutator to which we have referred.

PROF. EDISON'S INDUCTION BALANCE FOR TELEPHONE LINES.

On the opposite page we give a full description of Professor Hughes' induction balance—an invention for which he claims originality, and which he is receiving great credit in England. It is, however, identical in principle, and almost exactly the same in construction and arrangement as Professor Edison's apparatus, patented in England July 30, 1877, and in the United States April 30, 1878. The fact that Prof. Edison perfected the invention, patented it, and brought it into use so long before Prof. Hughes brought out his apparatus, is *prima facie* evidence that he—Edison—is the first inventor of the inductional balance.

From Edison's U. S. Patent Specification.

In telegraph lines there are very often numerous wires running in the same direction upon the poles, and it has long been known that currents passing through one or more of said wires set up inductive currents in the other wires. These, collusively, are harmless in the Morse and other systems of telegraphy; but where a wire for a telephone, acoustic, or speaking telegraph, runs parallel to or within the field of the electric influence of another wire, there are false and confusing sounds at the telephone—in some cases so much as to render it impossible to use the telephone. This is especially the case with the Edison system of telegraphy, which employs currents of high tension, and consequently induces powerful currents in neighboring wires.

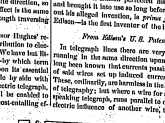


Fig. 1.

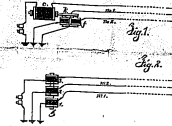


Fig. 2.

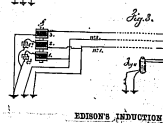


Fig. 3.

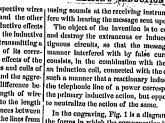


Fig. 4.

In telegraph lines there are very often numerous wires running in the same direction upon the poles, and it has long been known that currents passing through one or more of said wires set up inductive currents in the other wires. These, collusively, are harmless in the Morse and other systems of telegraphy; but where a wire for a telephone, acoustic, or speaking telegraph, runs parallel to or within the field of the electric influence of another wire, there are false and confusing sounds at the telephone—in some cases so much as to render it impossible to use the telephone. This is especially the case with the Edison system of telegraphy, which employs currents of high tension, and consequently induces powerful currents in neighboring wires.

In Fig. 1, A is an iron core, over which there are three or more coils—one for each line circuit. The coils 1 and 2 are in the ordinary or Morse circuits No. 1 and 2, while coil 3 is in the telephonic circuit. The coils are so wound and arranged, in relation to the induced currents thrown into the telephone wire by the proximity of the other wires, that they will act in the iron core, *g*, to set up a magnetism therein that will cause a powerful induced current to pass into coil 3 and telephone, equal and opposite in direction to the induced currents in the telephonic line due to the proximity of the other wires.

In cables consisting a number of wires there is not only dynamic induction, but static induction. The latter appears sooner than the former, and is of exceedingly short duration, so that magnetic impressions are not, as a rule, set up.

In Fig. 2 is shown a modification of Fig. 1 to meet this condition, which it does to a considerable extent, but not entirely. The induction coils 1, 2, and 3, are included in derived circuits from the line wires, 1 and 2, that pass to the condenser, *c* and *c'*, and to the earth. To obtain the best results, however, both the dynamical and statical induced currents must be, as nearly as possible, neutralized, so that they will circulate in the telephone wire in equal volume and opposite to those induced by proximity of the wires; and to obtain these conditions both magnets and condensers are necessary. Speaks former is set up dynamical induction currents, and the latter statical currents. If current No. 1 is opened there first appears a short wave of current due to static induction, then an interval, and then the dynamical induced current appears, which gradually dies away to nothing, when a compensation which will equalize the dynamical current will have taken that due to static induction free to circulate, and this current is continued by an induced current from a magnet, because time is required to charge and discharge the cores and the consequent production of the induced current.

Upon short circuits a coil with two or more wires, wound side by side upon a wooden bobbin is used, as shown in Fig. 4. One wire is placed in the telephonic circuit, while the others are placed in the circuits to be compensated for, and as connected therewith that the currents thrown into the telephonic coil are equal but opposite to the induction resulting from the wires running parallel.

By employing large wire, and a large quantity of it, I am enabled to obtain nearly perfect compensation, as the coils set up both dynamical and statical currents, no iron cores being used to retard the appearance of the currents.

From Edison's English Specification.

When several line wires run near each other, the wire used for the acoustic or speaking telegraph is influenced by induction, and false sounds will be produced. I counteract this tendency by placing one or more electro-magnets, A, (Fig. 5), in the circuit of the speaking telegraph, and one or more electro-magnets, B, in the circuit of the adjacent wires,

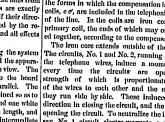


Fig. 5.

and bringing the opposite cores of B, at such a distance from the cores of A, that a certain magnetic action will be set up in A by induction in the opposite direction to the induction currents from the adjacent line wires.

By adjusting the distance between these magnets when the speaking telegraph is not in use, until there is no sound at the diaphragm from the induction currents, then these currents will be neutralized, whether strong or weak.

Les Mondes calls attention to the success with which M Baxel, a merchant of Montargne, near Blois, is cultivating the truffle. He is in a position at present to furnish thousands of these fungi, of excellent quality, at about 70c. each. He suggests that vines destroyed by phylloxera be replaced by truffle yielding oaks where the soil is calcareous or argillo-calcareous; the would be a means of recovering from the loss sustained. The products would be quickly realized, for M. Baxel has oaks six, seven, and eight years planted, which already yield truffles.

37

Magneto-Induction Currents.—According to the recent researches of Count du Moncel, if an iron stem or core wound with a coil be shifted in the direction of its axis in front of a magnetic pole, a series of induced currents in the same direction will be produced, succeeding each other, whilst the movement lasts, that is from end to end of the stem; but this effect will not manifest itself, without a special disposition of the coil upon a ring entirely enveloped by the coil, for, in this case the two opposite parts of the ring are oppositely polarised under the influence of a single inducing pole, and as the coil is wound in a different direction in relation to the two resultants corresponding to the neutral lines, the induced currents produced would be equal and contrary. For this reason M. Gramme has been obliged to divide the helix of his ring into sections, and to connect them in circuit by a collector. M. du Moncel also remarks that the induced currents in the Gramme machine are made up (1), of those which result from the movement of the coils induced before the conductor; (2) by those which are determined by the interversions of polarity of the iron ring; but the effects are the same as if those helices displaced themselves upon a fixed ring, having determinals and constant polarities. April 77

Edison's Induction Devices.—We have received from Mr. Edison, a copy of his United States Patent for "Circuits for Acoustic or Telephonic Telegraphs," No. 203,019, dated April 30, 1878. It describes several modes of compensating for the induction of neighbouring working circuits on a telephone line, by means of coils, electro-magnets, and condensers. Inasmuch as these are always permanently connected in circuit, his method differs from that of Professor Hughes, we have described in recent numbers. Professor Hughes reverses the ends of the compensating coils in the circuit by the signalling key itself in the act of signalling; his method not being specially designed for the protection of a telephone line, but of each ordinay circuit against all the others. Mr. Edison, however, does not confine his plans to telephone circuits. Another point of distinction between his methods and that of Professor Hughes, is the formation of the induction compensator itself. Professor Hughes arranges his coils with respect to their position, distance from each other, and length of wire, so as to imitate the actual disposition of the line wires. We cannot see that Mr. Edison has arrived at this idea. His specification, however, covers a good deal of Professor Hughes' preliminary work! Tel Journal Apr 79

Professor Bell on Induction. — Touching the reference made to the twisted wire plan for overcoming induction in connection with Professor Hughes' Induction Compensator, Professor Bell writes to correct the statement that the same method had also been "lately" patented by him. He says, "I presume from this that your information has been derived from a letter originally published by Mr. Brooks in the *Philadelphia Times*, charging me with having obtained his idea through the medium of a mutual friend, and with having subsequently patented the invention as my own, in England. In my reply to this letter, which has not been as extensively copied as the original charge, I showed that Mr. Brooks laboured under a misapprehension as to the date of my patent. Instead of this being November 20th, 1878, as would be inferred from Mr. Brook's statements, the actual date is November 20th, 1877. I intend publishing shortly to the American Academy of Arts and Sciences a paper upon Induction, giving the results of my experiments in England, a copy of which I will forward you as soon as published." Professor Bell also states his intention of testing Professor Hughes' beautiful induction compensator on the American Exchange telephone lines. Apr 79

Tribune Aug 2. 1881. (see B. Instruments, 40)

THE INDUCTION BALANCE TRIED.

EXPERIMENTS BY PROFESSOR BELL AND MR. TAINTOR WITH THE OBJECT OF LOCATING THE BULLET IN THE PRESIDENT'S BODY—THE RESULT REPORTED TO THE SURGEONS.

[BY TELEGRAPH TO THE TRIBUNE.]

WASHINGTON, Aug. 1.—As foreshadowed by a dispatch sent to THE TRIBUNE last evening, Professor A. Graham Bell and Mr. Taintor made experiments this morning with the changed and perfected induction balance, with the purpose and hope of locating with definiteness the position of the bullet in the body of the President.

Professor Bell made the following statement or report to the surgeons respecting the experiment:

VOLTA LABORATORY, 1, 221 CONNECTICUT-AVE.
WASHINGTON, Aug. 1, 1881.

To the Surgeons in attendance upon President GARFIELD.

GENTLEMEN: I beg to submit for your information a brief statement of the results obtained with the new form of induction balance in the experiments made this morning for the purpose of locating the bullet in the person of the President. The instrument was tested for sensitiveness several times during the course of the experiments, and it was found to respond well to the presentation of a flattened bullet at a distance of about four inches from the coils. When the exploring coils were passed over that part of the abdomen where a sonorous spot was observed in the experiments made on July 26 a feeble tone was perceived, but the effect was audible a considerable distance around this spot. The sounds were too feeble to be entirely satisfactory, as I had reason to expect from the extreme sensitiveness of the instrument a much more marked effect. In order to ascertain whether similar sounds might not be obtained in other localities, I explored the whole right side and back below the point of entrance of the bullet, but no part gave indications of the presence of metal, except an area of about two inches in diameter, containing within it the spot previously found to be sonorous. The experiments were repeated by Mr. Taintor, who obtained exactly corresponding results. We are therefore justified in concluding that the ball is located within the above named area. In our preliminary experiments we found that a bullet like the one in question, when in its normal shape, produced no audible effect beyond a distance of two and a half inches; while the same bullet, flattened and presented with its face parallel to the plane of the coils, gave indications up to a distance of five inches. The same flattened bullet, held with its face perpendicular to the plane of the coils produced no sound beyond a distance of one inch. The facts show that in ignorance of the actual shape and mode of presentation of the bullet to the exploring instrument, the depth at which the bullet lies beneath the surface cannot be determined from our experiments. I am, gentlemen, yours truly,

ALEXANDER GRAHAM BELL.

In conversation this morning Dr. Bliss said he believes the bullet lies from an inch to an inch and a half below the surface. There was no immediate purpose of extracting the ball, he said, but the experiment had set at rest all doubt in regard to its position, and in so far as the treatment of the patient might be influenced by that knowledge the experiment would have immediate value. Dr. Bliss said Professor Bell was a very cautious man, and in his letter had not set forth as explicitly as he might have done the completeness of his success.

MR. EDISON AND THE INDUCTION BALANCE.

ON page 29 of the present volume we gave a description of Professor Hughes' induction balance for preventing the action of what are known as induced currents in destroying the carrying capacities of adjoining wires. It appears that Mr. Edison claims priority in this invention, and forwards a copy of his specification forming part of Patent No. 203,019 (U.S.A.) which was applied for on February 21, 1878, but which, from a manuscript note, appended, we believe, was illustrated by Fig. 23 of Edison's English Patent, applied for on July 30, 1877. We give the substance: the invention was entitled "An Improvement in Circuits for Acoustic Telegraphs." In telegraph-lines there are very often numerous wires running in the same direction upon the poles, and it has long been known that currents passing through one or more of said wires set up induced currents in the other wires. These ordinarily are harmless in the Morse and other systems of telegraphy; but where a wire for a telephone, acoustic, or speaking telegraph runs parallel to or within the field of the electric influence of another wire, there are false and confusing sounds at the receiving-instrument that greatly interfere with hearing the message sent upon each acoustic lines. The object of the present invention is to compensate, neutralise, and destroy the extraneous or induced currents from contiguous circuits, so that the messages will not be in any

Orter

38

manner interfered with by false currents. The invention is primarily adapted to telephonic circuits, and is so described herein; but it may be used with any instuments where it is desirable to neutralise such extraneous currents.

The present invention consists in the combination, with the telephonic circuit or other circuit to be freed from external influences, of an induction-coil, connected with the contiguous circuits in such a manner that a reactionary induction is established in the telephonic line of a power corresponding and similar to the primary inductive action, but opposed to the same, so as to entirely oppose and neutralise the action of the same.

Fig. 1 is a diagram representing one of the forms in which the aforesaid compensation is effected. The large coils C C[1] are included in the telephonic circuit at each end of the line. In the coils are iron cores, surrounded by a primary coil,

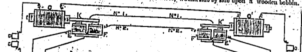


FIG. 1

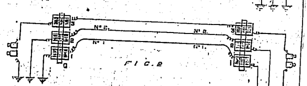


FIG. 2

the ends of which may or may not be connected together, according to the compensation desired.

The iron core extends outside of the coils some distance. Compensation for two circuits only is shown. These circuits, "No. 1" and "No. 2," running in close proximity to the telephone-wires for many miles, induce a momentary current in it every time the circuits are opened or closed, the strength of which is proportionate to the proximity of the wires to each other and the number of miles that they run side by side. These induced currents are in one direction in closing the circuit, and the opposite direction on opening the circuit. To neutralise the induced current from, say, No. 1 circuit, place electro-magnets E E[1] at each terminal in the circuit of circuit No. 1. These magnets are then adjusted to approach the iron cores K K[1] until the induced current thrown into the coils C and C[1] and telephone-line by the action of the magnets E and E[1] is equal, but opposite to, the induced current from the circuit No. 1 thrown into the telephonic wire by running parallel to it. Thus a perfect compensation is attained. If the two lines run parallel for long distances the two ends of the primary coil on C and C[1] are connected together, thus retarding the magnetism and demagnetisation of the cores K K[1], and consequently lengthening the induced currents thrown into C and C[1] by the action of E[1] and E.

Having thus compensated for circuit No. 1, the compensation for circuit No. 2 is exactly similar. If the latter circuit does not affect the telephone-circuit as strongly as No. 1, the electro-magnets F and F[1] are placed a greater distance from K and K[1]; the latter may be elongated, and compensation attained from many circuits by employing separate magnets in each circuit which affects the telephonic circuit.

Owing to the great diversity in the character of the induced currents thrown into telephonic wires from wires in close proximity—due to different lengths and the employment of different battery powers and systems of transmission—many methods to meet special conditions are necessary. Thus in Fig. 2, where the circuits 1 and 2 employ powerful batteries and reversals and many magnets are in circuit, the induced currents thrown into the telephonic wire are exceedingly powerful; hence a more powerful means of compensation is necessary. In Fig. 2, G is an iron core, over which there are three or more coils—one for each line-circuit. The coils 1 and 2 are in the ordinary or Morse circuits Nos. 1 and 2, while coil 3 is in the telephonic circuit. The coils are so wound and arranged, in relation to the induced currents thrown into the telephone-wire by the proximity of the other wires that they will act in the iron core G to set up a magnetism therein that will cause a powerful induced current to pass into coil 3 and telephonic line opposite in direction to the induced currents in the telephonic line due to the proximity of the other wires. It is obvious that these coils may be inserted at any number of points along the line, and that the intensity of the reverse currents will be proportionate to the intensity of the currents exerting the inductive influence, and hence they will always be neutralised.

Mr. Edison, after describing sundry modifications applicable to special conditions, goes on:—

"In my apparatus, if current No. 1 is opened there first appears a short wave of current due to static induction, then an interval, and then the dynamical inducted current appears, which gradually dies away to nothing; hence, a compensation which will eradicate the dynamical current will leave that due to static induction free to circulate, and this cannot be eradicated by an induced current from a magnet, because time is required to charge and discharge the cores and the consequent production of the induced current.

"Upon short circuits I use a coil with two or more wires, wound side by side upon a wooden bobbin. One wire is placed in the telephonic circuit, while the others are placed in the circuits to be compensated for, and so connected therewith that the currents thrown into the telephonic coil are equal but opposite to those due to induction resulting from the wires running parallel. By employing large wires, and a large quantity of it, I am enabled to obtain nearly perfect compensation, as the coils set up both dynamical and statical currents, no iron cores being used to retard the appearance of the currents. Instead of the coil of several wires wound side by side, several long strips of tin-foil may be placed side of side and insulated from each other, and the currents passed through the strips in the same manner as if they were wires."

Electro-dynamic Induction.

It is a common impression among electricians that a telegraphic conductor can be withdrawn from the induction influence of neighboring conductors by metallic envelopes which are connected with the ground, but H. de Manex tried some experiments in the month of February, 1878, preparatory to the establishment of the telegraphic service of the French Exposition, which led him to the discovery of a new law. In electrostatic action, the induction may be prevented by the proposed method, but the law relative to electro-dynamic induction is thus stated: In a closed circuit the intensity of the current, which is determined by the induction of a cylindrical conductor upon another of the same form, cannot be changed even by surrounding one or both of those conductors by a concentric metallic envelope communicating with the ground through its entire length.—*Comptes Rendus.*

INDUCTION UPON TELEGRAPH WIRES.

[16201.]—In your last number you publish the specification of Mr. Edison's American patent relative to a new plan for induction upon telegraphic lines, and with which I entirely concur in regards to that there are some points of similarity between the remedies proposed in my late communication inserted at the Patent Office, Society, on "Lateral Induction upon Telegraphic Wires"), and the specification of Mr. Edison.

At the time of the reading of that paper I was unaware of any remedies having had been in the matter, though immediately afterwards he sent a telegram referring to the application for the patent. Similar I at once obtained, and found that its objects were entirely different to those proposed by myself, consequently the original means differed, according to the object we had in view.

Mr. Edison's remedies for London were publicly invited by myself to discuss the subject at the discussion of the paper held there, but no one then appeared, and Mr. Edison's claims have not yet brought forward except by myself, when I further explained the essential difference to those fully capable of understanding the subject, it hardly fair now to report the remedies upon a technical subject resulting special knowledge of telegraphy, except in those journals specially devoted to telegraphy.

MECHANIC AND WORLD OF SCIENC

The use of counter-induction by neutralising either visible or dynamic currents is not new, nor can it be by either Mr. Edison or by myself, as it has been employed in France since 1868, and also in duplex working for many years.

The object of Mr. Edison's patent was to neutralise the induction upon a single wire. This he has done by means of all the end.

Mr. Gee Wilson, of Chicago, by a very superior method to that of Mr. Edison, produced completely any two wires without injury to the remaining wires.

To accomplish, I proposed contacts all wires, connecting the matter what material and equally proportion the inductive influences of the adjacent wires.

In order to accomplish this, it required what exactly the special features of my own invention, and what transforms it into the question *from failure to success*, viz.—

1. The coils must be reversed at the instant of putting on battery, and as instantly restored to normal condition.

2. The coils must have all a certain definite length of wire to exact proportion to that of the line upon which it is used.

3. The battery power must also be proportionate to the length, or no balance need form upon.

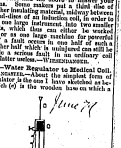
Now each of these conditions is vital, and in the specification of Edison it stated any coil each being different, to suit any line. The objection to this is obvious, as the slightest difference in the length of the coil, the balance cannot be, or believe Mr. Edison's object is of too technical a nature, not interesting to the general public, which I have to the special telegraphic journals.

Should you think this paper will be fed worthy of a place in your valuable journal, which I have long been a subscriber.

D. E. Hughes.

[20200.]—Water Regulator to Medical Coil. You would not find the above to answer your expectations. Some makes put a third disc of metal between the insulating material, midway between the two end discs of the induction coil, in order to divide its one large instrument into two smaller instruments, which then can be worked either separately or as one large machine for powerful effects. If a fault occurs in one half of such a coil, the other half which is unaligned can still be used, while a serious fault in an ordinary coil necessitates its later undue.—WIMSHURSTER.

[20200.]—Water Regulator to Medical Coil. —W. Lancaster.—About the simplest form of water regulator is the one I have sketched at below, in which (c) is the wooden base on which a

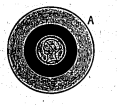


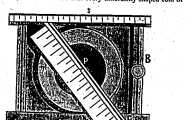
metal plate is screwed, containing a piece of brass tube in which is fitted the glass tube (f), on the top of the glass tube is another piece of brass tubing into which a cotton has been soldered, through which the brass rod (g) slides freely. The lower part is connected by a wire to the binding screw (F), and the upper part by a wire to the screw (B) for the glass tube is to be partly filled with water, and the position of the rod (g) regulates the strength of the current.—W. J. Lancaster.

ASSAYING BY INDUCTION.

In describing his new induction balance to the Royal Society (see TELEGRAPHIC JOURNAL for June 1), Prof. Hughes demonstrated its extreme efficiency as a means of assay for metals; and Mr. Chandler Roberts, F.R.S., the chemist to the Mint, has been much employed of late in testing its capacities in this direction as a measurer of the proportions of alloy in coins. In order to assist Mr. Roberts in his determinations, Prof. Hughes has introduced a novel mode of using the balance, which gives the instrument a great range of sensitiveness, and renders it capable of detecting one part of alloy in, at least, ten thousand parts of basic metal, a delicacy which far exceeds any known process of chemical analysis.

This modification of the balance will be readily understood by anyone who has read an account of the latter, by referring to the accompanying figure, where A represents the pair of coils, or induction pan, of the balance on which the coin to be assayed is placed, as shown, and B the other pair of





THE INDUCTION SCALE.

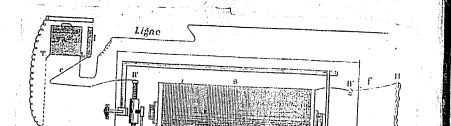
coils, framed round for steadiness, and fitted with a scale for measuring the disturbing effect on the balance of the coin placed in A. Formerly, the disturbing effect of a coin placed in A was obtained by rapidly transferring the telephone from the secondary circuit of the balance to the secondary circuit of a sonometer, and adjusting the sonometer until it gave a disturbance which to the ear seemed equal in loudness to the disturbance caused by the coin on the balance. The reading of the sonometer was then taken as a measure of the inductive power of the coin. An improvement on this method consisted in comparing each coin with a standard placed in the other pan of the balance B, and estimating the *difference* between them by means of the sonometer in the same way. But it is obvious that both of these methods are inferior to one which does not trust to the discriminating capacity of the ear, but which, like the Wheatstone bridge test of resistance, depends upon getting a balance or zero of sound.

This balance is got by means of a sliding scale of metal S, which is moved across the top of the measuring pan of the balance A. There are two elements in this scale which determine its power to produce a balance, namely, its width and its thickness. The width of metal appears to balance the intensity of the induction currents produced in the disturbing coin; and the thickness their quantity: but as the inquiries to be varied. The scale is, therefore, made of a uniform width a little over half the diameter of the coin; but it increases in thickness at a regular rate per unit of length, so as to give a mass-gradient. It is composed of zinc, which is a homogeneous, and not readily rusted metal, intermediate in inductive properties between copper above and bismuth below; and for measuring the whole series of metals, the thickness is made to increase at the rate of 1 millimetre in 5 centimetres length. It will be seen, however, that by taking a scale in which the slope of thickness is faster, say 1 millimetre in 50 centimetres length, a much higher degree of sensibility will be obtained in the balance. Such a scale would be requisite for assays of fine gold-silver alloys.

A straight guide G, is used to fix the direction of the scale as it is slid across the top of the coils in A. But it is found that every differently shaped coin or

band. This zero point can be d, for a millimetre or two to ent to cause a faint sound in to the zero is got, the scale is n, and the value obtained is an

Tables of the proportion of pounding to these readings can ared for immediate reference, ent, rapid, and clean mode of t is worthy of remark, too, that, balance, there is here no inter- ical friction, and the induction t sensibility whether the mass o be comparatively large or ow wide is its range of effi- ordinary scale, we give the ics of different metals: gold 17.5, aluminium 13.5, zinc 68, ness instruments is, we believe, ent.



Projet du nouveau Parleur pour la lecture au son.

APPLICATION DES EFFETS LUMINEUX DES COURANTS D'INDUCTION

I

LA LECTURE AU SON EN CAMPAGNE

Il y a des cas où l'appareil connu sous le nom de « *Parleur* » est appelé à rendre de grands services, même après la téléphone dont l'usage, sur les lignes de quelque longueur, n'est pas encore démontré.

Par exemple, en campagne, dans certaines éventualités, quand on ne peut s'embarrasser d'un matériel encombrant, où, suivant l'expression d'un publicistes, il est quelquefois nécessaire de réduire « *l'outillage du télégraphiste au bagage du philosophe* » (1), pour desservir des postes volants et provisoires, quand il faut un appareil commode et portatif pour dépêches et interrompre ses transmissions.

Mais on n'a pas toujours sous la main un personnel fugitifs.

C'est pour obvier en partie à cet inconvénient, amoindrir les difficultés de cette lecture *pénible* pour quelques-uns, que je propose le moyen élémentaire suivant [2] :

Le parleur est à peine modifié par l'adjonction d'une colonne métallique J, dont la borne C reçoit un fil de cuivre G, qui communique intérieurement à condensateur, avec laquelle il est constamment en relation. A l'armature du parleur, et solidaire de son mouvement, est attaché un deuxième fil conducteur mu qui a pour but de compléter le circuit d'une pile P; destinée elle-même à actionner la bobine toutes les fois que, le commutateur de celle-ci étant disposé pour laisser passer le courant, l'électro-aimant A attire l'armature B. Les extrémités polaires du fil induit, reliées aux bornes B'' et B''', sont terminées en f et f' par deux fils de platine aboutissant à un tube Geissler III''. Dans la position de repos du parleur, lorsque aucun courant ne traverse la ligne, le circuit de la pile P est par ce seul fait interrompu ; toute trace d'induction disparaît dans la spirale S qui ne saurait, en cet état, influencer le tube. En supposant au contraire le parleur en fonction, c'est-à-dire l'armature B ramenée au contact par un courant de ligne, le circuit se ferme, la bobine inductrice PD, parcourue par le courant local, agit sur l'hélice S, et malgré l'étrangeté du phénomène, le tube est aussitôt allumé par un flot de lumière plus ou moins prolongé, dont le degré d'intensité ou de continuité dépend de la durée du contact de l'électro-aimant et de son armature.

Ainsi s'établit entre le point et le trait une différence appréciable, assez sensible, qu'il est facile de reconnaître après quelques jours d'exercice.

Si l'oreille perçoit mal ces sons, les yeux peuvent en contrôler et rectifier immédiatement la valeur.

L'expérience faite avec une bobine semblable à celle dont on voit le plan grandeur naturelle à la page précédente, et avec un parleur ordinaire, a confirmé ces prévisions et donné des résultats satisfaisants.

L'élément employé était un couple *Guiffe* du plus petit modèle, charbon et zinc, avec solution de bichromate de potasse.

Dans le cas de coupure d'un fil ennemi, opération pénible qui a lieu généralement la nuit, le bruit est mauvais auxiliaire qu'il est prudent de diminuer, nouvelle tes-attitude par un réglage approprié devient inutile, pour faire place au mode de perception qui vient d'être indiqué : la lumière, conséquemment protégée des indiscrétions.

Le même dans supprimée.

Le même dans son ensemble, le rôle de la palette, que je l'indiquerai, ne borne à ouvrir ou à fermer l'unité d'une pile Daniell capable au besoin, par disposition spéciale, de produire un double effet récepteur et de transmission.

La lumière lorsque ce système permet au télégraphiste inhabile ou même à un soldat connaissant l'alphabet Morse, d'interpréter les signaux d'un télégramme.

L'induction au parleur de la machine d'induction Ruhmkorff, au poumon absent lui enlever son caractère utilité et sa principale qualité; mais ces deux instruments seront encore plus portatifs qu'un seul appareil deux emplois combiné aura toujours addition, 2° la lecture immédiate.

Les paroles pas un temps souvent précieux sont-il faut saisir ou donner, pour ainsi dire au ordre important à déchiffrer une handelement des à multiples, telles qu'un réglage insuffisant, un du mouvement d'horlogerie, une rupture d'une aux mécaniques, entraverraient momentanément fidélité de reproduction.

Ingénieux repos, application curieuse des effets aux des courants d'induction, fait naître l'idée système de télégraphie optique qui rendrait ce possible, plus simplement que ne l'a imaginé officier de marine d'un grand mérite, ses idées sur la signaux entre les différents de la même escadre.

E. NAVES
Employé du Télégraphe à Bordeaux

(1) *Les systèmes télégraphiques*, Bontemps.

(2) « Le condensateur *dérive* les deux électricités de « l'extra-courant, en les rétablissant sur ses armures, et « finalement exalte l'action inductrice totale et les fonctions « des extrémités du tuboleu. » (*Traité d'Electricité*, t. II, Guevarez).

JUNE 6, 1879.

AN INDUCTION BALANCE.

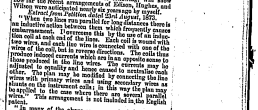
TO THE EDITORS OF ENGINEERING.

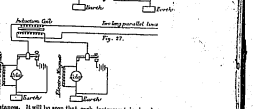
SIR,—I have been much surprised to learn that in none of the letters which appear had been written on the subject of the neutralization of dynamic inductive currents, which, when they are sensitive have any sensible effect on the line. Each call is wound with wires of the coil, but the two wires in connected with one of the poles of the battery, the other with the telephone. The coils thus produce induced currents which are in opposite sense to those produced in the line wire, and which can easily be adjusted to equality and hence caused to neutralize the effect. The plan may be modified by connecting the line wires to the primary wires and using secondary wires as shown on the accompanying coils; in this way the plan may be applied to the case where there are several parallel wires." This arrangement is not included in the English patent.

In many of the above arrangements inductive coils and electro-magnets are employed for the production of induced currents. I find that it is only necessary to use at least 50 per cent. of the strength of the induced currents may be obtained from the coils by winding the two electro-magnets together in the ordinary manner, but using for each instrument a soft iron armature to their axes form, as shown, in the case of Indicator Coils, each of the electro-magnets is wound with primary and secondary wires, and the primary wires are so connected as to form alternate pairs.

Extract from Patent dated 7th *November*, 1873.

"Finally, Fig. 26 will show the arrangement spoken of in my petition for procuring or constructing the inductive coils between the wire resting parallel for four





distances. It will be seen that each instrument is placed in the circuit of one of the induction bridges; this is done in order to counteract the electro-magnetic retardation caused by the line currents instead of by the local electro-magnets. Simple electro-magnets might be employed as in Fig. 27, but with less effect."

Yours truly,
C. W. WARREN.

ARUNDEL, May 5, 1879.

P.S.—The paper in the "Journal of Telegraph Engineers" gives an arrangement similar to this, the two wires of the induction coil being shown on the relays.—C.W.W.

[illegible] Inventive Life 1879

DANIELL.

[2097.]—Induction Coil.—Use the primary two layers No. 16 cotton covered wire, the intermediate of three layers No. 24 cotton covered wire, which is more than better of the paper; the sheets of thick alternately pasted on each side, and the two ends connected to the two pillars of the contact-breaker.—E. H. HILLS.

[2096.]—Intensity Coil.—The condenser will be found to consist of 36 or 38 silk-covered wire; for the secondary coil, calculate the space between primary should be made up of about 36 layers of thinfoil, and secondary 72 layers of paper, each layer being separated from one another and paper between each of the layers of secondary; the latter by a piece of paper previously soaked in paraffin before winding the secondary on. The finished bobbin should be placed in paraffin before winding the secondary on. The core should be connected to the binding-post of the secondary coil, and the other end of secondary to the binding-post marked sec. say, No. 2; the latter between each succeeding coil. To the end coming out from the centre of the bobbin paraffined paper should be which is connected to binding-screw on the terminal. Full instructions and take battery cells. Have a second bottom to the stand good coil. Do not put too much paraffin, but there be just sufficient to handle every wire from its neighbours.—W. J. LANCASTER.

[2095.]—Induction Coil.—For making a coil to give 1in. spark you want 1lb. of silk-covered wire, No. 36, for the primary, and 1lb. of No. 40 silk-covered for the secondary. Make the primary coil first, by winding over a paper tube 2in. in diameter and 8in. long. Fix the tube with soft iron wire, No. 22, well annealed, in the centre, with a piece between primary and secondary, and wind from 2in. to 1in. of No. 40 over the primary coil, and put in the condensing tube, best tinfoil (generally used) it is to match the size of your box. Then put the primary coil over the other, so that the 1in. of No. 40 will be between the 2in. and 3in. Then add the foil, 1in. wide, to the right side, and put a piece of paper over it. Then wind on the secondary coil, which is waxed and paraffined wire over each piece of tinfoil. Be careful in winding pieces on the right sides together, and connect wires from the vibrator of your contact breaker. The finish ends of the condenser to the same way, and connect same with the platinised screw-point.—WIRENGARDEN.

[2094.]—Induction Coil.—Don't use the iron wire for core, but use the best charcoal iron wire.

The condenser is quite large enough, if carefully done, I should not go beyond 12in. for diameter of the primary. The primary will do well but I prefer three layers when wound nicely; then put the second for primary into melted paraffin and leave it till the air all right. The thumbs will do well with the secondary, but not quite so good. The second I would wind on two bobbins, one each side. You will find this easier to wind, and better than having both together. These are simple, and have two cheeks 2in. between the cheeks, and 1in. between bobbins. In preference to wax I would use beeswax and resin, and put under the head of insulation. The battery should be two pints, and through the whole I would prefer to vary decant upon the coil working well. The condenser is not almost right in quantity for spark, but not when the whole coil is built up and used. If you have not got a good spark, you will be able to get a good one by adding 1in. spark, and with all in good order you will be able to reach from 6in. to 8in.—W. J. LANCASTER.

[2093.]—Induction Coil.—The plan of winding a great number of separate sections is a very good one; it has been used before by Mr. Apps, of the Strand. When your instrument is completed you ought to get nearly 9in. sparks with 6—E. H. HILLS.

[2092.]—Induction Coil.—Wire, No. 10 is decidedly too thick for the primary bobbin. The diameter of the size you are making. No. 36 would have been the right size. You ought to get a spark of 2in. at least with 2lb. of No. 36 secondary. The finish ends of each section of the secondary should be connected to the separate terminal screws. You then can work each section separately and find out and record the best way to use your battery.—WIRENGARDEN.

[illegible] You will find directions and

[2091.]—Intensity Coil.—The condenser is made up of sheets of thick brown sheets of parchment two; then you can wind three layers No. 36 silk-covered wire, then a layer of cotton-covered and then get a much thicker spark; for the secondary coil you want 2lb. of No. 36 or 38 silk-covered wire; be sure and calculate the space between primary should be made up of about 36 layers of tinfoil, and secondary 72 layers of paper, each layer being separated from one another and paper between each of the layers of secondary; the latter by a piece of paper previously soaked in paraffin before winding the secondary on. The finished bobbin should be placed in paraffin before winding the secondary on. The core should be connected to the binding-post of the secondary coil, and the other end of secondary to the binding-post marked sec. say, No. 2; the latter between each succeeding coil. To the end coming out from the centre of the bobbin paraffined paper should be which is connected to binding-screw on the terminal. Full instructions and take battery cells. Have a second bottom to the stand good coil. Do not put too much paraffin, but there be just sufficient to handle every wire from its neighbours.—W. J. LANCASTER.

[2090.]—Vibrating Wire and Coil.—To Mr. LANCASTER.—Your model of Bright's spiral is not quite right; in the first place, use No. 22 wire instead of No. 16, and at least 30 to 40 coils, about 1-16th of an inch from being about 1-32th to charge, the top to a binding-screw, and the bottom to the bottom to just dip into the wire, the latter making the current from the Bunsen or battery, the current from the coil readily. Of course, the spiral will vibrate without a condenser to the contact; if you do it will not answer the purpose. In that case, if you do, it will be very, very small. You should have a coil to 7 inches of silk-covered wire, the other two of insulated wire. Then follow the same directions as named above. Of number of wind one pound is more accurate as described in the book referred to this will give a good inch spark. The condenser your intended to be used for Ruhmkorff to be charged and used for, charging the wire will packed into that space.—W. J. LANCASTER.

[illegible]

[2089.]—Induction Coil.—Ib. No. 16, silk-covered, 1lb. 16oz., primary, 1lb., No. 36, silk-covered, 1lb. 8oz. 2lb. 8oz., used for the condenser thirty sheets of foil, 6in. by 4in. The condenser in core would be comparatively useless.—E. H. HILLS.

[2088.]—Induction Coil.—To make a coil to give 1in. sparks, you want 1lb. of silk-covered wire, No. 36, for the primary, and 1lb. of No. 40 silk-covered wire, No. 36, for the secondary. The pieces of foil may be 12in. by 4in., or more you want 12lb. of insulated wire, No. 22. The box should be 8in. by 12in.; the coil 8in. long; the core 6in. by 1in. 6in. The primary coil should be wound in two layers, No. 16, well insulated. The insulation may be made of paper well soaked in melted paraffine wax or of guttapercha thin.—WIRENGARDEN. [illegible]

[2087.]—Induction Coil.—The plate for winding the coil of induction coil is made by simply fixing a small cup-wheel on the spindle which carries the coil, and a bigger one on a slotted tube acting on the iron bar which by means of a screw-thread on the axle to advance in a bearing, and thus the wire through which the wire passes. The core should be 1in. less than the coil the wire will advance as much as the thickness of the wire. There is no difference in the size of wire for horizontal and that of the vertical contact-breaker. Both are good. Your condenser is all right, and a good Ruhmkorff battery, and coil will have no bad box. By 1in., will work, the coil to your satisfaction.—WIRENGARDEN. [illegible]

[illegible] QUESTIONS.

L'appareil Volta faradique de Gaiffe (torpille).

L'APPAREIL Volta faradique de Gaiffe se compose: 1° d'une pile de deux éléments du système Marié-Davy et bi-sulfate de mercure; 2° d'une bobine de Ruhmkorff M; munie d'un marteau interrupteur commun aux bobines de Ruhmkorff ordinaires. Tous ces organes sont renfermés dans une boîte ebénoque A B C D dans laquelle nous voyons : les deux éléments de pile I; une cuiller en caoutchouc servant à doser la quantité de bi-sulfate de mercure nécessaire au fonctionnement de la pile; un flacon K contenant une provision de bi-sulfate de mercure; une pince élastique qui porte les extrémités des fils inducteur et induit et en laquelle viennent s'attacher les réophores ou conducteurs de la pile; N est un manipule ou manche destiné à servir de porte-éponge; P un levier interrupteur au repos que l'on imprime suivant la ligne pointillée P, pour mettre le trembleur automatique Q en vibration; R est la tête du tube graduateur dans laquelle est enfermé le noyau de fer, et que l'on tire plus ou moins, suivant que l'on veut modifier l'intensité du courant; S, sont des conducteurs ou pièces en boule, en olive, en pinceau, que l'on fixe à l'extrémité libre des réophores pour les porter, sur les parties de l'organisme qui doivent influencer les courants.

Comme on le voit, cet appareil est tout à fait simple; sa boîte n'est pas en tout plus grosse et plus longue qu'un livre ordinaire et on peut dire que le praticien muni de cet appareil a l'électricité en poche. C'est l'un de ceux que l'on appelle communément torpille à cause des excitations et des secousses nerveuses qu'il produit et qui sont comparables, sauf l'intensité, à celles que détermine l'introduction du poison appelé torpille.

C'est au médecin qu'appartient le soin de déterminer quelle nature de courant pour supporter le malade, courant induit ou courant inducteur, courant né dans le petit ou dans le gros fil, ou bien les deux courants réunis. Le petit appareil que nous venons de décrire peut donner à volonté l'un ou l'autre de ces deux courants

THE INDUCTOMETER.

Wurz Professor D. E. Hughes brought his beautiful induction balance before the Royal Society more than a year ago, he pointed out, among other applications of the instrument in research, how it could be used in making electrical measurements after the manner of the Wheatstone balance. The adaptation of the balance to this purpose has been very efficiently managed by Dr. O. J. Lodge, who exhibited his arrangement, which he terms an inductometer, before the Physical Society during its last session. It is to be understood that Dr. Lodge does not claim any novelty for the apparatus beyond its particular form, and one or two details of its construction. The inductometer is, in fact, a modified inductive balance fitted for electric testing. The testing principle of the induction balance, as our readers are aware, consists in causing an intermittent electric current to circulate in a primary coil or coils which induces corresponding currents in secondary coils placed near. These induced currents are passed through a telephone and observed by the continuous hum or noise which they make in the ear. The application of the telephone to electric measurements in this way, instead of a galvanometer, was early foreseen by its inventor, Professor Graham Bell.

The inductometer, as will be more readily understood by reference to Fig. 1, consists of a primary

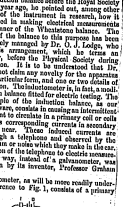
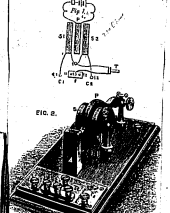


FIG. 2.



coil P, in which is circulating the current from a battery B, which may be either one or two Grove or other cells, interrupted rapidly by a clockwork make and break" key K. Two secondary coils S, S, are placed very near the primary one on each side. The primary coil is of fine copper wire (No. 30), and has a resistance of about 32 ohms, which is a little less than the joint resistance of the battery and the interrupter. The primary is permitted a slow adjusting motion to and fro by means of a screw. The secondaries, which are fixed, are made of fine wire, each having a resistance of some 270 ohms, and it is very important that they should be precisely equal in all respects.

The primary with its battery circuit may be considered the electromotive source of the apparatus. The two secondaries constitute two arms of the induction balance, and their ends are led to terminals f_1, f_2, f_3, f_4, by means of which the other two arms of the balance and the telephone connections are made. The telephone T is connected between the terminals f_1 f_3. The gap C_1 between the terminals f_2 f_4 is filled up by one of the condensers or resistances to be measured, and the gap C_2 between f_3 f_4, with the other, thus completing the four sides of the Wheatstone balance, with induction coils instead of resistance coils, as ordinarily, and with a telephone instead of a galvanometer in the "bridge" wire. Fig. 2 presents a general view of the apparatus, as made by Mr. Groves.

If C_2 and C_1 (the electric quantities to be compared) are the capacities of condensers or insulated wires, such as submarine cables, there will be no sound heard in the telephone, for the induced current in one side of the balance will neutralise that in the other. Hence the arrangement furnishes a ready means of adjusting two condensers to equality by this well-known method of "null-testing," that is, reducing the indicator of the observing instrument or indicator to nil or zero. In this case the zero will of course be silence. When the telephone is silent the equality has been obtained; when it "roars" the balance is far out; when it "murmurs" it is getting close. In fact, the degree of loudness of the telephonic hum enables the eye, with a little practice, to judge approximately how far out the balance really is. Of course to carry out the comparison properly one of the condensers must be a standard, one of known capacity, such as the standard condensers manufactured by Messrs. Latimer Clark, Muirhead and Co., and Messrs. Elliott Brothers.

In using the inductometer for such a purpose it becomes a question whether or not the element of time will enter and prevent a good balance being got when the dielectrics of the condensers compared are of different sorts, for example glass in the one case and air in the other, or gutta percha in the one case and parchment paper in the other, as usually happens in testing submarine cables for capacity. Dr. Lodge has not, we believe, completely satisfied himself on this point yet; but he has found that with ordinary glass and air as the dielectrics, a reasonably good balance can be obtained. Experiments made by Sir William Thomson about the year 1861 demonstrated that there is little or no difference between the discharges from equal condensers having air and glass for dielectrics, during the first few quarter-second, a result which confirms Dr. Lodge's observations.

When C_2 and C_1 are electric resistances to be compared, the telephone will only be silent if they are equal not only in resistance, but in self-induction. For instance, it would be impossible to balance a coiled wire with a straight one by this means. Ordinary resistance, however, might be balanced in this way, since both coils being wound of wire doubled on itself, are practically free from self-induction. But there is little inducement to employ this method for measuring resistances, which can now be so accurately and safely done by means of the Wheatstone balance, except perhaps on board ship, during the paying out of a cable, when the galvanometer may break down or prove troublesome through bad suspension or rough weather. It may also prove useful for measuring high leakage resistances; and in any case it is convenient for the electrician to have a testing instrument combining in itself the office. Moreover it may be occasionally useful to the physicist in comparing liquid resistances, as subject to polarisation under the direct passage of the current. But it is questionable whether or not the polarisation would not vitiate the results given by it, too.

The best thicknesses for the wires of the coils in the inductometer for the purpose of comparing high resistances or such capacities as are given by Dr. Lodge as follows; the wire of the secondary coils may be as thin as one pleases, and the wire of the primary coil such that the resistance is to the joint resistance of the battery and interrupter as the thickness of the uncovered wire is to the thickness of the covered wire with which the coil is wounded, a condition which also, we may add, defines the highest efficiency of a galvanometer coil.

DURÉE DES COURANTS INDUITS

1er article (voir le n° du 1er juillet).

Les machines à courants alternatifs deuxt très-employées aujourd'hui pour la production de la lumière, il peut être intéressant d'étudier les perturbations que la durée des courants induits amène dans leur fonctionnement.

Les phénomènes qui se produisent dans ces machines sont extrêmement compliqués, et l'étude complète de toutes les actions et réactions qui constituent la transformation du travail mécanique en électricité, nous entraînerait beaucoup trop loin ; mais parmi toutes ces causes acolytes, on peut choisir les principales, établir sur elles les bases de la théorie et tenir compte de l'influence des autres à l'aide de coefficients variant avec les différentes types des machines.

Pour l'étude que nous allons faire, nous n'avons besoin de considérer que les deux inducteurs et l'induit, dont les bobines sont représentées, figure 1, coupées par un plan passant par l'axe de leur fer doux et parallèle au plan de projection.

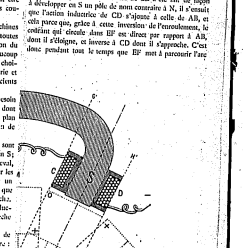
Sur les deux inducteurs AB, CD, les fils des bobines sont enroulés de façon à produire des pôles opposés en N et en S ; ils constituent en réalité un électro-aimant en fer à cheval, dont la partie montre A est ordinairement formée par les flasques des machines. L'induit EF est supposé par un moyen quelconque qui lui permet de passer aussi près que possible des pôles N,S en tournant dans le sens de la flèche.

Nous considérerons la machine au moment où les inducteurs étant aimantés, l'induit EF est sous la susdite flèche et commence son mouvement.

La bobine AB du pôle N développe dans la bobine de l'induit EF un courant de sens inverse du sien propre : cette action va en augmentant jusqu'à ce que la bord G de l'inducteur se trouve dans le prolongement du bord I de l'induit (1er position, fig. 1) ; alors commence une action contraire : la partie F du fil de l'induit s'éloignant à partir A du fil de l'inducteur et tend à produire un courant de sens inverse à celui que forment encore les parties E et B; cette action neutralisante va en augmentant jusqu'à ce que les deux lignes d'axe du fer de l'induit et de l'inducteur se trouvent dans le prolongement l'une de l'autre (2e position, fig. 1); à ce moment, la neutralisation est complète, aucun courant ne se produit. Aussitôt que cette position est dépassée, l'action neutralisante qui va toujours en augmentant à mesure que les deux bobines se recouvrent davantage, devient prépondérante; elle entraîne par conséquent le changement de sens du courant. Le premier courant que nous avons considéré était inverse de l'inducteur, celui qui vient de prendre naissance est direct.

Pendant tout le temps que le bord J de l'induit s'approche du bord H de l'inducteur, le courant qui se développe va en croissant ; il atteint son maximum quand J arrive dans le prolongement de H, parce qu'alors toutes les parties de AB s'éloignent de toutes les parties de EF ; puis le courant

Lorsque l'induit arrive dans une position telle que le bord I soit dans le prolongement du bord G de l'inducteur, un second maximum se produit, puis le courant décroît pour la raison indiquée plus haut jusqu'à ce que les axes soient dans le prolongement l'un de l'autre (3e position, fig. 1) : le courant devient nul ; puis il change de sens, etc., etc.



trouvent dans l'angle de gauche supérieur et dans l'angle opposé les différentes positions de l'induit.

EL D'ÉLECTRICITÉ

Comme l'enroulement des fils de CD a été fait de façon à développer en S un pôle de nom contraire à N, il s'ensuit que l'action inductrice de CD s'ajoute à celle de AB, et cela parce que, grâce à cette inversion de l'enroulement, le cordant qui circule dans EF est direct par rapport à AB, dont il s'éloigne, et inverse à CD dont il s'approche. C'est donc pendant tout le temps que EF met à parcourir l'arc

Si nous supposons les électro-aimants symétriquement placés en forme de couronne autour des induits, les mêmes phénomènes se reproduisent indéfiniment.

La figure 2 montre parfaitement cette succession de courants alternatifs, mais c'est tout ce qu'elle peut donner ; elle ne se prête pas à la démonstration d'un ralentissement mathématique, et c'est pour cela que nous l'abandonnerons maintenant pour employer la méthode des courbes.

Sur une ligne droite horizontale OX (fig. 3), portons des lon-

DURÉE DES COURANTS INDUITS

3e article (voir les 1er du 1er juillet et du 15 août) (1).

Pour nous rendre compte de la force nécessaire pour mettre en mouvement une machine produisant de l'électricité par voie d'induction, il importe avant tout de bien connaître les causes qui agissent comme résistance à la rotation.

Quand ces machines produisent un courant, leur marche est continuellement entravée par la production de ce courant lui-même : il s'établit entre les inducteurs et les inducteurs une série de réactions qui déterminent la formation d'ondes électriques dirigées de telle sorte qu'elles se repoussent quand le mouvement de la machine tend à rapprocher les bobines qui les produisent et qu'elles s'attirent quand au contraire elles s'éloignent. De là la nécessité d'exercer un effort continuel pour entraîner les bobines à la rencontre l'une de l'autre et pour ensuite les séparer.

Ces actions et réactions qui constituent en réalité et à elles seules la cause de la transformation de l'effort mécanique en ondes électriques, sont connues et étudiées sous le nom de « lois de Lenz ». M. Verdet les a formulées d'une façon très-précise ; voici sa formule :

« Lorsqu'un courant est induit par le mouvement relatif « d'un conducteur et d'un courant ou d'un aimant, l'action « inductrice tend à développer dans chaque élément du « conducteur un courant dirigé de telle façon que sa réaction « électro-dynamique sur le courant ou sur l'aimant inducteur « tend à produire un mouvement contraire au mouvement « relatif. » (*Conférences*, page 168, tome II.)

L'expérience a toujours confirmé cette formule, d'ailleurs, s'il n'en était pas ainsi, même dans un seul cas, il faudrait mettre en doute l'équivalence des agents physiques, et la recherche du mouvement perpétuel entrerait d'être abandonnée.

Faisons sur la figure 1 l'étude des courants qui se développent quand un induit s'approche d'un inducteur. (Voir aussi la figure 1 du numéro du 15 août, page 323).

Afin de faciliter l'explication, nous supposerons les induits constitués sur un tambour de fer dans l'section carrée ou bien de la section circulaire ordinaire, ce qui nous donnera quatre directions bien tranchées.

A B et C D sont les extrémités polaires de l'inducteur. A B est un pôle nord (austral), et C D est un pôle sud (boréal). D'après la théorie d'Ampère et en personnifiant le courant à la manière classique, c'est-à-dire en le représentant par un personnage couché sur le fil conducteur de façon que le courant lui entre par les pieds (pôle +) et lui sorte par la tête (pôle —), et regardant constamment le barreau nous aurons que le pôle austral (celui qui se dirige vers le nord) est toujours placé à la gauche du personnage, et comme conséquence de la production de ce maximum.

1° L'induit E F tend à s'éloigner de l'inducteur A B.

2° Chaque spire de fil induit tend à devenir rectiligne.

3° Toutes les spires s'attirent mutuellement, d'où tendance de la bobine à se contracter dans le sens de la longueur.

De ces trois actions la seconde et la troisième sont détruites ou doivent être détruites par la construction de la machine ; la première peut librement s'exercer si aucun effort de sens contraire ne vient empêcher la marche rétrograde de l'axe de rotation. Or, c'est précisément pour produire cet effort qu'intervient la force motrice.

Au premier abord une objection s'élève contre cette manière d'envisager le phénomène, car il est évident que si la réaction électro-dynamique du courant est égale et contraire à la force motrice, il doit en résulter non le mouvement mais le repos, l'état statique dans la conséquence du principe qui dit que deux forces égales et de sens contraires se détruisent. Or, si la réaction d'un ressort est égale à 10 kilogr., je suppose, alors que la force qui tend à le faire fléchir est aussi égale à 10 kilogr., il ne peut y avoir déplacement.

Pour tourner la difficulté, nous admettrons qu'un certain temps s'écoule entre le moment où la puissance en application et celui où la résistance se manifeste. Cela n'a rien de contraire aux expériences faites jusqu'à présent. D'ailleurs une force dynamique quelconque, même celle due aux explosions, ne se produit pas instantanément ; il est logique de penser que la force croît depuis le moment où elle prend naissance jusqu'à celui où elle atteint son maximum, et que ces deux instants ne auraient coïncider un même moment horaire.

Décomposons la force en nous arrêtant aux moments où elle passe de 0 aux valeurs + 1, + 2, + 3,... — 9, + 10 kilogr. ; il nous suffira d'admettre que les valeurs des résistances partielles — 1, — 2, — 3,... — 9, — 10 kilogr. s'opposent aux valeurs des actions partielles + 1, + 2, + 3, + 4,... + 9, + 10, ainsi que le montrent les deux progressions suivantes, c'est-à-dire que la résistance — 1, fait obstacle à

l'induit marche dans le sens des flèches. La partie *b*, *c*, de l'inducteur tend à repousser la partie *n*, *m*, de l'induit et à attirer *n*, *o* ; *o*, *l* ; et *l*, *m* ; mais comme la force répulsive décroît avec la distance et avec la grandeur de l'arc que font les courants entre eux, il en résulte que l'action exercée par *b*, *c* sur *n*, *o*, *o*, *b* et *l*, *m*. D'ailleurs, le sens général du courant développé dans le noyau E F un pôle austral N, de même nom que N ; or comme les pôles de même nom se repoussent, leur action s'ajoute à la précédente.

La répulsion va en augmentant jusqu'à ce que *n*, *m* et *b*, *c* se trouvent l'un au-dessous de l'autre ; cette position correspond à un maximum (1re position de la figure 1, page 323 du 15 août).

Arrêtons-nous un instant sur cette position.

Les ondes électriques développées dans l'induit tendent à le repousser de A B. Cette action extérieure E F n'en pas la seule qu'il produise : il agit aussi sur lui-même de la manière suivante.

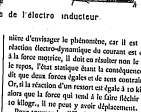


Fig 1.

de l'électro inducteur

Ms. Jones Trowbridge, of Harvard University, Cambridge, Mass., has published some very interesting results respecting the behaviour of the earth's surface as a conductor of electricity, and its capacity for transmitting electric signals without the aid of a conducting wire. The experiments were made between Boston and Cambridge, a distance of 3 miles. The method of observation was by telegraphing, the existence of an electric current was plainly registered upon the tick. ing which the making and breaking of the circuit produced in the [illegible] Signal. The conclusions [illegible] are somewhat startling, and, if correct, are to [illegible] to telegraph across the Atlantic Ocean. Some of these experiments [illegible] were made in 1901 (Nos. 1299) was taken out [illegible] by C. E. Mining, for a method of telegraphing [illegible] water without wires, and a mode of using [illegible] Siemens and Amelon by means of wires from [illegible] Edison (No. 1241) for effecting a similar object was taken out in 1854 by Mr. J. B. Lindsay.

In a note to the Vienna Academy (Mon. December 16) [illegible] Stefan describes experiments on the influence of terrestrial induction in the development of an electric current, and of excitement of the telephone by currents from a rotating coil. The coil used was [illegible] 56 mm. in external diameter, and 11 mm. in width. The earth's influence is best shown by so connecting the apparatus with a galvanometer that the circuit is closed during one half of the coil's rotation, and broken during the other half ; if the completion of the circuit correspond to the positive maximum of electromotive force of the earth's magnetism, and the interruption to the negative, the galvanometer is positively deflected. The deflection may be increased to zero by displacing the contact, and from the displacement and the number of rotations the potential may be inferred in absolute measure. Next the telephone was so connected with the coil that the fall alternately opposite currents went successively through the circuit. This gave a simple tone. With 100 rotations per second the horizontal component of the earth's magnetism did not suffice to excite an ordinary telephone, but it excited one having a horse-shoe magnet. (When the intensity of the field was doubled the ordinary telephone was also excited.) The tone corresponded to the number of rotations. When the coil was rotated 220 times in a second the ordinary telephone sounded. The telephone was shown to be less sensitive to currents whose intensity periodically changes than to interrupted currents (an ordinary telephone sounded with 100 rotations or fewer, when the circuit was closed only during a short time of each rotation).

evening, June 5, 1883.

THE INDUCTION BALANCE.

Upon the Electrical Experiments to determine the Location of the Bullet in the Body of Mr. Ida Presidents Garfield; and upon a new Instrument, the Balance of Induction Balance for the prolonged Detection of Metallic Masses in the Human Body.

By ALEXANDER GRAHAM BELL.

The subject of my paper is simply a line of intense excitement and long suspense. The long weary struggle with the ultimately fatal result, the increasing anxiety, the feeling known or keenly and well by the whole people, that Garfield—must still be fresh in every recollection. The whole world watched by his bed-side, and hopeful days of hours filled every passing hour. No one could venture to hope that he could so long as the position of the bullet remained unknown. The bullet might become safely encysted, but, on the other hand, the wound might directly cause his extinction. The search, cautious and gentle among vital and sensitive tissues could not be made with too patient and diligence and the thought constantly arises that science should be able to discover some instrument of exploration.

Among those most the thought occurred that the bullet might be located by some effect resulting in modifying the induction of a coil brought near to the body of the President, and that the locality of the bullet might be thus determined without danger to the patient and without pain; for it is well known that induction can be powerfully exerted through the human body without producing any sensation whatever.

Upon the Laws of Electric Induction.—The influence that I expected upon induction by metallic masses has formed the subject of numerous experiments in my laboratory for years; and the principle of balancing the effects of induction on one portion of a circuit by equal and opposite effects on another portion has been applied with success in nearly all such investigations.

The Induction Balance.—The instrument for this purpose appears to have been devised independently by Prof. Hughes about the year 1881, and a description of it in the London English language may be found in his letter of June 22nd, 1881, to the Electrician (1881 edition, vol. i., pp. 166—168). The earlier and superior arrangement for the same end is the well-known induction balance of Prof. D. E. Hughes.

The static induction balance of J. E. H. Gordon,* through primarily intended for experiments upon specific inductive capacity, might also, perhaps, be employed in the same class of investigations.

My attention was directed to the balancing of induction a number of years ago by the disturbing noises in telegraphic instruments by the operation of telegraphic instruments upon lines running near the telephone conductor.

The difficulty was remedied by using two conductors instead of one, and by so arranging the instruments that the induction effect upon the one should exactly balance that of the telephone conductors were exactly equal and opposite in direction to each other. In this way the disturbing noises were produced and a quiet circuit secured for telephonic purposes. This method was first patented in England in November, 1877, and during the whole winter of 1877-8 I was engaged in London upon experiments to perfect the system.

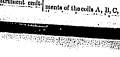
Another source of these researches I made frequent use of the induction balance, which I described in the paper by the Prof. Hughes† in his experiments upon induction.

My method was to use a carefully interrupted voltaic current through one half of a primary coil, and to balance it by the induction of another half opposed and connected with a telephone. The currents induced in the latter coil produced a musical note from the telephone.

At every point in the field of induction it was found that by turning the plane of the exploring coil a position of perfect silence was obtained, and another of maximum sound, the two positions making a right angle with each other.

It was also noticed that when a position of silence was obtained, any metal mass brought within the field of induction would cause a disturbance to sound. The effect was most marked when the two coils were close to each other proximity, and were arranged with their planes parallel, as shown in Fig. 1.

Fig. 1.



If a silver coin, such as a half-crown or florin, was placed across the face of the two coils, the silence of the telephone was broken three times. The instrument could be used as a musical tone when the micrometer screw passed the points marked 1, 2, and 3 in the illustration, but the

* A paper read before the American Association for the Advancement of Science, at the Montreal meeting, in which position many notes relating to the matter was published in the *Comptes Rendus* of the French Academy of Sciences, October 29, 1881.

† See Appendix, note 1.

‡ Phil. Trans. for 1879, pp. 305—335.

§ A similar apparatus was independently devised in America a number of years ago by Professor Peirce, and used in his researches. It is to be regretted that the discovery of the fact that he had been anticipated by Peirce prevented Prof. Hughes from completing and publishing his researches.

¶ Phil. Trans. July, 1879, vol. ii. p. 50.

** Phil. Trans. for 1879, p. 474.

†† Gordon's Patent, 1879, 3,529 ; 1880-81, 209, xii. 117.

loudest effect was produced when the coils crossed the position 2, where the two coils intersected.

I may return to America I embodied these and other results in a paper "On Methods of Exploring the Field of Induction of Flat Spirals," which was read before the association at the Montreal meeting, August, 1882.

Practical Application.—While brooding over the problem of the detection of the bullet in the body of President Garfield, these experiments made in England returned vividly to my mind. It seemed as even if the cooperation of the two coils shown in Fig. 1 could be brought over the body of the bullet without disturbing the relative position of the coils, the telephone would probably announce the presence of the bullet by an audible sound.

A crude experiment was at once made to test the idea. The primary induction-magnet (the core of which was formed of a bundle of fine iron wires) was used in place of one of the coils, and it was found that the induction upon the other coil could be balanced by the induction of a single coil of fine insulated wire wound upon a bundle of soft iron wires. The small coil passed through the coil of the electromagnet, and the whole system was tended and looked by an assistant.

Under these circumstances a much better balance was obtained than could possibly have been anticipated. There was nothing a trifle bulky near the instrument. The slightest motion of the coils, the telephone would instantly announce the presence of the bullet by an audible sound.

Being absent from my laboratory, and not possessing facilities for experiment, I commissioned my assistant, Mr. Sumner Williams, Jun., of Boston, manufacturer of electrical apparatus, to construct the instrument, who kindly placed the resources of his large establishment at my service; and, at great expense, and with much labour, completed his best instrument for my experiments.

Upon attempting to produce a comparable form of instrument for the special purpose in view, I found that there was great practical difficulty in the way of obtaining the two coils shown in Fig. 1, and to overcome this difficulty the apparatus of Professor Hughes might perhaps be employed with great advantage as the basis of my experiments. In the ordinary form of Hughes' induction balance four coils are used, as shown in Fig. 2.

The object of this arrangement is to enable the balancing of a clock circuit containing the two primary coils, A B, without disturbing the two secondary coils, C D, which are connected with the telephone circuit. The primaries are so arranged that the currents induced in the telephone circuit through the coils C D by the coils A B are directly opposite, the thickness of the clock is heard very faintly, but if they are in the same direction no sound is heard.

In the latter case the action of one primary coil A on the secondary C of the other, C, and a electrical balance was obtained. If now a piece of metal is brought near one of the clock's audible at the telephone. The arrangements of the coils A, B, C, D, was the point to be studied,

Fig. 2.

the microphone attachment seems of no importance in the combination; for it is well known that a resistance in circuit with the primary circuit consequently at intervals can be secured to use that two of the coils, A B in the Hughes induction balance might be advantageously used in parallel circuits, so as to be moved over the body of the all the while maintaining the balance in the position of the coils, the necessary might be made on the other pair of coils, which would be fixed in position. Two coils would not therefore be liable to disarrangement. If the coils were to be moved over the body of the patient, a single pair of coils were to be used, and the balance secured by the movement of the coil B, Fig. 1, that if during the process of exploration the coil B, Fig. 1, was moved from the position parallel even in the extend only of a few degrees from a millimetre, the balance would be destroyed and the telephone would cease to be silent. This might have a fatal termination. These considerations Hughes induction balance was accordingly abandoned for the purpose, and I immediately commenced the construction of the instrument.

Experimental Trials.—Just at this time I learned from the newspapers that Sir Charles Bright, Messrs. Sheldon, and Professor Jenkin were making a magnetic needle to facilitate the detection of the bullet in the body of President Garfield, these experiments made in England returned vividly to my mind. It seemed as even if the cooperation of the two coils shown in Fig. 1 could be brought over the body of the bullet without disturbing the relative position of the coils, the telephone would probably announce the presence of the bullet by an audible sound.

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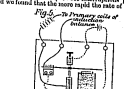
Fig. 3.

ENGINEERING.

[JAN. 5, 1883.]

To test the influence of speed of interruption, Mr. Marconi, superintendent of the Western Union Telegraph Company in Washington, arranged a rotating disc by means of which we were able, with the aid of a metallic contact-spring, to vary the interruptions of the primary circuit from about 100 to 600 interruptions per second,* and we found that the greater the rate of interruption

Fig. 5. *Primary coils of Induction Balance.*



the more distinct was the sound in the telephone. The hearing distance, however, was not appreciably affected by speed. The microscopic interrupter shown in Fig. 5), working about 100 interruptions per second, was found to be very satisfactory. The microscopic interrupter and the microphone interrupter were therefore afterwards used exclusively in our experiments.

The two principal forms of coil suggested by Professor John Trowbridge were carefully tested, and the one proposed by Professor Hughes was finally adopted.

The arrangement was quite simple. The bullet was placed in the centre of the primary coil, and the secondary coil or bullet external to the coils was no greater than before.

Fig. 6.

Professor Hughes proposed to have two flat superposed coils wound on a single reel, so that the two coils should be, as it were, at opposite their relative distances; and Mr. F. W. Stubbs, of Messrs. Siemens' establishment, offered to wind the coils for us. After a single coil, as shown in Fig. 7, had been wound, the balance could be readily obtained by Mr. Chas. R. Bailey and Dr. Chichester A. Bemis, who proceeded to determine the depth of the bullet the balancing coil by causing a similar bullet to approach secondary bullet. When the balance was restored the same distance from the balancing coils as the embedded bullet was from the exploring coils.

The results of all the experiments so far made were satisfactory, and I at once tried everything that had been suggested, and I also measured the extreme limit of audibility of the induction balance. The results are given in the following table, in which a bullet was flattened by being fired against a board, and was presented with its flat side parallel to the coils of the explorer—the most favourable mode of presentation—no better result was obtained.

Fig. 7.

Distance between the Bullet and the Coils when Balance is Obtained.

Primary Coil.	Distance Between—			Secondary Coil.	Distance Between—		
	AB.	BC.	AC.		AB.	BC.	AC.
inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.
6	0	11	11	6	0	11	11
	2	12	10		2	12	10
	4	13	9		4	13	9
	6	14	8		6	14	8
	8	15	7		8	15	7
	10	16	6		10	16	6
	12	17	5		12	17	5
	14	18	4		14	18	4
	16	19	3		16	19	3
	18	20	2		18	20	2
	20	21	1		20	21	1
10	0	15	15	10	0	15	15
	2	16	14		2	16	14
	4	17	13		4	17	13
	6	18	12		6	18	12
	8	19	11		8	19	11
	10	20	10		10	20	10
	12	21	9		12	21	9
	14	22	8		14	22	8
	16	23	7		16	23	7
	18	24	6		18	24	6
	20	25	5		20	25	5
	22	26	4		22	26	4
	24	27	3		24	27	3
	26	28	2		26	28	2
	28	29	1		28	29	1
14	0	19	19	14	0	19	19
	2	20	18		2	20	18
	4	21	17		4	21	17
	6	22	16		6	22	16
	8	23	15		8	23	15
	10	24	14		10	24	14
	12	25	13		12	25	13
	14	26	12		14	26	12
	16	27	11		16	27	11
	18	28	10		18	28	10
	20	29	9		20	29	9
	22	30	8		22	30	8
	24	31	7		24	31	7
	26	32	6		26	32	6
	28	33	5		28	33	5
	30	34	4		30	34	4
	32	35	3		32	35	3
	34	36	2		34	36	2
	36	37	1		36	37	1

These figures show that the distance from the primary coil A (Fig. 6) at which the influence of the bullet B becomes perceptible, increased with the diameter of the primary coil A, and that the secondary coil D was affected comparatively considerably beyond the plane of the primary coil, as shown in the diagram, Fig. 6.

The second column represents a constant ratio between the diameter of the secondary coil and the distance of projection A B of the secondary coil should proportionally increase with the diameter of the primary coil but the last tabulated figures did not fully confirm the inference.

The experiments were therefore repeated on a smaller scale then, and I thought the difference between the results that should have been observed according to the above hypothesis, and those that were actually observed might have been due to the gradual extension of the iron in the battery employed and to the polarization, although every care had been taken to preserve its power unchanged by frequent renewal of the solution, and by allowing when no observation was made. To test whether the battery exerted any material influence upon hearing distance, a further series of experiments was made with the same battery.

The following table contains the tabulated statement which shows that the maximum hearing distance (6 feet) was obtained with a primary ring 17.5 cm. in diameter and a secondary A A 3 cm. from the primary coil, when only coils was one centimetre. This arrangement of the instrument was therefore adopted throughout the following experiments:—

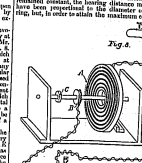
	Hearing Distance.
1. Apparatus tried with 1 cell Daniell battery	(10 C. Plg. 8 cm.
2. Coil in series	(10 C. Plg. 8 cm.
3. Six cells in multiple arc	(10 C. Plg. 8 cm.
4. Same experiment repeated	(10 C. Plg. 8 cm.
5. Same experiment repeated	(10 C. Plg. 8 cm.
6. Same experiment repeated by Mr. Hanscom	(10 C. Plg. 8 cm.

* I desire specially to express my gratitude to Dr. Frank Hamilton for very much assistance rendered me at a later date when sympathy and encouragement were greatly needed.

These experiments proved that battery power did exert an influence upon the hearing distance, and also that the battery in use was not powerful enough.

A considered, therefore, that if the battery power had been increased in the same proportion as the primary ring, but, in order to attain the maximum effect, the primary

Fig. 8.



position of the secondary coil beyond the plane of the primary coil might also have been found to increase its fine proportion.

This led me to try the effect of a second primary coil A with the secondary B at the apex, as shown in Fig. 9, but this arrangement proved unsatisfactory.

Subsequently enough Mr. J. H. C. Wattz, to Baltimore, and Dolbear suggested a method of using a single primary coil and with the instrument shown in Fig. 10 he had obtained

Fig. 9.

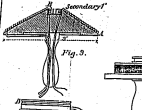


Fig. 10.

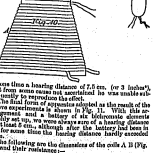


Fig. 11.

At one time a hearing distance of 7.5 cm. (or 3 inches), with the secondary coil reversed, he was unable to obtain a sound, and consequently reduce the effect.

The final form of instrument adopted as the result of the above experiments is shown in Fig. 11. It consists of a suspension and a battery of six Leclanché elements (Fig. 12), and a telephone (Fig. 13). The primary coil consists of an insulated wire, although after the battery had been in use for some time the hearing distance hardly exceeded 3 cm.

The following are the dimensions of the coils A B (Fig. 11) and their resistance:—

Coil A	External diameter	9 cm.
	Internal diameter	4 cm.
	Depth	4.5 cm.
Wire used, No. 36 Brown covered	Resistance, 2 ohms.	
Coil B	External diameter	3.2 cm.
	Internal diameter	1 cm.
	Depth	2 cm.
Wire used, No. 36 silk covered	Resistance, 2 ohms.	

See Appendix, note 11.

See Appendix, note 2.

See Appendix, note 3.

See Appendix, note 4.

See Appendix, note 5.

‡ *Ibid.*, note 7.

§ The balance obtained was not quite perfect, and was somewhat unstable, but the effect was decidedly that of a balance as many as 6000 interruptions of the coil per second.

See Appendix, note 6.

¶ *Ibid.*, note 9.

See Appendix, note 10.

THE INDUCTION BALANCE.

Upon The Electrical Experiments to determine the Location of the Bullet in the Body of the late President Garfield; and upon a successful Form of Induction Balance for the positive Detection of Metallic Masses in the Human Body.

By Alexander Graham Bell.

(Continued from page 72).

The Late President Garfield.—During the forger experiment (*July 20*) a sudden increase in the sound was observed upon passing a point near the spot where the surgeon supposed the ball to be lodged, but I had been unable to verify this by a second observation, although the exploring instrument (A B, Fig. 12) was repeatedly passed over the same spot. The sound had been so loud that I had supposed that the position of the ball must have been found by a sudden intensity in the vibration of this end of the rheotome used to interrupt the primary circuit, for the arrangement (as explained above, p. 28) was not perfectly balanced, and any irregularity of the steel would, under these circumstances, have affected the telephone. At the same time the coincidence was remarkable, and I had hoped that the experiment might at that time be one in our favour; but the sound was faint, and the key to the thought that perhaps after all the bullet had been the cause of the sound. I felt confident that the new instrument (Fig. 12) would at once decide the question, for the extreme hearing distance of the former apparatus (Fig. 12) was only 9 ins., and the sound heard at the spot in question was superior to the point that if the sound had not been due to the bullet it would also exhibit with the new instrument distinct and well marked effects. When the new engineer (Fig. 19) was passed over the suspected spot nothing was heard excepting a slight pulsating sound as the instrument was moved to and fro. This was evidence to me that the former sound was due to the bullet, and, again, that the bullet was there now. I think that the most astonishing new error of observation caused by the pulsation of the artery was the movement of the instrument, I lifted the latter (without changing the inclination of the coils) to a height of about 50 centimetres above the body of the President, and moved it to and fro in as nearly as possible the same way as I had done at the former attempts.

I perceived that if the pulsation heard were due simply to the movement of the instrument, that the sound with great strength at the two elevations when the position of the successive effect was due to the influence of the bullet, the pulsations at the two elevations would be different in intensity. I was struck by the fact that, although the sources pulsation was very feeble, they were exactly louder when the instrument was close to the body than when it was held at a height of 50 cm. Confirming the explanation, I found that a sudden noise over which similar effects were noticed, but upon moving the instrument towards the back of the President, the difference between the pulsations produced at the two elevations grew less and less, and finally could not be distinguished.

The difference in the loudness of the sound at the two elevations was so slight that it probably would not have been noticed by me unacquainted with the nature of these effects, and I found that the general conviction that the bullet would be found in that part of the body might have led me to imagine a difference that did not exist. For the purpose of eliminating as far as possible any personal error, I requested Mr. Sumner Tainter (who was the only other experimenter whose ear had been sufficiently trained to be reliable) to make observations for me, as he was experienced and it was know his search. Upon his return to my laboratory we compared notes, and I found that our observations tallied with mine. He declared he could not obtain a distinctly localised effect, but stated that he had heard the movement of the pulsation over an area of at least two centimetres in the neighbourhood of the spot to which his attention had been directed, and that he was of the opinion that the bullet was there that area.

It appeared reasonably certain that the sound of the bullet would was due to some external cause, and was not simply an effect of experiency. In the absence of any other explanation for the phenomenon I was forced to agree with Mr. Tainter that it was due to the presence of the bullet, and I proceeded to act upon this supposes. * I was by no means satisfied, however, with the results obtained, for no such effects had been observed in any of our experiments with bullets. I tried to reproduce the effects by moving the instrument (Fig. 19) at different distances from a bullet, but in every case where an effect was observed the sound was quite sharply localised. I thought that perhaps the vibrations of the patient might have affected the result, and so experimented upon a bullet buried in a piece of meat, but the effects were the same as before. This led me to fear that the extended area of audible sound might have been due to some extraneous cause in the room. The experiments were repeated at the time, and I personally and Mr. Sumner Tainter went through (August 2) to ascertain if there was any way whether they were perfectly insulated of the bed. Iron removed from the neighbourhood of the bed. Every precaution was taken to understand the insulate matters so as to ascertained that by was another mattress composed of steel wires.

After obtaining a duplicate, the mattress was found to consist of a net of net of woven steel wires, with large meshes. The wires, which were somewhat springy, were small, so compared with the area of the bed, it seemed reasonable to conclude that the effect matters had produced no detrimental effect. I was unable to continue experiments with the steel mattress, as at this time I

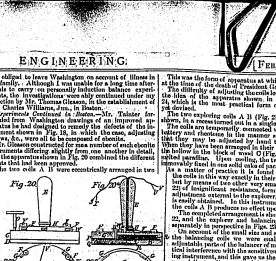
* See Appendix, note H.

was obliged to leave Washington on account of illness in my family. Although I was unable for a long time afterwards to carry on personally induction balance experiments, the investigations were ably continued under my direction by Mr. Thomas Cleaver, in the establishment of Mr. Chester Williams, Jun., in Boston.

Upon my return to Washington Mr. Tainter forwarded from Washington drawings of an improved instruments he had designed to remedy the defects of the instrument shown in Fig. 12, in which the case, adjusting screws, &c., were all to be composed of ebonite.

Mr. Cleaver constructed for me a number of such electric instruments differing slightly from one another in detail, and the two principal ones shown in Fig. 20 combined the different points that had been approved.

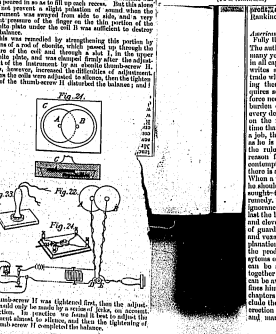
The two coils A B were eccentrically arranged in two



circular discs of ebonite, C D, and the adjustment was obtained by means of an elastic key (), like the key used in Gutta-percha, which turned a cam M provided on the spindle and working in a slot X in the lower disc.

In order to prevent any movement of the coils, except that produced by the adjusting key (), each coil was firmly secured to its disc by means of a screw S, the ends of which were bevelled so as to fit. Paraffine was then poured in so as to fill up each slot. This, while it did not prevent a slight rotation of sound when the instrument was swayed from side to side, and a very slight pressure of the finger on the portion of the ebonite plate under the coil B was sufficient to destroy the sound.

This was remedied by strengthening this portion by means of a screw of ebonite, which passed through the centre of the coil and through the disc, in the upper ebonite plate, and was clamped by a milled nut on the top of the screw, by an ebonite thumb-screw H. This, however, increased the difficulties of adjustment. When the coils were adjusted to silence, then the tightening of the thumb-screw H disturbed the balance; and I



the thumb-screw H was tightened first, then the adjustment would only be made by a series of jerks, on account of friction to resolve we found it best to adjust the instrument almost to silence, and then the tightening of the thumb screw H completed the balance.

This was the form of apparatus at which we had arrived at the time of the death of President Garfield.

The difficulty of adjusting the instrument to ultimately to the idea of the apparatus shown in Fig. 21, in which the two principal faces of the instrument were horizontal.

The two exploring coils A B (Fig. 21) are arranged as shown, and are connected one in a single block of wood C.

The coils are temporarily fastened within the block by rubber and elastomer in a manner shown in Fig. 1, so that they may be adjusted to the same plane of action. When they have been arranged in this way they are fixed in the hollow in the block of wood C (Fig. 21) is filled with paraffine wax. Upon melting, the two coils are found immovably fixed in one solid cake of paraffine.

It is then found impossible to fix the coils in this manner with any exactly in their position of silence by means of the adjusting screws, but by means of a coil of insignificant resistance, forming a part of the adjustment external to the engineer, a perfect balance is easily obtained. In this instrument the engineer E and the coils A B produces no effect upon the balance.

The completed arrangement is shown in plan in Fig. 21, and the engineer and balancing coils are shown separately in connection in Fig. 21a.

The amount of balancing coil of slight resistance in the balancing coils we were enabled to obtain the adjustable point of the balance of maximum silence, and elicited interference with the sensitiveness of the exploring instruments, and this gave us the power of making very delicate adjustments of the balancing coils.

The most delicate instrument, so would plastic of the two sensitive ears of the coils, as had been done in the instrument shown in Fig. 20.

In the balancing apparatus shown in Fig. 23 (which is the most perfect one yet constructed) the lever, to which the coil is attached, is made of hard rubber.

In Fig. 26 is shown the most convenient form of case yet devised for holding the exploring coils.

By invitation of Dr. Lyon Hamilton experiments were made with it at his office in New York October 7, 1882, the instruments used being those shown in Figs. 22, 23, 24.

As this was the first successful application of the induction balance to the discovery of a bullet imbedded in the body the position of which was previously unknown, I may be pardoned for entering somewhat into detail.

(*To be continued.*)

Locomotive and Livery Engineer

Hamilton's book contained it.

American Foundry Practice. By Thomas D. Weet. Fully Illustrated. New York: John Wiley and Sons.

The author of this work offers it as the outcome of many years' experience in the foundries of America, in all capacities from apprentice to manager. He writes as a practical man to the members of the trade which he follows, and the impression on reading them that the moulder's art is one that requires considerable thought, and that experience alone can be successful. This indeed is the burden of the book throughout; and the class of every description or explanation the author insists on the necessity of the moulder thinking all the time that he works; thinking before he commences a job, thinking as he proceeds with it, and thinking as he is finishing it off. For the men who follow the rule-of-thumb, and can give no satisfactory reason for the method they adopt, he has a vast contempt, although it is evident he knows that there is a large proportion of them in every shop. When a man has made a bad casting he insists that he should never begin it again until the cause is sought—the cause of the—mishap, and devised a remedy. But this is not one that will help the ignorance under a cloud of advice; from first to last the chapters are full of practical hints, sound and clever notions, and no opportunity is missed of guarding the reader from the disappointments and vexations that beset the moulder, by simple explanation of the conditions that are necessary for the production of good work under the different systems of moulding. Every possible disaster that can be suggested by a long training is set forth, together with the means by which it may be met or can be avoided. But the author by no means confines himself to the humblest of the business: his chapters extend over the whole subject, and include the designing and building of foundries, the erection of ovens and cupolas, the mixing of iron and many other points that are useful both to foreman and manager. His advice to apprentices is summed up in one homely sentence that was short, pointed, and pithy, and as such are likely to be relished at this season, "Learn your business, observe as examples: "He that practises hard manual work will always have the most breathe." "A poor slack turbo when once well do" " A fast-poured muddle should not be continued."

We have not the space to recite the many subjects treated in this book. It is divided into four sections, dealing respectively with (1) the moulder and the foundry, (2) green sand moulding, (3) loam and dry sand moulding, (4) manipulation of patterns, gates, and (5) notes and receipts. In the second and third sections a number of representative objects are taken and the methods of moulding them, with and without patterns, is described. Among these we notice gear wheels, pulleys, kettles, and anvil blocks. Section 3 relates to the construction of castings, learning and moulding of castings, splitting pulleys, mixing loam, and rays of smiling iron, preparing cupolas and the like, while the last section deals principally with blacking, loam, and sand mixtures. In conclusion we can recommend this book to our readers, as we find in it much that is interesting. The moulder's art is not a new one, and no one expects to submit to announce any great discoveries or sudden advances in its practice. If he can give to the public an intelligible account of the best processes in vogue in the country, and can put the experience of a few of the service of the many, he should earn the recognition of the members of his craft.

BOOKS RECEIVED.

Hints on Boat Sailing and Boating. By Captain C. C. P. Fitzgerald, R.N. Portsmouth: Griffin and Co.

Technisch-Chemisches Jahrbuch 1881-1882. Herausgegeben von Rudolph Biedermann. Berlin: Julius Springer. Illustrations. London: E. and F. N. Spon; Chester: T. G. Lewis.

Papers on Mechanical Subjects. By Sir Joseph Whitworth, Bart., F.R.S., &c. Vol. I., Part II. *Rifled Small Arms.* London: E. and F. N. Spon; Chester: T. G. Lewis.

The Electric Lighting Act, 1882, and the Acts therewith Incorporated. With Introduction, Notes, and Index. October, 1882; and *Introductory Address.* By W. Cunningham Glen and Alex. Siemens, LL.B.

WIMSHURST'S DUPLEX INDUCTION MACHINE.

In our issue of the 6th of October last,* we described a very interesting electrical plate induction machine, invented by Mr. James Wimshurst, of the Board of Trade, and which possesses several points of superiority over the Holz machine, while at the same time it is of considerably smaller size for a fraction of the cost. Since we published that notice Mr. Wimshurst has made a suggestion theoretic, has substituted a smaller and far less costly form of glass for the original plate machine for producing the initial charge, and has thereby made the apparatus more efficient, reducing at the same time its cost.

Mr. Wimshurst has quite recently again added to his reputation as a scientific inventor, by designing and constructing the very remarkable and interesting machine which we illustrate on the following page, an examination of which would lead one to suppose that simplicity could go no further in the design of a statical induction electric machine capable of producing a continuous and powerful discharge between its terminal electrodes.

The case consists of two circular glass plates discs of ordinary window glass 14¼ inches in diameter, mounted upon a fixed horizontal spindle in such a way as to be rotated in opposite directions at a distance apart of not more than one-eighth of an inch. Each disc is attached to the end of a hollow boss of wood, or of ebonite, upon which is turned a small pulley. This is driven by a cord or belt from a larger pulley, and these are now also attached to a spindle below the machine, and which is rotated by a winch handle in opposite directions in the direction of rotation being obtained by the crossing of one of the belts.

Both discs are well varnished, and, attached by cement to the outer surface of each, are twelve radial sector-shaped plates of thin brass disposed around the discs at equal angular distances apart, and which play a very similar part in the action of the apparatus to the "carriers" of Nicholson's "*revolving doubler*," and those of the "Electrophorus" of Sir William Thomson, but it would

* See Engineering, vol. xxxiv., page 325.

† *Ibid.*, vol. xxxiii., page 378.

y Hills, with their vertical a comparison of intensities ficulty.

ATURE.

Steps to Mensuration, Engineers' Surveying, &c. By W. Mackenzie Smith, M.E. London: Whittaker and Co. Tables, Tests and Weights and Measures. By Clifford Richardson, Fellow of the Chemical Society. London: Crosby, Lockwood and Co.

The publication of a supplementary volume to the well-known and very useful a notable addition in the contributed by Professor ny supplies a want in the t makes the work of Pro- Miller complete. Evidenced of late with rapid ion a place with mechanical erefore the publishers of Tables" have done the e Jamieson's section on ans, and indeed engineers ons their design. Further, find a gentleman better than Mr. Jamieson, who unites once, gathered in various the necessary theoretical with practical experience, engineers which enables s Tables data from different es, rules, and formulæ, as in Mr. Jamieson's book almost say could not have no idea, and but few have ut. † After explaining the ion of the slide rule, the mission gives a compressed arithmetic, giving the best ods, first only on telegraph ments, and subsequently to ordinary specifications for dal matter of great value the land-line electrician. table is first given the particulars about electric ts, there is a great deal of nicals's work, and where 16 of the most proved and trician will consult it with. ‡ We are glad to find that

THE INDUCTION VANE.

The induction balance of Professor Hughes was early recognised as a valuable instrument of molecular research; and it is impossible to foresee the great extent of usefulness that may be open to it in the difficult department of study, when a good clue to the interpretation of its results has been obtained.

Up to the present time the most important application of the apparatus has been in metallurgical testing. Its suitability for this kind of work was demonstrated by the extreme sensitiveness to the presence of the minutest particle of metal within the coils, and to the physical nature and condition of the metal. Our readers will remember that when a piece of metal was placed in one pair of coils on "scale-pan" of the balance, as it were, the electric equilibrium was disturbed, and the observer heard the indicating sounds in the telephone. It required an exactly similar piece of the same metal to restore the balance, and produce the corresponding silence in the telephone. It was not enough that this compensating piece of metal was of the same size and substance; but it was necessary, in addition to these properties, that it should be at the same temperature, density, and temper, or to put it briefly, in the same molecular condition. A slight alloy in the compensating metal was at once detected by a residual disturbance in the telephone which showed that the balance was not perfect.

It was pointed out by Professor Hughes that this discriminating power of the induction balance afforded a ready means of detecting counterfeit coins, since if a good coin were placed in one pan of the balance as a standard, a base coin of the same coinage could be at once proved by putting it in the other pan, since it would not quite neutralise the disturbance in the balance created by the genuine coin.

The serviceableness of the induction balance in metallurgical tests of this kind was promptly appreciated by Mr. Chandler Roberts, F.R.S., the chemist of the Mint, who immediately adopted it for the purpose. Availing himself to the fullest extent of the suggestions of Professor Hughes, he at once began a series of experiments which have already afforded results of much interest. Full descriptions of these experiments will be found in his published papers on the subject in the Proceedings of the Royal Society, vol. xxix., page 56, in the *Philosophical Magazine*, vol. viii., page 16, and in the Proceedings of the Physical Society, vol. iii., page 81.

To fit the instrument for giving accurate numerical results in testing the relative effects of different alloys, Professor Hughes divised a graduated zinc scale of a larger form to take the place of the standard coils or metal. It is, of course, clear that a single fixed standard against which to put the metal to be tested could not give a quantitative result. At best it only showed whether there was a disturbance of the balance or not, and did not show how much was the disturbance. It made of the instrument an inductometer; but the zinc scale made of it an inductometer.

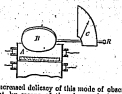
This ingenious device, which we illustrated at the time in Engineering, vol. xxvii., pp. 217 and 457, did not, however, prove sufficiently sensitive for the finer purposes of Mr. Roberts. As will be seen from the annexed Table, taken from an official report of that gentleman, the method is not adapted for accurately equal and similar volumes of gold-copper alloys which vary but slightly in composition.

Standard by Assay.	Readings on Zinc Scale.	Standard by Assay.	Readings on Zinc Scale.
999.0	100	911.7	61
993.6	93	911.3	61
992.8	76	910.8	61
925.0	70	910.2	61
919.1	69	910.2	61
918.1	67	709.2	60
916.9	66		

"But it soon became evident," says Mr. Roberts, "that the instrument was capable of indicating more minute differences of standard, and I at first tried to obtain trustworthy indications by raising or lowering a supplementary horizontal disc by means of a micrometer screw, and this disc was subsequently replaced by an obtuse hollow cone of silver, by which the sensitiveness of the instrument was increased. Professor Hughes, however, who throughout his experiments has afforded me the most generous aid, suggested the following arrangement which has given the best results yet obtained."

Instead of the zinc bar or scale, a disc of gold or other metal A (see the annexed diagram) is placed within one pair of coils as a standard of comparison, and over it is supported a metal vane or damper B, the nature and dimensions of which may be varied to suit particular cases. This vane is attached to a rod or handle H, which can be turned by the fingers so as to set the vane at any angle with respect to the coils beneath. A graduated arc and index to show the angle turned through completes the device.

It will be seen that the vane is an auxiliary to the standard coin. The latter compensates for the greater part of the disturbance due to the insertion of the metal to be tested in the other coils of the balance, and the vane compensates for any difference that may remain. The effect of the vane is minimum when it is in a vertical attitude, and maximum when horizontal. The difference is given by the number of degrees from zero indicated on the scale.



The increased delicacy of this mode of observing over that by means of the zinc scale is readily shown by the annexed Table from the report of Mr. Roberts before cited. It gives the results obtained by the induction vane on a gold-copper series from 901 to 925, which, as has already been shown, is comprised within a range of 24 parts of gravimetrous on the zinc scale. Alloys whose composition lies beyond these limiting values could not be examined by the disc and vane employed, but suitable ones can be selected for any given series of limited extent.

Standard by Assay.	Degrees on graduated Arc.	Standard by Assay.	Degrees on graduated Arc.
925.0	74	914.2	44
920.3	65	911.5	42
916.8	53	901.3	28
915.7	51		

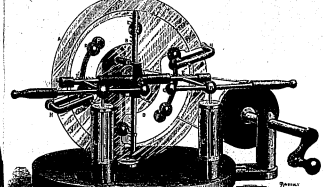
It has been proved by the experiments of Mr. Roberts, Mr. Fleeming, and the mathematical researches of Dr. Lodge and others, that the induction balance effect is mainly, if not quite, dependent on the electrical conductivity of the metals compared, and especially in the gold-silver and gold-copper alloys the effect is greatly influenced by minute differences of composition. Unfortunately, the gold-silver alloys used for coinage are not those which have the most disturbing effect on the balance, a circumstance which adds materially to the difficulty of using the instrument in verifying the standard of this kind for verifying the composition of alloys of the precious metals must in part depend on the distances the accuracy of the results; and the molecular state of an alloy under certain conditions also affects the balance more than small differences of composition." For example, annealing certain alloys of silver, produces changes in their induction-balance effect that are equivalent to considerable variations of standard, and it will, therefore, be necessary, yet to ascertain whether some simple method can be found for bringing any given series of alloys under identical molecular conditions.

The possibility of ascertaining the fineness of alloys by aid of electricity long ago engaged the attention of physicists. In 1820 M. Becquerel suggested that trustworthy indications might be afforded by the electromotive force developed when the alloy is placed in an exciting fluid together with an alloy of known composition. The subject was partially investigated by Oersted in 1825, and, as its practical importance was further influenced by Guy Lussac in 1830, Mr. Roberts made a series of experiments in order to ascertain how far the more delicate appliances in use at the present day could be made serviceable. The results, however, were not entirely satisfactory.

Professor Hughes's induction balance has rendered it possible to attack the problem from a new basis, and though there is, in the opinion of Mr. Roberts, but little hope of finding a more accurate method of assaying than that now in use, it would be so highly advantageous to possess a means of verifying the standard of coins "without damaging their integrity that the capabilities of the induction balance demand careful investigation."

Besides his researches on the gold-copper alloys, Mr. Roberts has also determined the important fact that in the case of the copper-tin alloys the curves of the conductivity for heat corresponds closely with that representing the induction balance effect. He has also pointed out the incomplete character of Matthiessen's curves of electric conductivity, and confirmed the remarkable observations of Mr. Du la Rive, that the conductivity of bismuth is less in the solid than in the molten state. The conductivity of liquid metals is an interesting and probably fruitful branch of research, which has hardly been touched hitherto, and it is satisfactory to know that Mr. Roberts has taken it up. By means of the induction balance, he designs to measure the conductivities of different molten metals contained in small porcelain crucibles enclosed in non-conducting jackets of pumice stone, and we think it highly probable that he will bring to light some unsuspected facts.

VOSS'S INDUCTION ELECTRICAL MACHINE.



We illustrate on the present page an exceedingly well-designed and interesting induction electrical machine which has lately been brought out by Dr. Robert Voss, of Berlin, and which is at the present time being introduced into this country by Mr. Apps and some other English makers. Dr. Voss's machine possesses several points of special interest and value, the most important of which, at all events as regards this country, is its apparent independence to a degree of humidity of the atmosphere. All who are acquainted with the induction machines of Holtz, are aware that when the atmosphere is at all damp, either from meteorological causes or from the presence of a number of people, as is a lecture-theatre, the ordinary Holtz machine is a very often than not practically useless, so that the satisfactory working of such a machine is confined to obtaining some precautions be taken for artificially drying the surrounding air.

Another interesting point in Dr. Voss's machine lies in the fact that it is self-charging, requiring neither friction nor any outside initial charge to start it into action, nor is it necessary to bring the discharging terminals into contact, as in the Holtz machine, before it will commence to work it.

In principle this machine, while being distinctly original, has points of resemblance to the electrostatic multiplier of Mr. Varley, and the electrical replenisher of Sir William Thomson, as well as to the Influence electrical machines of Holtz and Toepler, but it is far simpler and more compact than the last, and is at all times certain in its action.

On reference to the Illustration it will be seen that the apparatus consists, like the Holtz machine, of two glass discs, unequal in diameter, of which the latter, A, is held in a fixed position, while the other is mounted upon a horizontal axis, and can, by means of multiplying gear (seen to the right of the figure) be rotated at a high velocity in front of the fixed disc and in a plane parallel to it. To the front face of the larger plate are attached two pairs of tinfoil discs, F F, F^{1}F^1, each pair being connected together by a strip of tinfoil, and by a second strip to one of the two bent arms H and H^1, by which they are connected to a light metallic brush directed towards the front face of the rotating plate. At the back of the fixed plate are pasted two paper coatings which correspond to what used to be called the paper "armatures" in the Holtz machine. To the face of the rotating plate are attached, at equal angular distances apart of 60 deg., and in a short distance from the circumference, six discs of tinfoil (one of which is marked D in the figure), about an inch in diameter, corresponding in position and size with the tinfoil discs upon the fixed plate, that is to say, if the discs D were numbered in rotation 1, 3, 5, 4, 6, 2, those numbered 1 and 2 would, in a certain position of the rotating plate correspond and be opposite to one connected pair of discs on the fixed plate, Nos. 4 and 6 would similarly correspond to the other pair, and Nos. 3 and 5 would have no discs on the fixed plate opposite to them. To each of the little tinfoil discs there is a metallic point connected, with it is attached a metallic button of the form of a plano-convex lens, and these buttons, to the revolution

* See ENGINEERING, vol. xxii, page 27.

† *Ibid*, vol. xxiii, page 319.

of the plate, pass under and are lightly touched by the metallic brushes F F, which are held by the bent arms H H^1, the brushes being so adjusted as to touch the buttons and not to come in contact with the glass of the rotating plate to which they are attached. E and E are two horizontal collecting combs, connected to one another by being attached to a horizontal bar of ebonite, but connected respectively to the two discharging terminals C and C in the front of the instrument by the metal rods here shown in the figure, and the distance between these terminals can be varied at pleasure by sliding them through the balls which are attached to the outer ends legs of the two cylindrical Leyden jars by which the charge is accumulated and the discharge is effected. B is a vertical bar of brass carrying at each end a comb, directed towards the rotating plate, as well as a pair of metallic brushes, similar to P and P, and which also in their turn make momentary contact with the metallic buttons as they pass beneath them, and at a moment when the latter are under the inductive influence of the metal discs of the fixed plate.

Such is the construction of the machine, and an idea of its general appearance may be formed by reference to the figure. Its principle of action resembles that of Mr. Varley's "multiplier" probably more closely than any other apparatus, but it has points of principle common to the machines of Holtz and Toepler. Assuming in the first instance that a minute initial charge of electricity be given to the tinfoil discs on the fixed plate, or indeed to almost any part of the apparatus, the effect of setting the machine into action will be to build up and accumulate by induction and counter-induction an increasing charge of electricity of opposite signs at the two discharging terminals respectively until their differences of potential is sufficiently raised for sparks to pass between them. The physical process involved in this accumulative action will be better understood by consulting the apparatus with the replenisher of Sir William Thomson figured on page 319 of our twenty-third volume. The paper coverings and the tinfoil discs on the fixed plate correspond to the two fixed inductors in Sir William Thomson's instrument, and the metallic buttons to the carriers, the metallic brushes being omitted, as in the Holtz machine, between the replenisher. The figure of the instrument is, however, more near to Mr. Varley's multiplier, which is very similar in principle to Sir William Thomson's replenisher.

It would be difficult to say at what point in the continuous cycle of operations the first generation of the initial charge takes place, and it is the fact that constitutes the special point of physical interest in the machine; it may occur at the points of contact between the buttons of the rotating plate and the brushes attached to the paper coatings of the fixed plate, or it is possible to be due to a minute difference of potential existing, at the moment of starting, between two conducting parts of the apparatus insulated from one another, causing the electrification of one part of the system to be slightly more positive than another, and such a difference, however minute, would, under the action of the machine, be developed and accumulated by induction into powerful charges. It is probable that the initial action may, in general terms, be attributed to the whole system being in extremely unstable electrical equilibrium, so that the very smallest disturbing influence, such, for instance, as the friction of the contact brushes, or the proximity of some foreign inducting body, will upset the balance, and from the moment that the electrical equilibrium is disturbed the building up of a charge is easily accounted for.

Another very remarkable property of this machine is its independence of moisture. We have made a number of experiments bearing on this point, and have always been able to obtain a continuous stream of sparks between the terminals, although the plates and conductors were bedewed with moisture from having been breathed upon. With a machine, the rotating plate of which is only 200 millimetres (about 10$\frac{1}{2}$ in.), and weighing complete under 7 lb., a series of from 4 in. to 5 in. sparks, accompanied by loud snapping reports, can easily always be obtained; and by placing the terminals a distance apart greater than the striking distance of the sparks, Leyden jars may be charged with great rapidity, and all the ordinary electrostatic experiments may be performed.

Electric Inductive Speech.

The recent experiments of Professor Hughes on electrical tension have been recounted in our columns; and as the subject is just now occupying the attention of several experimenters, we may mention that Mr. C. W. Robinson, Professor of Physics and Mechanical Engineering in the Ohio State University, has made some interesting observations on the electric currents induced in a coil by longitudinally streaming an iron bar passing through it. Professor Robinson was led to these experiments by Joule's result that when a bar of iron is magnetised by means of a helix the bar becomes elongated. He argued that the mere magnifier of the bar by a reversal of the same physical process should produce a current in the helix, and with this aim he fixed a bar of soft iron about $\frac{1}{2}$in. in diameter by its middle point, leaving both ends free to vibrate longitudinally. Upon this bar he caused to slide freely a helix or bobbin of insulated wire in circuit with a telephone, and on striking the bar endwise with a mallet, or rubbing it up and down with a friction cloth, so as to set it into longitudinal vibration, he could hear tolerably loud sounds in the telephone. Strange to say, these sounds were loudest not at the free ends of the bar where the amplitude of the vibrations were greatest, but at the middle where there was a practical node. Sounds produced by the transverse vibrations which mingled with the longitudinal ones were readily distinguished from the latter by their difference of pitch. By a strange oversight Professor Robinson does not state the position of the bar with respect to the magnetic meridian, but it doubtless lay under the influence of the earth's magnetism, and hence the currents were induced by molecular disturbance.

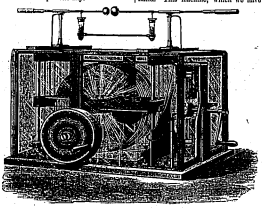
WIMSHURST'S INDUCTION ELECTRICAL MACHINE.

THE history of induction electrical machines, of which perhaps the Holz machine is the best known modern type, dates as far back as about a hundred years ago, when the immortal Volta, the father of electrical science, added the electrophorus to the apparatus of the electrician; and just as the celebrated pile of the same pioneer or the modification of it to which he gave the name of the "*couronne de tasses*" must ever be regarded as the type and precursor of all voltaic batteries, so must the electrophorus be regarded as the origin and germ from which have been developed all the electrostatic induction machines of the present day.

We have from time to time in the pages of this journal, described and referred to the induction machines of Bennett,* Nicholson,† Holtz,‡ Carré,§ Bertsch,‖ Varley,¶ Sir William Thomson,** Töpler,†† and Voss,‡‡ all of which may more or less be regarded as modifications of Volta's electrophorus, and all of which depend for their action, in part or in whole, upon the building up from a small initial charge of electricity, and by a succession of inductions and counter inductions, a far more powerful and accumulated charge capable when desired of producing the most brilliant effects of static electricity.

Up to within a very recent period the most powerful and certainly most widely known machine of this class was that introduced by Mr. Holz, of Berlin, in 1865, and which is to be found in all the important physical laboratories, but the Holz machine has one very serious disadvantage, and that is its dependence upon a favourable state of the atmosphere for successful working; in a climate such as ours in England, there are comparatively few days in the year when a Holz machine can be made to work without great coaxing and difficulty unless means be adopted for artificially drying the air in the immediate neighbourhood of the revolving plates; moreover, the cost of the machines has always been very great. A little more than a year ago Mr. Voss, also of Berlin, introduced an extremely interesting form of Töpler's machine, which we described at the time,§§ this was remarkably independent of atmospheric influence, appearing to work almost as well in damp weather as in dry, but its form did not admit of a number of plates being united to the instrument, as in the compound Holz machines, without very largely and inconveniently increasing its bulk.

We illustrate on the present page a highly interesting and valuable machine, the invention of Mr. James Wimshurst, one of the Consultative Staff of the Board of Trade, which, while possessing all the power of the best Holz machine, is as completely independent of the state of the atmosphere as is the Voss machine, and what is perhaps more important to the majority of scientific men and others requiring a powerful source of static electricity, it can be made and sold at a remarkably small price. Mr. Wimshurst, having himself constructed several experimental machines of the same type, has been enabled to bring the design in a very high degree of perfection, and in its improved form the instrument is now being introduced by Messrs. Peterson and Cooper, of Little Britain. At apparatus of this class has been recently made by Mr. Wimshurst, and is, we believe, the most powerful electrostatic inductive generator in existence; with it all the most brilliant and powerful effects of static electricity may be produced with no more expenditure of power than can comfortably be transmitted by the turning of a wheel by one hand. This machine, which we have had opportunities of seeing at work under atmospheric conditions that would be fatal to the working of a Holz machine, and at a time when all its parts were covered with dust, is capable of giving dense bundles of spark discharges in the open air, upwards of 7 in. long between its terminals, and when small Leyden condensers are attached to its terminals the sound of the discharge is almost deafening. The discharge is capable of piercing all the pages of a Bradshaw's sixpenny railway guide, and most of the brilliant effects of the discharge through vacuum tubes may be exhibited in a most remarkable degree. This machine consists of twelve circular discs of ordinary window glass, 32in. in diameter, mounted upon an insulating spindle, which, by simple multiplying gear, can be rotated at a high velocity by hand. These discs rotate between twenty-four rectangular slips of window glass, twelve above and twelve below the axis, the space between the upper and the lower sets being sufficient to allow the spindle to pass freely between them. These slips are not fixed in any way, but are simply dropped into grooves to receive them, and can in a few minutes be all removed, cleaned, and replaced; they are not coated with varnish or any other insulating substance. The rotating discs rest freely between the plates without touching them, so there is no friction in the working of the apparatus except at the bearings, which is inconsiderable, as the discs, being of thin window glass, are extremely light. It is true there is a series of paper "armatures" or combs on each side of the spindle which rest against the revolving discs, but then contact with them is of the lightest possible character and offers no resisting friction to the working of the machine. Mr. Wimshurst has effectually protected the apparatus against one defect to be found generally in induction machines with several plates; that is, the existence of different potentials in the armatures on the same side. For the successful working of the apparatus all the armatures on one side should be positively electrified and all those on the other side should be of the opposite sign; generally in compound induction machines this is not the case, and a large proportion of the useful effect is lost by neutralisation. To prevent this Mr. Wimshurst connects all the armatures on one side together by a fine wire, which terminates on the outside of the case and serves as a conductor for giving to the apparatus its initial charge, which can be produced by an electrophorus or by an ebonite rod excited by friction.



In the smaller machines which are being made by Messrs. Peterson and Cooper, and which are shown in the illustration, a small frictional plate machine of the ordinary type is fixed at one end of, and within the case, for the purpose of producing the initial charge, but this addition, while making the whole apparatus very complete and self-contained, adds considerably to the expense. If the machine be well insulated the smallest possible charge is sufficient to start the induction, and in our opinion a very much smaller and less costly generator for this purpose might with advantage be substituted for the extra plate machine.

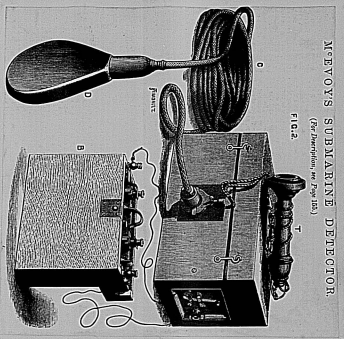
There can be no doubt that Mr. Wimshurst has added a very valuable instrument to the laboratory of the physicist, and we feel sure when it becomes known that powerful electrostatic induction machines can, by carrying out his principle of construction, be made with the simplest possible materials and at remarkably small cost, it can only be a matter of a short time for those interesting machines to take the foremost place among electrostatic generators, and another will at the same time be added to the long list of honoured names who [illegible] science of electricity.

* See ENGINEERING, vol. xxiii., page 310.
† *Ibid.*, vol. xxiii., p. 310.
‡ *Ibid.*, vol. xxiii., p. 311.
§ *Ibid.*, vol. xxiii., p. 359.
‖ *Ibid.*, vol. xxiii., p. 367.
¶ *Ibid.*, vol. xxiii., p. 367.
** *Ibid.*, vol. xxiii., p. 367.
†† *Ibid.*, vol. xxiii., p. 367.
‡‡ *Ibid.*, vol. xxxi., p. 367.

McEVOY'S SUBMARINE DETECTOR.

(For Description, see Page 135.)

FIG. 2.



TANK LOCOMOTIVE; CENTRAL PACIFIC RAILROAD.

CONSTRUCTED AT THE WORKS OF THE COMPANY, SACRAMENTO.

We annex a perspective view of a tank locomotive constructed at the Central Pacific Railroad Works, Sacramento, for working local traffic from San Francisco, or rather from the ferry pier or wharf at Oakland, where the ferry boats from San Francisco land. The company have a large suburban traffic, which is carried across San Francisco Bay, a distance of four miles, by a ferry. The ferry boats discharge at Oakland into a pier which runs into the bay about two miles, and on this pier trains which convey the passengers from the outer end of the pier to the Alameda. In the mornings and evenings the trains are very heavy and make frequent stops; they run from three to eight miles from the end of the wharf.

As will be seen from our illustration the engine is of the six-coupled outside cylinder type, with a two-wheeled truck in front and rear. The chief dimensions are as follows:

Cylinders and Valve Gear:	ft.	in.
Diameter of cylinders	1	2
Stroke of piston	2	0
Distance between centres of cylinders	4	6½
Width of steam ports	0	2
Width of exhaust ports	0	3½
Length of ports	1	0
Maximum travel of valves	0	4
Lap of valves, outside	0	0¾
,, inside	0	0
Lead in full gear	0	5/16
Length of connecting rod between centres	6	0
Wheels		
Diameter of coupled wheels	4	2
,, trucks	2	6
,, journals of coupled axles	0	5½
Length	0	7
Diameter of journals of truck axles	0	4½
Length of journals of truck axles	0	6
Diameter of main crank-pin bearings	0	4
Length	0	4
Diameter of centre coupling rod bearings	0	3
Length	0	3
Diameter of other coupling rod bearings	0	3
Length	0	3
Distance between centres of front and rear coupled wheels	11	0
Total wheel base	22	0
Boiler:		
Diameter of barrel inside smallest ring	4	0
Thickness of barrel plate	0	½
Number of tubes	138	
Diameter ... outside	0	2¼
Length ... over tube plates	10	6
Distance apart of tubes centre to centre	0	3¼
Length of firebox inside	7	0
Width ... at bottom	3	11
... top	3	4½
Height of firebox at tube plate end	6	0
... at back	5	9
Thickness of plates of inside firebox, sides and back	0	5/8
Thickness of crown plate of inside firebox	0	5/8
... tube plates	0	5/8
Diameter of dome	2	0
Height	2	3
Working pressure, 125 lb. per square inch.		
Description of blast nozzle ... Double		
Diameter ...	0	3
Smallest diameter of chimney inside	1	4
Height of top ... above rails	14	11
Grate area	14·7 square feet	
Heating surface: firebox	87	,,
Tubes (inside)	773	,,
Total	860	
Weight, &c.:		
Capacity of tank	1200 gals.	
,, coal box	8000 lb.	
Weight on coupled wheels	60,400 ,,	
Total weight of engine	104,100 ,,	

The boiler shell and inside firebox are constructed of Otis steel, and the tubes of Morris, Tasker, and Co.'s iron, No. 10. The boiler has lap seams, the transverse seams being single, and the longitudinal seams triple riveted; these latter seams are also provided with inside welt straps. The tank is fitted with retaining bituminous coal, the boiler being fitted with rocking grate bars and Ashpan of the usual pattern. In construction we may add, I state that we are indebted to our contemporary, the *Railroad Gazette*, of New York, for our illustration of the engine above described.

McEVOY'S ELECTRIC SUBMARINE DETECTOR.

THE induction balance invented by Professor D. E. Hughes, F.R.S., has had a number of useful applications, and the latest of these is the electric submarine detector of Captain McEvoy, whose name is well known in connexion with torpedo work. In his early

McEVOY'S TORPEDO SYSTEM.

THE part that torpedoes will play in all future wars between maritime powers renders them objects of great interest, not only to naval men, but also to the general public. In the late Russo-Turkish war small, although it had the whole of the Black Sea coast, and both banks of the Danube at its mercy, from the fact that its commanders seamed, very often erroneously, that all the Russian harbours were studded with mines, and that the same appliances were held very far out to sea. Looking further back to the American Civil War, we find evidence not only of the moral, but also of the destructive powers of torpedoes, and see how a nation with numerous harbours and rivers was able by a system of submarine warfare to defend its coast for years against a powerful fleet, and an enemy that lacked neither courage nor resources. Prominent among the officers who derived practical experience from their connexion with torpedo work in the American war was Captain McEvoy, who has since devoted himself to the improvement of submarine coast and harbour defences, and has, perhaps, done as much as any other single experimenter to bring them to their present state of perfection. One of Captain McEvoy's inventions, viz., his "single main system," which has been adopted by several foreign governments, was, until the last few days, on exhibition at the Westminster Aquarium, and forms the subject of the annexed illustration.

In this system of harbour or coast defence the whole of a group of normal torpedoes communicate with the station shown by a single electric conductor. Along this they continually telegraph evidence of their being afloat and in working order, and upon any one being struck by a ship it gives immediate notice of the fact to an observer on the box, any one of these conductors can be separately placed in connexion with the main cable, or the whole may be coupled to it at once. At its other end each conductor enters a torpedo, and passes successively through a telephone coil and a platinum fuse, and thence to earth. Over the telephone, instead of the usual mouthpiece there is placed a bell, or a box containing loose shot, which under the influence of the rolling motion of the waves, continually make a noise that can be heard in a telephone at the central station. The

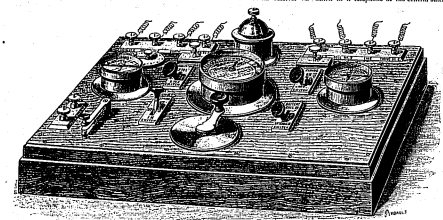


FIG. 1.

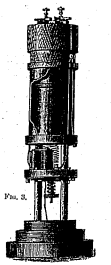


FIG. 3.

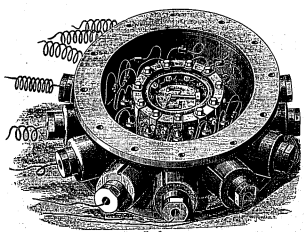


FIG. 2.

above, who can, if he think fit, instantaneously explode the exact mine without any time spent in preliminary adjustments. Further, each torpedo can be electrically isolated from the rest, and can then be tested so that the continuity of the electrical connexions may be determined, or can be exploded without coming in contact with the ship whose destruction is desired.

The single electric cable, which is the modern way by which the currents for producing these various effects are conducted, runs from the signal station on shore to a point in the channel or harbour mouth where the assemblage of torpedoes is situated, and there enters a junction-box. From this box there emerge as many conductors as there are torpedoes to be manipulated, one going to each, and by means of electrically controlled apparatus within this box, any one of these conductors can be separately placed in connexion with the main cable, or the whole may be coupled to it at once. At its other end each conductor enters a torpedo, and passes successively through a telephone coil and a platinum fuse, and thence to earth. Over the telephone, instead of the usual mouthpiece there is placed a bell, or a box containing loose shot, which under the influence of the rolling motion of the waves, continually make a noise that can be heard in a telephone at the central station. The fuse is a piece of platinum wire, through which a current of moderate intensity can be sent without any danger of heating it, but which can be ignited and fed by a more powerful current when desired. The arrangement for effecting explosion by concussion consists of a weight held down in a seat by a spring, but not otherwise secured. When the case is violently struck the weight is displaced, and by its motion brings two contact pieces together, diverting the current from the telephone coil and directing it through an electro-magnet, which maintains the parts in the new position until the exploding current is transmitted, or the current is reversed, when the contact is broken by a spring.

After this general account of the capabilities and mode of action of Captain McEvoy's single main system, we will describe the extremely in-

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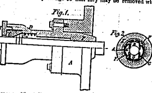
mination of the coils B B is connected with the line or earth wire 2, and also to the switch lever Q; the other terminal is in connexion with the metal plate G. One terminal of the call-bell coils is connected to G by wire 3, the other terminal connecting to the plate k by wire 4 and to the metal segment R by wire 5. The telephone T is connected to the upper and lower contact plates of key S¹, the upper plate of the said key being also connected to segment R by wire 8, the lever of key S¹ being in metallic connexion with main line 1, and with the insulated metallic spring Q¹ by brand wire 9. The steel polarised armature is so arranged that an electrical current through the coils B B, having a polarity to cause the soft iron tongue D to move towards the pole b will also cause the poles b b¹ to attract the said armature, and from this it follows that the said armature will be repelled and fall back, and the tongue D will move toward the pole b¹. The aperture in the disc in each instrument is set in a different position with relation to the pin from all the other instruments, so that only one instrument can be in working position at a time. The operator at the central office can send over the main line the proper number of impulses to move the disc at any desired station into position to receive the pin, the current being of the proper polarity to cause the tongue D to rest against the pole b. Coincident with the movement of the tongue the arm K is carried out of contact with k, and the end of K rests on K¹, so that the direction of the current passing from main line will be by wire 1, branch wire 9, spring Q¹, wire 5-4, call-bell coils, wire 2, to main line or earth. The call-bell coils being now in the main line circuit, each impulse operates the bell. When the subscriber removes the telephone from the hook the main line current passes through the telephone outside the coils of the polarised relay by wire 1, key S¹, wires 6 and 7, telephone T, wire 8, segment R, spring Q¹ to wire 2. The invention further relates to means for preventing the other subscribers from overhearing the message, and to a modification of the above apparatus. (November 23, 1880).

4890. Metallic Packings: J. A. Osgood, Grantville, Mass., U.S.A., and E. P. Monroe, New York, U.S.A. [6d. 15 Figs.]—In this invention twenty-four "claims" for novelty are made. It relates essentially (1) to devices for packing piston rods of engines, pumps, &c.; (2) to a spring and follower for holding the packing up to the rod so that it can follow any lateral deviations of the rod from its normal plane of motion; (3) to that class of packing in which segmental packing or guide blocks are used, and arranged so that by the use of springs they encircle and pack the rod; (4) to means for dividing the portions of the packings so that they may be removed when



necessary without disconnecting the rod, or applied in instances where they cannot be slipped upon the rod from the end. In the illustration Fig. 1 shows the invention applied to a locomotive engine from which the stuffing-box has been removed. A represents the head of the steam chest through which the valve stem passes; F is a sleeve which may extend through the valve chest wall, and as far beyond as may be without interfering with the valve; H is a shallow cap or cover bolted to the stuffing box D. Fig. 2 shows a horizontal section of the packing set up within a vibrating ring or packing receptacle A, and cylinder head X; B, G are the packing blocks or segments with the cavity filled with packing material. Springs F are used to keep the block in position. The packing material is of Babbitt metal, or an alloy of tin and copper or other soft metal. (November 24, 1880).

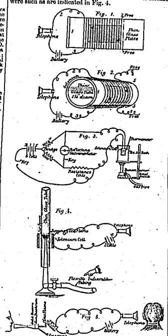
UNITED STATES PATENTS AND PATENT PRACTICE.

Descriptions with illustrations of inventions patented in the United States of America from 1847 to the present time, and reports of trials of patent law cases in the United States, may be consulted, gratis, at the offices of ENGINEERING, 35 and 36, Bedford-street, Strand.

THE PHOTOPHONE.

A SHORT time since, Mr. Andrew Jamieson, Principal of the Glasgow Mechanics' Institution, read a paper before the Philosophical Society of Glasgow, on "The History of Selenium and its Action in Professor Graham Bell's Photophone." He briefly reviewed the history of the peculiar element selenium, mentioned some of the most interesting experiments made with it by Mr. Willoughby Smith, Dr. Werner Siemens, Professor W. G. Adams, and others, and exhibited a few exceedingly simple and inexpensive forms of selenium cells designed by himself of the construction shown in Figs. 1 and 2.

In the cylindrical form, Fig. 2, the wires are prevented from spreading or endangering contact (and consequent "short circuiting") by longitudinal binding (5). By the aid of apparatus and well-made diagrams of large size, the lecturer gave a practical description of how the cells were made, and he kept up a constant series of tests during the whole process of melting and annealing the selenium, so as to ascertain and demonstrate its behaviour at different temperatures. This form of cell, it will be seen, can easily be made without the assistance of a lathe or other special tools, and does not necessarily involve the possession of much dexterity on the part of the operator. Fig. 3 shows the arrangement of the "connexions" employed by Mr. Jamieson during the annealing of the sensitive "cell" in a hot-air bath (a common tin-plate mustard canister), which he prefers, owing to the nicety with which the temperature can be regulated and observed. The "connexions" are simply those for a Wheatstone's bridge, with Sir William Thomson's dead-beat reflecting galvanometer, resistance box, and selenium cell. Mr. Jamieson indicated the results of a number of tests which he had made, more especially some which show that selenium experiences a fall of resistance up to a "turning point," at about 213 deg. Cent., thus behaving like a dielectric; as also a curious change and rise in resistance after that temperature has been reached, when it behaves like a metal; together with the polarising effect which takes place when a strong battery is used, being similar to a fault in a submarine cable. As indicated in Fig. 3, he joined up one of his selenium cells with Wheatstone's bridge, a reflecting galvanometer, and a telephone, and showed the diminished resistance of the sensitive cell on exposure to light rays and heat rays by the simultaneous action of the galvanometer and telephone. The spot of light from the galvanometer mirror moved quickly off the scale placed against the wall, and returned but slowly to its normal zero position, the "click" in the telephone being heard upon a sudden exposure of the cell; and Mr. Jamieson proved conclusively, by comparing the intensity of the heat rays from a dark but hot iron plate and the light rays from a gas burner, that the latter exerted by far the greater amount of effect in reducing the resistance of the selenium cell. He exhibited and described Professor Bell's rotating disc for showing the effect of interrupted rays of light, as well as the photophone, both of which had been prepared for him by Messrs. D. and G. Graham, of the Glasgow Telephonic Exchange. What may, however, be regarded as *the* experiment of the evening was the distinct reproduction in the telephone of the note of a singing gas flame by the aid of one of his circular forms of glass cells. His "connexions" in this instance were such as are indicated in Fig. 4.



The sensitive selenium cell is shown in section, and the supports are removed in order to make the drawing simple.

Not only was the note of the singing flame very distinctly reproduced in the telephone, but the "dot-and-dash" Morse code, which was played with the finger upon the india-rubber tube, was rendered clearly audible. The singing flame seemed like the "skirl" of the bag-pipes sounded in a distant Highland valley, while the "dots" and "dashes" were not unlike the intermittent beats upon a small drum. In the course of his experiments, Mr. Jamieson acknowledged his indebtedness to Professor Blyth, of Anderson's College, for the novel suggestion of using the singing gas flame in conjunction with his sensitive cell. Principal Jamieson still further exceeded the novelty of the preceding experiment by reproducing speech and vocal music distinctly audible, in the manner illustrated in Fig. 5, Sir William Thomson, Professor Blackburn, Mr. W. M. Miller, and other persons present at the meeting, being the hearing "witnesses" as to the success of the experiment. One of the members who occupied the position indicated on the right hand of the diagram, with his ear applied to the telephone in a distant part of the society's buildings, was able to report on returning to the lecture theatre that he had heard some strains of "The Last Rose of Summer" very well rendered. This was stated to have been the first time that a gas flame had been known to vibrate in perfect unison with the human voice.

The changes which take place between the speaker and the hearer in this experiment are, said M. Jamieson, one more than those enumerated by Professor Bell in his experiment. They are as follow: (1) The voice vibrates the air in the speaking tube; (2) the air vibrates the thin diaphragm of goldbeater's skin; (3) the vibrating diaphragm regulates the gas supply; (4) the intermittent supply of gas determines the light-giving power of the flame; (5) the flame affects the electrical resistance of the selenium cell; (6) that resistance regulates the battery current; (7) the electrical current next produces an action in the telephone; (8) the telephone reproduces the speech or vocal music in clear sounds; (9) these sounds, or sonorous vibrations, are taken up by the tympanic membrane of the hearer; and (10) they eventually pass to the sensorium of the hearer, who perceives them as the actual voice of his colleague, or some other operator.

The Table given above gives the times, temperatures, and corresponding resistances observed during the annealing of one of Jamieson's form of selenium cells, according to the plan shown in Fig. 2.

ELECTRIC RESISTANCES OF SELENIUM IN ANNEALING.

Time in Bath.			Temperature of Bath in degrees Cent. Rising.	Resistance in Ohms.	Remarks. Six Cells used in Test.
p.m.	h.	m.	deg.		
12.45	0	5	130	4000	Cell put in cold at 10 deg. Cent., after scraping off surplus selenium.
	0	10	140	2300	Resistance falling fast. Left cell for some time at 140 deg. Cent.
	0	35	160	1700	
	0	45	185	800	Resistance falling as temperature rises. Cell in dark all the time of the test.
	0	48	195	650	
	0	50	200	440	
	0	55	210	300	213 deg. Cent. seemed to be a turning point, for on increasing the temperature above that point the resistance of the cell steadily and quickly rose.
	0	56	210	290	
	0	58	215	350	
	1	0	218	600	
	&c.		&c.	&c.	Began to lower temperature slowly, and resistance decreased, then rose gently.
	1	35	140	295	Left cell to a very slowly lowering temperature. Resistance rose slowly.
	2	45	125	350	
	2	55	110	360	
	3	15	100	360	
	3	18	90	340	

After continuing the experiment for 3 hours 18 minutes, the cell was removed from the hot-air bath and was found to be fairly sensitive to light and shown in action with the singing flame.

At the close of Mr. Jamieson's most interesting paper and the accompanying experiments, a discussion took place which was opened by Sir William Thomson, who asked whether or not the selenium varied much in its electrical resistance by being kept for considerable periods of time at a constant temperature.

Mr. Jamieson, referring to a series of tests which he had made, said that after the cell had been properly crystallised it did not vary much; and, as the experiments performed during the evening showed, light rays had a much greater effect than a corresponding amount of simple heat rays.

Sir William Thomson remarked that that had been apparent to all, and he attributed the particular sensitive action of selenium to a molecular change produced in the substance by the action of light, and similarly, but to a smaller degree, by heat. He complimented the author of the paper very much on the results of his experiments made within the last few weeks, and he was pleased to know that he had received such suggestive aid from Professor Blyth. The society was greatly to be congratulated on having on such an auspicious occasion had the honour to admit both of these gentlemen as members on the same evening.

Mr. R. R. Tatlock, F.R.S.E., asked Mr. Jamieson whether or not he had observed a peculiar change in the selenium at or about 213 deg. Cent., independently of the heat applied to it from the hot-air bath.

Mr. Jamieson replied that he had observed a change, and that the electrical action of the cell seemed to change from that of a dielectric to that of a metal at or about the point named.

In reply to one of the members, Mr. Jamieson stated that speech could be distinctly heard by means of the

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NOTICES OF MEETINGS.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 18th, at 8 p.m. Discussion upon "Harbour Works," and (time permitting) upon "Breakwaters and Docks." Paper to be read: "Notes on Lighthouse Illumination," by James N. Douglass, M.Inst.C.E.

THE METEOROLOGICAL SOCIETY.—Wednesday, the 19th instant, at 7 p.m., at the Institution of Civil Engineers, the following papers will be read:—"On the Climate of Ceylon," by Dr. Thwaites, F.R.S. "On the Inclination of the Axis of Cyclones," by the Hon. William Clement Ley, M.A., F.M.S. "Contributions to the Meteorology of Australia, No. 2," by Mr. Ferdinand Baron von Mueller, by Robert L. Scott, F.R.S.

PHYSICAL SOCIETY.—Saturday, March 29th, at 3 p.m. "On Solenoidal Distribution of Electricity," by Prof. J. J. S. "On the Fluxions of Colours," by Captain Abney, R.E.

INSTITUTION OF ELECTRICAL ENGINEERS.—Monday evening, March 17th, on "Constructive Value," by Mr. H. J. Smith, Esq. The chair to be taken at 8 o'clock.

ENGINEERING.

FRIDAY, MARCH 14, 1879.

THE NAVY ESTIMATES.

It is hardly to be wondered at that much interest as attaches to the introduction of this year's Navy Estimates centres rather in questions affecting the *personnel* than the *matériel* of the Navy. The vote of credit not only enabled the Admiralty to make good, in the popular view, the accumulated deficiencies of years of sluggish shipbuilding, but it only too *likely* to be made the unconscious excuse for similar defects in the future. Yet the additions to the Navy of a number of masted ironclads, of which only two can be described as of the first class, should form no reason for relaxing the construction of the real fighting ship, the Devastations and Inflexibles, when it is remembered that, except by a not very large party who hold that quite small ironclads should be substituted generally for large ones, it is now almost universally allowed that ships more or less of the Devastation or Inflexible type, whether monsters like the last named, or vessels of comparatively moderate size like the Ajax and Agamemnon, must be relied upon to do the heavy fighting of the future. Yet though it is nearly *ten years* since the Devastation, Thunderer, and *Fury* (now the Dreadnought), were put in hand, and although they have long become obsolete as regards thickness of armour, it is actually the case that the last named of the three has still to make her first cruise, and that *only one* other vessel of the first class—the Inflexible—has been brought to any thing like a forward condition. Two more, the Ajax and Agamemnon, though they have figured for years in the estimates, are little more than on the third part completed, and though they are expected to be launched in a few months, it is not even proposed to get them much more than half finished even by March, 1880. Ten years after putting the pattern ships of the type in hand, and at least four years after their universal acceptance, we have succeeded in nearly giving them one consort, while there is a distant view of two more, and three others are now being seriously talked of! No doubt the public is quite as much to blame as the Admiralty. The intense interest excited by the Devastation—or rather by the charges against her: their triumphant refutation was less noticed—has long since died out, and the certain knowledge that, directly a big ship is nearly built, somebody will find out that she is all wrong, and must be "suspended" for a couple of years' argument, tends to damp public interest in shipbuilding. The days when every Briton, assigning or otherwise, was either a vehement broadsider or a vehement turret-man, produced, no doubt, a great crop of nonsense, and may even have been responsible for Admiral Fishbourne, but they were the days of rapid progress. Now nobody worries the Admiralty seriously, and though it doubtless makes progress as good, in kind, as when most Englishmen were its austere advisers, its progress in quantity is not satisfactory, as we have shown. Part of the public apathy about the building of large ships is perhaps due to a new and not ill-founded conviction that the English Navy has lately given evidence of great power, and, inferentially, of the possession of its old superiority to the fleets of other nations. Considering that we have made it our business for years to defend the Navy against the charge of weakness so often brought against it by ignorance, or worse, it need not be said that we accept fully, up to a certain point, the very respectable note recorded to its efficiency. But though this has satisfactory display of English naval power serves to confirm the arguments frequently urged, and fully illustrated by comparisons with the fleets of other countries, in these columns, it proves nothing beyond the *present superiority* of our Navy. We have urged with equal constancy that that superiority will not be maintained except by a reasonably rapid development of the heaviest fighting class of ships, in which other nations are fast overtaking us, and as years pass without the necessary additions, we can but commence to change sides with our old opponents. They are content, because the Navy has received additions of the kind they believe in, but which we believe to have been sufficiently represented in our fleet already; we are not content, because the additions we consider necessary appear almost as distant as before. If there were the slightest hope that in two years' time the Ajax and the Agamemnon, the Majestic, Colossus, and Conqueror, could be added to the Navy, we should feel satisfied with the fleet of nine great turret ships the country would then possess, backed up by the three rams, Rupert, Hotspur, and Polyphemus. But experience forbids any such hope, and at least four years must be expected to elapse before the fleet is completed, and by that time there will be enough vessels of the class afloat in other countries to inspect our supremacy seriously. Italy, alone, has now two Inflexibles to our one, and whereas all our later vessels are less powerful than the Inflexible, the Italians are building to a design of much greater power. As is well known, they have given up their armour, and limit the plating to the protection of the guns, and of a sort of central trunk connecting them with the lower part of the ship. A thickness of only 2 ft. of armour is thus obtained, upon which a tonnage considerably exceeding that of the Inflexible, and as the case of making all temporary, as well as stability, dependent upon keeping the water out of an unarmoured hull by contrivances more or less resembling those used in the ends of the Inflexible. We entirely agree with Mr. Smith in his refusal to adopt this principle of shipbuilding in the English Navy, but it is obvious that such vessels might go through many actions without paying the penalty of their undoubted weakness in that one particular. He would be a bold man who would attempt to assess the value of a ship carrying 2 ft. of armour, and guns to correspond, against a ship like the Inflexible, or, still more, like the Devastation, whose guns could make no impression on the Italian armour, and whose own plates would yield like sandskin before her guns. With the Italian building, we ought to neglect anything rather than the construction of first-class ships. Praise is due to the present Admiralty for its insistance upon keeping up the repairs of ships; but no repairs to old, and therefore obsolete, ships, can do as much for the strength of the Navy, as regards heavy fighting, as the construction of one or two vessels of the newest type.

The discussion following Mr. Smith's speech was unusually tame. It was the speech of a plain but capable man of business determined to work his important upon common-sense principles, and generally allowed to have worked it with success. There was little criticism, for the gratifying reason that the country places confidence in the present First Lord, while the only weak point in his programme, to which we have adverted, awaks as yet no remark.

PROFESSOR HUGHES'S INDUCTION BALANCE.

From the moment when the electric telegraph ceased from being but a beautiful laboratory experiment, to become a practical application of science, and before it could take its place among the commercial undertakings of the world, it became necessary, from the very exigencies and requirements of its useful application, to multiply the number of conducting wires along the same routes, carrying them one below the other and parallel to one another, for any one route, upon the same line of poles. From the moment that this was done the telegraph engineer found that he had conjured up an enemy in his own camp which has gone on growing and becoming more powerful to constant augment, defying every effort to conquer it, and increasing with the extension of the system and with the greater perfection and sensitiveness of the instruments employed. This enemy is what we now term electro-dynamic induction, and may be generally defined as that property of electricity by which electric currents are produced in conductors by the influence of other currents passing through conductors in their vicinity. Electro-dynamic induction was discovered by Faraday in the year 1831, and his researches in connexion with this subject culminated in his transcendent discovery of magnetoelectricity, the development of which has lately produced so much excitement in the commercial world, and is at the present time rapidly taking a position as one of the most valuable and important applications of science to the comfort and convenience of man.

If a current of electricity be transmitted through one of two wires which run more or less in a parallel direction, a momentary electric current is produced in the other at the moment that the current is started in the first; and the secondary current so produced is in the opposite direction to the primary. Again, at the instant of breaking the circuit of the primary wire, a momentary impulse or current is produced in the secondary wire, but this time in the reverse direction to the former one, that is to say, the current induced in the secondary wire is, on the cessation of the current in the primary wire, in the same direction as the primary current which produced it. The strength of the secondary current in both instances depends, upon the combination of several conditions, such as the degree of parallelism between the two wires, their distance from one another and their length, as well as upon the strength of the primary current, and the resistance of the secondary wire in which the induced current is produced. As the distance between the two wires is diminished, the strength of the induced current is lessened in proportion; and when the directions of the two wires become precisely coincident to one another, inductive energy ceases, no secondary current being produced. The primary current is broken or breaking the circuit in the primary wire. Again, if the distance between the two wires be increased, the inductive action is lessened, and when the circuit is diminished, and *vice versâ*, the maximum effect being produced when the two wires are so placed as possible to one another without their insulation being destroyed, and, as this inductive influence is exerted both by and through the electric impulses of the parallel portions of the two whole wires, it follows that an extension of this length increases the effect of induction by a sort of cumulative process, and for this reason the resistance of the secondary wire does not play so important a part as the other conditions above referred to. The

ELECTRICAL INDUCTION.

*Experimental Researches into Means of Preventing Induction upon Lateral Wires.**

By Prof. D. E. Hughes.

The induction upon lateral wires has of late years been a serious question upon telegraph lines—the constantly increasing number of wires upon the same poles, added to the adoption of high speed and consequent sensitive apparatus, renders the study of these effects of the first importance.

The disturbing effects have become each year more and more remarked; and in 1868, by the desire of the French Telegraph Administration, I undertook a series of practical experiments, with the view of finding a remedy. I at once perceived that we had to deal with a question of a more complicated nature than was at first supposed. We found then that we had to deal with the static charge of its own line and the dynamic induction of the lateral wires; that the effects of each were very different; and whilst it was easy to deal with the comparative feeble static charge, the more powerful and rapid effects of dynamic induction could hardly be suppressed. By introducing extra resistance coils we could reduce the induced current, but, at the same time, we should reduce the current with which the line was working. The remedy was in most cases (particularly during faulty insulation) worse than the disease. Condensers and polarisation batteries would allow the momentary induced currents to act, whilst they prevented the more prolonged currents of the distant station. The only remedy we then found was by the introduction of an electro-magnet, with an armature fixed upon its poles—thus being a closed magnetic condenser. This practically absorbed or destroyed all the short momentary currents; but then if on this line the apparatus was working at high speed, with consequent short currents, we practically cut off the best part of the current needed.

In this case, whilst the remedy was practically perfect for an apparatus at low speed with comparative long currents, it was useless for those working at high speed requiring shorter currents, and consequently more sensitive organs of reception.

Other duties prevented me at that date from following up this line of research. The disturbances on the lines from this cause have been on a constant increase from the adoption of more rapid, and consequently by more sensitive, organs; and in the telephone we have at last arrived at an organ of rapidity and sensitiveness, which not only reveals the constant induction, but which is the main reason why the telephone has not been more largely adopted upon telegraph lines.

In a late paper upon induction† we brought to notice the powerful organs of research in this field that we possess in the telephone and microphone; and we thought that by the aid of these we might investigate, theoretically, the cause and remedy for lateral voltaic induction.

* Paper read before the Society of Telegraph Engineers.

† "Comptes Rendus de l'Académie des Sciences," Paris, December 30, 1878, and January 20, 1879.

The following experiments are a *résumé* of the results obtained:

We made use of three separate and distinct means of research. The first consisted of two or more parallel wires, 20 ft. long: the one being used as a primary was connected to battery and microphone, with clock as source of sound (both ends of wire being to earth). The secondary wire, upon which the induced current was observed, was connected to telephone—both ends of this line also being to earth.

The second arrangement was made, in order to study the effects upon a much shorter length, and with more accuracy than could easily be obtained on the longer line.

Two parallel—1 millimetre—copper wires were strung upon a board, 15 in. by 15 in.; these wires were placed 10 in. apart, and both united at one end with 1 Daniell element placed near. The free ends of these wires could be put alternately in connexion with battery; and thus, if we surrounded one of these wires with tin-foil, or other means of protecting wires, we could observe the degree of protection obtained, by comparing it with the unprotected wire. A difficulty was at once felt in obtaining sufficient induction upon a parallel wire of such a short length. We obviated this, however, by the construction of a flat rectangular coil of 100 turns, having 4 in. side exterior. Now, by placing either of the sides of this coil near primary wire, we had 100 parallel insulated wires, of a few inches—the influence, therefore, was multiplied greatly; we had also in this coil, on the opposite side, 100 parallel layers running in a contrary direction, so the resultant strength of current was simply that due to the different distances; and it was in order to diminish this, as far as practicable, that we made the coil square. The sound obtained by this means was amply sufficient for all the researches needed.

The third means was that usually employed, namely, the use of coils either superposed or wound together in the same helix; by this means powerful effects could be easily obtained; and as the results were identical, and verified by the three systems, we will at once relate the experiments with coils.

I. If we construct two flat coils of 100 yards of No. 30 copper wire each, and join one as primary to battery and microphone, the second coil as secondary, joined to telephone alone, we find that by placing one of these coils near, or within a few inches distance from the other, we hear distinctly the sounds of the clock on the microphone. Our object now being to screen the secondary coil, so as to reduce the induced current, and consequently sound obtained on telephone, we joined both coils to the same earth plate, without effect. We then took a sheet of copper, 1 millimetre thick, 12 in. square, and placed it between the coils, without effect; joined both coils to this plate, as if it were an earth plate between the coils, but no perceptible reduction of the induced current was thus obtained. We then put 10 thin $\frac{1}{16}$ in. iron plates, 18 in. square, between the coils, again joining them as earth, but still no perceptible reduction.

II. The two coils were surrounded with several layers of tin-foil, thus enclosing each separately in a continuous metallic sheath. This, however, had no effect, and sounds were quite as loud, even when the sheaths were joined to earth. Placing both these metallic covered coils in a vase of salt water, and all to earth, had not the slightest effect, even when the copper plate was also interposed between the coils. Theoretically, these two coils here represented a submarine cable; and as we shall see by some following experiments, neither the sea water, nor even a metallic sheath or tube around each wire would entirely prevent dynamic induction; and this has been proved in practice, as, upon a trial of the telephone between Dover and Calais, a Morse message was clearly read by Mr. Bordeaux, simply by the induced current from another wire in the same cable.

III. A single coil was made, having four separate insulated wires all wound together in the same direction. We could thus join these coils at their free ends, making several combinations each giving very different results. We will call these separate coils Nos. 1, 2, 3, and 4—the microphone remaining on primary, and telephone on secondary. No. 1 joined to microphone, No. 4 to telephone—induction strong, and consequently sounds loud and clear. Nos. 1, 2, 3, to microphone, all same direction, No. 4 to telephone—no perceptible increase of sound by the increased quantity or surface; similar results when 1, 2, to microphone, and 3, 4, to telephone.

Thus by no combination of parallel wires can we hope to diminish induction; but if we join No. 1 and 2 to microphone, so that the current from 1 returns by 2, then we have a complete screen—no sound whatever being now heard on the secondary coil No. 4. The same effect takes place if we join 1, alone, to microphone, and 3 returning by 4 to telephone. Consequently, if a telegraph line or a telephone line had a return wire upon same poles, and absolutely equidistant from the inducing wire, we should have perfect protection, from the fact that the primary would then induce parallel currents in both wires in the same direction, but contrary to itself, and these parallel currents would, being of equal force, neutralise each other. The remedy here is complete, although it is true that it would introduce a double resistance, and the cost of a double wire cable would probably prevent its use. Leaving, however, the practical objections to its use aside, we shall see by some following experiments that the remedy as regards prevention is absolute.

IV. Taking the same 4-wire coil, and joining 1, 2, and 3 to microphone, so that current goes through 1, returns by 2, and back again by 3, we then hear on No. 4 only one half the induction that would be caused by either wire alone.

V. Using still the same 4-wire coil, and sending by 1 and returning by 2, no sounds are heard as we have already shown, out if we short circuit either 1 or 2 we at once hear strongly the sounds induced by the coil that is not short circuited, in this case without interrupting the flow of the current or breaking the communications. We have produced or annulled an induced current merely by cutting off its protecting contrary direction coil, and if the microphone instead of being placed in the direct primary circuit is placed between the junction of 1 and 2, and either coil, we hear the sounds not by any variation in the primary circuit, but simply by the more or less protective influence of the return wire.

VI. If instead of a return of wire of same length in this four-wire coil we use a shorter wire in same coil, it does not protect it, except for the same length as the protective wire; and if as return we use an exterior coil at some distance apart but of same length as primary, it does not protect it at all; this is evident, as from theoretical considerations we know that the return wire must be equidistant, and should be of equal length and diameter.

VII. Knowing that a metallic envelope diminishes in a slight degree the induction—first, by the work done in inducing parallel currents in this wire itself when on a closed circuit, and secondly, by the consequent diminution of force after such work—we tried how the many similar closed coils, introduced between the primary and secondary, would reduce the amount of induction to one-quarter of its original amount. The primary and secondary being placed 6 in. apart, the introduction of one or two similar coils between them gave no perceptible reduction of force, and it required twelve such coils to reduce the induction to one-quarter of the original amount, and this reduction only took place if the interposed coils had closed circuits; the instant the circuits were opened there was no perceptible difference with or without the twelve interposed coils. From this we draw the conclusion that the only reduction takes place when work is done in interposed coils by being on a closed circuit, and that it would require a tube of metal to surround a conductor at least twelve times the amount of primary wire, in order to reduce its inductive effects to the one-quarter as above stated.

VIII. The results obtained with coils were now applied to two lateral wires in a straight line 20 ft. long—the primary being insulated by gutta-percha, and covered externally with tin-foil several times. Here we had the exact conditions which have been more than once proposed as a remedy or prevention of induction for the use of telephone lines. This covering, however, was found to be no protection at all, the induction was equally as strong with exterior coating to earth or open—theoretically there should have been a slight, and, as we have already seen, *very* slight reduction, but the difference was not perceptible. The induction through this protective covering gave loud sounds on telephone, but if we used the outer tin-foil covering instead of a return wire for primary, then no sounds at all were heard; in fact it formed a perfect protection, as we have already seen, in the four-wire coil.

IX. The short local wire of 15 in. already spoken of as the "second arrangement," was now used. The primary wire was led through a glass tube 12 in. long, which had ten coverings of tin-foil, all joined to earth. This arrangement proved, as above stated, of no avail; the current however being returned by tin-foil covering proved a perfect protection. In addition to the ten tin-foil coatings we added twenty coatings or cylinders of thin charcoal iron—making an exterior diameter of 4 in., and a total thickness of metallic sheath of $\frac{1}{4}$ in. between primary and secondary wire. As but little reduction was perceptible, we placed a magnetic needle, suspended by a silk thread, at a distance of 4 in. from the primary, and measured the deflection by current. Without any protective coating it gave 3 deg. deflection, with glass tube and ten tin-foils to earth 3 deg., with the additional twenty iron cylinders about $2\frac{1}{4}$ deg.; thus the magnetic lines of the voltaic current pass easily through non-magnetic and magnetic bodies, and as the dynamo induction is due to the change in this field of force, it is easy to see why the numerous metallic sheaths failed to arrest the inductive force.

We have seen by the preceding experiments that we should have perfect freedom from induction if we employed a return wire at equal distances from the inductive wire, and instead of a metallic sheath, as we have seen might serve, it would be best to employ two separate gutta-percha or insulated wires, and in order that each wire should have absolute equal effect, a slight twist of these two wires should be given, this twist would then successively bring each portion under equal influences.

Since making these experiments we have learnt that Mr. David Brooks, of Philadelphia, first suggested a twisted double wire as above described as a preventive against induction, and that it has also lately been patented by Professor Bell.

A more perfect solution of this question than that of using a double wire with one as a return, giving double resistance to that of an ordinary wire, would be to use a double wire having a slight twist, each wire acting as an independent line with its own earth at each station, and its own separate battery at transmitting station. The transmitting instrument should be so arranged as to send simultaneously positive in one line and negative in the other—these if of equal force would exactly balance each other as regards induction on other lines. The receiving electro-magnet should be wound differentially, or, what would be still better, should have two separate wires wound together. The external end of one of these wires should be to one line, and the internal end to earth; the other wire should, on the contrary, have its internal extremity to the other line and its external extremity to earth.

The effect of this would be, that if any current of same direction passed both wires at the same instant, no effect whatever would be felt on the balanced electro-magnet, but if two currents, each of opposite direction, passed through the coils or electric-magnet, then it would work at its maximum effect; we should thus have a double wire line with less resistance than the single wire, with complete freedom from earth currents, dynamo induction, and from all extraneous disturbing causes.

If two ordinary aërial lines are thus used, they should have the twist given to these wires by changing their position relatively to other wires from vertical to horizontal, and *vice versâ*, at each pole or mile—thus if we had two lines A and B they should have these four relative positions repeated as often as possible, viz.: A B, then $\frac{B}{A}$, then B A, and $\frac{A}{B}$.

We have tried to a find a theoretical remedy by means of which a single wire would be free from this disturbing influence, and we have found that there is no possibility of a perfect solution of this question, provided that we send and receive on alternate wires at the same end, but if all the wires send in one direction during a stated period only, or work constantly in one direction only with one set of poles, receiving by another route or set of poles, then the resolution of this question becomes not only theoretically possible, but, I believe, practically so, provided the lines are, as in France, all arranged in one plane, or nearly so—the only departure from the vertical plane, consisting in the wires being alternately strung on each side of the poles—and this is perfectly followed by the compensating instrument, which I have the honour to present this evening for the first time to public notice.

Suppose three or more parallel lines, A, B, and C; now, A induces a current on B and C proportional to its force of battery power and the several distances of these wires from the inducing wire. If we can send into the wires B and C an opposing current of exactly equal strength and duration to that of the induced current, we evidently reduce the induced current to zero, and have consequently no disturbing effects on those wires.

After numerous experiments, I have found that if coils of wire be so placed in relation to each other, that their relative distance represents the relative distance of the wires from each other, and if each line at its transmitting station be joined to earth through these coils, then in passing the battery current through one of these coils to its line, it would induce a current whose direction would be contrary to itself; and as this would be exactly what takes place on the line itself, we should (supposing the coils to have equal inductive force to the lines) simply double the induced current, and the disturbing effects would be twice as much as what they were before the use of the coils: but if at the same instant that we send battery on line we reverse the terminals of the coil in relation with it, then the induced current sent by coil will be in the same direction as battery on primary, and this would neutralise the contrary direction of the induced current, reducing it to an absolute zero.

I have embodied this idea in the instrument which I present this evening, consisting of a series of coils of insulated iron wire. There are two of such coils, 10 centimetres diameter, 100 metres long, connected together so as to form a single line; these are placed at a distance of 10 centimetres from two similar coils, and between them, at the distance of five centimetres, is a single coil. We have thus two long lines and one intermediate short one. The induction of these coils on each other represents the induction on similar iron aërial wires; the effects, however, are much greater with coils than on straight wires, and this fact allows us to reproduce with a hundred metres of wire only the full amount of induction on a line of a hundred miles or more. The reason of having a shorter intermediary coil is, that it represents, as we have found, the most difficult portion of the problem.

To compensate for the induction on these lines, we have three small No. 32 copper (covered) coils; these are so arranged on a graduating scale that they can be gradually approached until the exact balance for each line is found; and this is found very rapidly, for we have only to slide it until complete silence is obtained from the induced currents passing other wires. These coils have no necessary absolute relation as to length or power to that of line, as we can increase the force by approaching them; but in the case of intermediary wires, and also several wires of same or unequal length, the coils should bear a definite ratio to the length of the line, say 100 metres of copper coil to 100 miles of line; but, from the powerful effects I obtain with the coils I have experimented with, I believe that 100 metres per 500 miles of line would be amply sufficient.

Each coil should be reversed by the key of the instrument at the instant of putting on the battery, and with these conditions the compensation is most perfect, and lines that were full of powerful induced currents all become perfectly free from it, whilst it in no way militates against the transmission of the battery current on its own line. But as our object this evening is not to bring forward new instruments but to discuss the question generally, we will at once sum up our conclusions.

There are three points on ordinary telegraph line or lines where we may attempt a solution of the difficulty by compensation or other neutralising effects, namely—receiving, intermediate, and transmitting stations.

At the receiving station, ordinary induction coils, or the compensating coils I have described, would be injurious, as they could not be reversed in relation to each other, and would thus increase the induction.

Voltaic currents, direct or by derivations from primary line, would answer only where the signal consisted of a dot or a short signal exactly equal in duration and force to that of the induced current.

Polarisation batteries, direct on line, would allow the induced current to pass, and if used as a derivation would require a very great resistance, and would allow the extra current from the working electro-magnet to affect all the rest.

Condensers would be similar to the polarisation or secondary batteries. Resistance coils would reduce the induction, but also in equal proportion reduce the voltaic

current needed. Magnetic condensers would absorb the induction, but also absorb the first part or the part most needed of the voltaic current.

Secondary or intermediate stations all these would give contrary effects to those of the primary secondary batteries and condensers in deviation; but these would weaken the primary current, and for a line of ten wires would, from a calculation we have made, require 45 such condensers, and even then it would be impossible to fulfil all the necessary requirements.

As to the assembling station ordinary induction coils do not act sufficiently strong for a line of ten wires only.

Deviations from synchronism, as we have required, but a great resistance between the instruments should be introduced, and, moreover, the current would be prolonged beyond the induced current.

Polarisation batteries and condensers would also, if in derivation, require great earth resistance, and would require ten or fifty wire for the same number of conductors as the intermediate system, which is objectionable.

Commutating coils, as arranged in the instrument we have established, fully meets the difficulty, giving perfect compensation for any number of wires, with but one coil in each wire, provided that the lines are used for transmission in one direction only for stated periods, and that they are arranged as in Preston, as already explained.

The Bell telephone, however, itself gains five fresco inductions, and not lacking in clear voice, and therefore requiring no compensating arrangements, as in the instance we have already mentioned, wires both ends are to earth, and its electro-magnet wound differentially.

I have studied this subject with much interest because I believe that the future improvement in telegraphy depends to a great extent on its entire solution, and I hope that a fair discussion on this subject now rests may be brought to light.

MOLECULAR ELECTRO-MAGNETIC INDUCTION.*

By Prof. D. E. Hughes, F.R.S.

(Concluded from page 58.)

THE measurements of electric force mentioned in this paper are all measurements on an arbitrary scale. Their absolute value has not yet been obtained, as we do not, at our present stage, require any exact comparative measures. Thus, if each coil in the 100 mile circuit had 100 ohms resistance, 2 Daniell cells would give by the aid of the key 1 and that the following are the comparable degrees of value:—

Soft iron	59 Tertiary current.
Hard drawn iron	50 " "
Steel	45 " "
Hard tempered steel	30 " "
Copper, 60 cents.	3 " "
Copper balls, 1 centm. diameter, 20 turns in 20 centims.	45 Secondary currents.
Iron, spiral, ditto	45 " "
Glass	65 " "

The tertiary current increases with the diameter of the wire, but not in the same ratio as the secondary determined; thus, an ordinary hard iron wire of 1 millim. diameter giving 50°, one of two millims. diameter gave 100°, and the maximum of force obtained by any degree of torsion is at or near its limit of elasticity, as if in some fibres or wire that point, producing a permanent twist the current disappeared. Thus, for instance, with a wire in the case of a permanent twist, the point of which was 1 millim. hard iron wire was 50° of torsion, but in hard steel it was 60°.

* The substance of a paper read before the Royal Society, March 17.

† 50° successor has the same electromotive force as 0·50 of a Daniell battery.

Longitudinal strains do not produce any current whatever, but a very slight twist to a wire, under a longitudinal strain, produces its maximum effects: thus, 50° of torsion being the critical point of iron wire, the same wire under longitudinal strain, required but 10° of torsion to produce the same effect; however, to produce a perfect longitudinal strain alone. I have, therefore, only been able to try the effect of longitudinal strain on fine wires, not larger than 1 millim. in diameter, but as to all cases not effect whatever manufactured by longitudinal strain alone, a larger case will be found if absolutely perfect. Thus, if a perfectly annealed iron wire under strain are equally under no elastic strain or tension, but the path of their motion is now parallel with its wire, or the axes of electric induction effect, but the compound strain, composed of longitudinal and transverse, react upon each other, producing the increased effect due to the compound strain.

This successor is not only useful for showing the direction of the current and measuring it by the zero method, but it also shows at once if the current measured is secondary or tertiary. If the current is secondary its period of action coincides with that of the successor, and a perfect zero is obtained, but if at any case obtained, and its value in successors is given; but if the current is tertiary, no zero is obtained, and if the value of the tertiary is 60°, we find 120° the nearest approach to zero possible. But by the aid of separate induction coils to convert the secondary into a tertiary, a perfect zero can be obtained, and the value of the secondary and its force corresponding to that which we wish to measure.

If I place a copper wire in the balance, and turn the coils at an angle of 60°, I obtain a current which the successor gives, as in the instance of the copper, as eternal; and, that is secondary. If I now replace the copper by an iron wire, the coil remaining at 60°, I have again exactly the same values for the iron as copper—viz., 60°, and in both cases secondary. Now, it is evident, that in the case of the iron wire there was produced at each passage of the current a double molecular change; but this longitudinal magnetism did not disturb change the character of the current or its value in force.

A most beautiful demonstration of the fact that longitudinal magnetism produces no current, but that natural magnetism can act equally as well, no matter the direction of the longitudinal magnetism, consists in forming an inductive circuit, or taking two parallel but separate wires, bringing electricity at their final ends, the free ends being connected with the circuit, so that the current generated must pass up one wire and down the adjacent one. Or, testly, still better, one of there are no internal strains, complete zero of electro-motive current will be found. Now, giving a slight torsion to one of these wires in a given direction, we find, say 60° positive; twisting the parallel wire in a similar direction produces a perfect zero, thus the current of the second must be 60° also positive of the first. If, instead of twisting it in a similar direction, we twist it in the contrary direction, the zero is increased in value from 60° positive to 120° positive, showing, in this latter case, not only a doubled increase of force, but that the currents in the iron wires travelled up one wire and down the other, corroborating that both were strongly magnetic by molecular action. This beautiful and perfect experiment also proves that its molar magnetism has no effect, as the currents are equally strong in both directions, and both wires can double or efface the currents produced in each. If, instead of two wires, we take four, we can produce a zero, or a current of 120°, and with twenty wires we have a current of 300°, or the maximum power of the apparatus. We have here a means of multiplying the effects by giving an elastic torsion to each separate wire, and joining them electrically in tension. If loops are formed of one iron and one copper wire, we can obtain both currents from the iron wire, positive and negative, but none from the copper wire, as the effect of a conductor upon which tension has no effect.

I have already mentioned that internal strains will give not tertiary currents, without any external elastic strain being put on. In the case of iron wire, these disappear by a few twists in both directions, but in flat bars or forged iron, they are more permanent; evidently, portions of these bars have an elastic strain, whilst other portions are free from it, and, as I have already mentioned in the instrument, however, is so admirably sensitive, and able to point out not only the strain, but its direction, that I have no doubt its application to large forged pieces, such as shafts or cannon, would bring out most interesting results, besides its practical utility; great care is therefore necessary in the manufacture of iron that it should be free from internal strains, or that we know their value.

Magnetising the iron wire by a large steel permanent magnet has no effect whatever. A hard steel wire can likewise become strongly magnetic, but no current is generated, nor has it any influence upon the faults obtained from molecular movement, as in elastic tension. A flat wire iron bar, or a bundle of iron wires, when magnetised by an iron bore produces transversal, instead of longitudinal, but neither shows any trace of the currents produced by molecular magnetism. I have made many experiments with wires and bars thus magnetised; but as the effect in every case was negative when freed from superficial errors, I have not thought it necessary to describe them. In bending round which the instrument gives, that longitudinal magnetism first passes through its successive modifies before and during the discharge, or recomposition of its magnetism. For this purpose, using no battery, I put the terminals and telephone to the coil, the wire having no current passing. I then magnetise the iron wire at one end of the wire. I find by slightly moving the coil, that there is a Faradaic induction of 50° at both poles, but very little or none at the centre of the wire; now fixing the coil at the central or neutral point of the wire, and listening intently, no sounds are heard; but the instant I give a slight twist to the wire, a sound is heard, and a perfect tertiary induction is heard, whose value is 60°. Again, testing this wire by moving the coil, I find only a remaining magnetism of 10, and upon repeating the experiment of elastic torsion, I find a tertiary of 2 thus we go on gradually discharging the wire, but its discharge will be found to be in proportion to the force that has passed through the stage I have mentioned.

Heat has a very great effect upon molecular magnetic effects. Up to 100 it increases the current, but in what the current is diminished. For experimenting on iron wire, which gave a tertiary current of 50° positive (with a torsion of 10°), when heated, but retained its set to cold, with a torsion of 10°, when cold. I very much doubted the experiment at first, but on repeating the experiment with steel several times, I found that on heating it, I had restored the extreme hard (yellow) temper to that of the well-known blue temper. Now, at this temper, the wire, as stated was but 10 to 15°, whilst soft iron of similar size gave 50° of force cold, and 100° at red heat. This fact, so completely shows that the effects I have described depend on molecular elasticity, it proves at least, as far as iron and steel are concerned, that a comparatively perfect elastic body, such as tempered steel, has the greatest molecular elasticity, and that heat reduces it, but that soft iron, having but little molar elasticity, has a molecular elasticity of a very high degree, which is increased by heat.

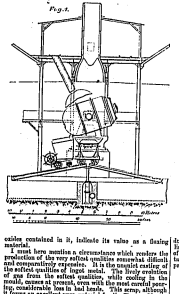
The objects of the present paper being to bring the experimental facts before the notice of the Royal Society, and not to give a theoretical solution of the phenomena, I will simply add, that if we assume with Poisson, that all parts of the molecules of iron are elastic, and that the molecules slightly compressible or elastic, and that they are capable of being polarised, it would sufficiently explain the new effects.

Jenkin has shown that no iron bar is longer and shorter when magnetised than when before, and in the case of the successor we see the extreme portions of the wire are under a force equal to more than three over the centre, and as the polarised ellipse are at an angle with the molecules of the central portions of the wire, its polarisation ceases upon them, producing the comparatively strong electric currents I have described.

Engineering Aug. 5. 1881.

PRESIDENT GARFIELD AND THE HUGHES INDUCTION BALANCE.

One of the most interesting and important applications of electricity that has ever been made, involving as it does the saving of human life and the amelioration of human suffering, has recently been employed with complete success for the localisation of the bullet which so nearly deprived the Republic of the United States of America of their President. On the 16th of July last the following telegram addressed to Mr. W. H. Preece, was transmitted across the Atlantic by Professor Graham Bell. "Bell to Preece—Can Hughes suggest form of induction balance to locate ball in President Garfield? If so telegraph at once at my expense." In reply to this telegram, which was handed to Professor D. E. Hughes, F.R.S., an answer was telegraphed back the same day, in which Professor Hughes gave instructions for the construction of an instrument, a special form of his induction balance which has already been described in these columns,* and Professor Hughes at the same time sent by post to Professor Bell sketches, and a more detailed description of the way to proceed. Professor Hughes's instructions were immediately carried out in Washington, and our readers will have seen by the telegrams which reached this country on Monday last, that the position of the ball within President Garfield's body has been localised with great accuracy by the electrical method devised by Professor Hughes. The method was as simple as it could be; an induction balance was constructed, in which one pair of coils fixed at a definite and invariable distance apart by being wound on a double bobbin or spool, being separated from one another by the thickness of the middle flange, and the four free ends of the two coils were made into a tube by which the two coils or searching apparatus were connected to the battery, telephone, and rheostone, and with a second pair of coils which formed the initiating apparatus. From the construction of the induction balance it follows that by varying the distance of the adjustable coils of the indicating apparatus, until the inductive currents in the apparatus are balanced or neutralised, silence in the telephone is produced so long as there is no outside disturbing metallic body within the induction range of the searching instrument. The moment such is the case the equilibrium is destroyed and the sound is brought back in the telephone, becoming louder or less audible as the disturbing body is nearer or further from the pair of searching coils. By passing such an apparatus over that region of the President's body in which the bullet is known to be, as on are placed at the telephone at the other end can immediately detect by the sounds becoming louder when the foreign body is exercising its maximum inductive effect upon the bobbins, and as it is a fact that for equal distances the maximum disturbance is produced when the metallic body lies in the axis of the coils, it will be seen at once that not only the distance of the bullet from the surface of the body, but also its direction from any one spot can be ascertained with extreme accuracy, and by repeating the operations on different parts of the region under examination, a number of distances from the surface are obtained as well as a number of lines of direction, all of which have a common origin in the bullet, and by this simple arrangement the surgeons attendant on the President of the United States have been able to locate the bullet within his body with unerring exactness.



removed, the liquid is stripped, and finally the cleanup of bullions is effected on the same truck. A small ten-horse power locomotive is employed to do all this work.

The new plant contains other peculiar arrangements and modifications, which we propose to pass over, as they do not appear to us to be worthy of the basic process.

The slag produced in the blast furnaces is held, I have given analyses above, is employed over again in the blast furnaces, since we are thus enabled by means of the phosphorus present in it to raise the content of phosphorus in our pig iron. The small amount of silica and high content of lime in the slag, as well as the iron and manganese lime upon President Garfield, and there was every reason to believe that the position of the bullet had been satisfactorily localised.

III. Although Hughes's induction balance is well known, a brief résumé of its principle will not be out of place. Whenever a current of electricity from through a wire, it converts the neighbourhood of that wire into a magnetic field. A "magnetic field" is a term applied to any space in which a magnetic influence of magnetism, and it is observed by the appearance with lines of magnetic force which have sometimes been called lines of magnetic force that rays of light have to light itself. Whenever a conductor moves through these lines of force or whenever these lines of force are projected through a conductor, a current of electricity is generated in the conductor. Now, if we take our wire and form it into a coil (as at A in the accompanying figure), and pass a current of electricity through

this coil, its neighbourhood becomes a "field;" and if we suddenly start another coil (B), a current of electricity will be induced in this coil for every current that passes through A. If we suddenly stop the current in A, a current is induced in B. The strength and direction of this induced current will depend upon the strength and direction of the primary or inducing current in A, and upon the intensity of the magnetic field and the lines of magnetic force passing through it. Anything that disturbs the field will vary the current in B. Now if a battery of four or five cells is joined to A, and a vibrating contact piece is rapidly and alternately interrupts the flow of the current through A. As B is represented another coil, precisely similar to the first, through which no current can flow at first, and at A and C are represented two coils of wire precisely similar to each other, but so connected that the current induced in the one are in the reverse direction to those induced in the other. If, then, a piece of metal be now applied to the two, before with great sensitiveness any currents, however feeble, that may be flowing. If the instrument is connected up, as shown in the diagram, and the "interrupter" be set going, there will be silence in the telephone, because the current that are induced in the coil are balanced by currents induced in the others. If, however, a piece of metal be brought near enough to affected any wires in the field of A, other currents are induced in this piece of metal, the lines of force are disturbed, and the balance is destroyed, and sounds are heard in the telephone. These sounds can again be destroyed by bringing the coil into the same position of field of A, readjusting the coils at B until perfect silence is obtained, as we have the primary and secondary coils in the same relation to the field of A. Hence, a graduated scale can be used to obtain measurements of the amount of disturbance. The instrument is so sensitive that it can trace the smallest impurity in a sovereign; and Professor Chandler Roberts informs us that it has been utilised in the Mint for the detection of base coinage.

IV. In order to apply this apparatus to the localisation of a bullet in a wound Professor Hughes recommended that the pair of coils C should be made movable and portable, so that they might be moved over the body of the wounded man. He anticipated that if the coils were brought within 30in. of the bullet its presence would be detected. The bullet could readily be brought in close to the axis of the coils by observing the position of maximum sound. It remains when that is done to ascertain its depth, and Professor Hughes suggested by moving a similar bullet in the field of A, and observing in the small receiver B attached to it that the depth of the total bullet could be ascertained. Professor Hughes will shortly devise a practical form which can be placed in the hands of any surgeon.

ELECTRICITY AND GUNSHOT WOUNDS.

*On the Application of Electricity to the Localisation of a Bullet in a Wound.**

By W. H. Preece, F.R.S.

I. Any application of electricity which can aid the practice of surgery and lead to the total suppression of pain must fulfil one of the highest functions of the art of applying the great forces of nature to the wants of man. I purpose to show how an electric current can be made an invisible and immaterial probe, localising the position of a bullet in the human body by the production of a well-known kind of sensation of pain. Electricity has already been used for probing purposes, but only to detect, by the ringing of a bell, the fact that a metal has been touched by the point of the instrument. The operation was performed with all the pain to the wounded sufferer, and electricity was employed only as an agent more sensitive than the finger.

II. The sensation of using electricity alone as the test itself, for this purpose, occurred to Professor Graham Bell in Washington. He telegraphed to me on the subject to consult with Professor Hughes as to the use of his induction balance for the purpose. That gentleman threw his whole heart into the matter. Full directions were sent out to Professor Bell by telegraph, practically corresponding to the subject with Mr. Tainter. Experiments were made by

* Paper read before Section A, British Association meeting, York.

* Paper read before the Iron and Steel Institute.

WIMSHURST'S ELECTRIC MACHINE.

We have from time to time, in the pages of ENGINEERING, described the very interesting electrostatic induction machines * of Mr. James Wimshurst, one of the consulting engineers to the Marine Department of the Board of Trade, and who, combining as he does a remarkable intuitive knowledge of electrical matters with great skill as a mechanician, has designed and constructed a number of new forms of induction, machines of a high order of excellence and originality, and which he has moreover freely given to the world. These several machines form so many advanced links in a most interesting chain of development in the history of electrostatic science, besides placing in the hands of the physicist and science student most valuable additions to high-class apparatus at their command, and which can be made and supplied with a reasonable profit at an exceedingly moderate cost.

We illustrate this week a very large machine which has just been completed by Mr. Wimshurst in his own private workshop, and which, unquestionably, the most powerful and efficient electrostatic machine in existence. This apparatus has been constructed for and presented to the Science and Art Department at South Kensington by Mr. Wimshurst, the cost of the raw material being defrayed by the Department.

On reference to the illustration it will be seen that the form of this machine is nearly identical with the smaller type which we illustrated and described two years ago.† In point of difference lying in its size and in the construction of the supporting parts, which the greater weights have necessitated. Thus, while the diameter of the circular plates of the smaller machine was 14 in., that of those of the great machine is 24 in.; the former being cut out of ordinary window glass, while the latter are discs of plate glass $\frac{1}{8}$ in. in thickness, and weighing 280 lb. each. Each of these discs is pierced at the centre with a hole 6 in. in diameter, and is firmly attached to a gun-metal tube 18 in. in length, carrying the disc at one end and a pulley at the other, and which is let on so as to run freely on an iron tube 3 in. in diameter, this tube being supported at each end by strong oak frames, rising from a firm base, also of oak, and which is fitted with lockers at each end, for holding spare parts and accessory apparatus. The heads of the two frames, A A frames, consist of massive castings of gun-metal which are so shaped as to hold the hollow iron tube, and into the clouts rail rods are attached. The iron tube projects at each end beyond the frames, and to the projecting ends are attached the brass "neutralizing" rods, which terminate in fine wire brushes, shown in the illustrations.

To the discs, which are well varnished with an alcoholic solution of shellac, are attached, at equal angular distances apart, radial sectors of tinfoil, 10 on each disc. These sectors are 19 in. long, and have a mean width of 1.63 in., thus having an area of 31.35 square inches. They is thus on each plate a metallically coated area of 500 square inches, or a thousand square inches in the two discs together.

As we have in the article in our thirty-fifth volume, to which we have before referred, described the principle and action of Mr. Wimshurst's electrical machine, we need not repeat it here, but we may remind our readers that the machine may in principle be regarded as a sort of doubled-up "Nicholson's revolving doubler," the sectors on the one disc acting as inductors on the other, and vice versâ, and that the probably due to the fact that both plates continue charges of electricity to the collecting combs, and that the sectors on the one disc act as inductors and as carriers respectively to those on the other when they approach the best positions for those respective actions to take place.

The collecting combs are attached to the discharging rods, as shown in the engraving, by interchangeable best adjustments in the segment, by interchangeable best their positions with respect to the lines of equal distance of the discs may be varied within a range of 2 in., that is to say, between about 6 in. above and 8 in. below the horizontal diameter. The discharging rods or terminals are constructed of brass tubing 1$\frac{1}{4}$ in. in diameter, and are fitted with terminals of different diameters, which are also interchangeable. The distances of these spark discharges can be varied by the glass handles with which the discharging rods are fitted at their lower ends, and as these handles have their attachment in a hinge-joint, they can be used as levers wherewith to turn the terminal rods around a vertical axis, and thus to vary the distance between their upper ends.

The two discs are rotated in opposite directions by the lower driving gear shown in the figure; this consists of a horizontal spindle fitted with a winch handle at each end, and carrying a pair of cast pulleys which are connected respectively to the two pulleys attached to the discs by endless cords, one of which being crossed, causes one disc to be rotated in the opposite direction to the other; and as the weight of the bearings of the lower spindle is adjustable, the driving cords can always be maintained perfectly tight.

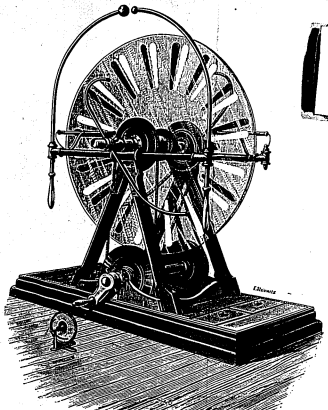
The principal characteristics of this form of electrostatic machine, and to which its exceptionally high values as a laboratory instrument is due, are (1) that it is readily self-exciting in almost every condition of the atmosphere; (2) that the polarity of the opposite inductor charges, as it is so liable to do in other forms of induction machines; (3) that the charge is very large compared with the area of the glass employed in the discs, and (4) the small cost at which the machine may be constructed.

Although the great machine which we illustrate in this notice was constructed in a workshop in which there was a steam engine and boiler at work, and consequently with an unlimited quantity of water in the atmosphere, and although it was closely surrounded with lathes and shafting, the former metallic conducting bodies, into only did it take up its charge even before a stream of discharge sparks between its terminals of over 14 in. in length. The same was always found far more satisfactory than was ever allowed before it was tried, but when it is set to work at South Kensington (where it will be located by the time these words are before our readers), and where it will be under far better conditions for developing its full powers, still higher results may be expected. We may, indeed, congratulate Professor Ayrton and the science schools generally on this new acquisition to the physical laboratory, which must prove a most valuable instrument for experimental research.

Mr. Wimshurst has in his laboratory what is probably the largest collection of the most powerful electrostatic induction machines in existence, having worked for several years in perfecting this class of apparatus. We have in the illustration introduced (partly to serve as a comparison of size and partly to illustrate a very interesting and typical form of the apparatus) a sketch of what is perhaps the simplest and the cheapest electric influence machine ever constructed. This little apparatus consists simply of two discs of varnished glass 12 in. in diameter, fitted with tinfoil sectors, and mounted on a spindle, which can be held in the hands, and the discs can be rotated in opposite directions by turning them with the finger and thumb. When this is done—although there are no collecting combs or discharging terminals—most brilliant effects can be produced, the whole apparatus literally bristling with electric discharges immediately the rotation commences, and one of the most remarkable and not the least valuable features of this beautiful little instrument lies in the fact that it can be constructed in a good saleable and workmanlike manner and sold at a very small charge.

While we would urge Mr. Wimshurst to go on still further in the important experiments, in hope of further discovery, we are bound to admit that we are unable to see how it is possible to get greater simplicity to be reached, or for higher efficiency to be obtained.

THE WIMSHURST 7-FT. DUPLEX ELECTRIC MACHINE.



ECONOMICAL STEAM TRAMWAY.—The Directory, Batley, and Birstal steam tramways, the first ever constructed in England (worked by Merryweather 7-in. engines), show, by the last half-year's working account, that the total cost of the running of the engines was 2.37 pence per mile, and the total expenses of the whole undertaking, including locomotive charges, 5.16 pence per mile. This is one of the most economically worked lines in the country.

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* See ENGINEERING, vol. XXXIV, p. 323, and vol. XXXV, p. 6.

† *Ibid.*, vol. XXXV, page 1.

‡ *Ibid.*, vol. XXIII, page 316.

Lines of force due to a Small Magnet

I have been recommended by Sir William Thomson to send you the following construction for the lines of force due to a very small magnet.

The equation to the lines of force due to a very small magnet placed at the origin of co-ordinates and lying along the axis of x is—

$$\frac{y^2}{(x^2+y^2)^{\frac{3}{2}}} = \frac{1}{C} \quad \ldots \ldots \quad (1)$$

By varying C we obtain a series of similar curves.

Transforming to polar co-ordinates by putting $x = r\cos\theta$, $y = r\sin\theta$, we get for the equation (1)

$$r = C\sin^2\theta. \quad \ldots \ldots$$

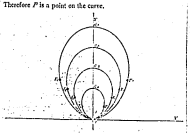
This immediately suggests the following construction:—

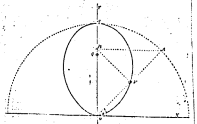
Take $OC = C$, and with this as radius, describe a semicircle. Draw any radius OA, then take AP perpendicular to OY, and DP perpendicular to OA: then P is a point on the required curve. Because

$$OD = OA\cos OAD \qquad \text{where } \theta = \text{angle } AOX.$$
$$= OA\sin\theta,$$

Also $OP = OD\sin\theta$
$= OA\sin^2\theta$,

Therefore P is a point on the curve.





In a similar manner any number of points on the curve may be obtained; and by varying the length OC, we get different curves of the same class.

Near to the point C in the figure, the points on the curve cannot be constructed accurately by the method just given; but if the radius of curvature for the point $(x = a, y = 0)$ be calculated, it will be found that for the point G it is $\frac{OC}{3}$. Q is the centre of curvature. And a large arc of the circle described about Q with radius QC coincides with the curve. Thus the whole curve may be constructed with great accuracy.

From equation (1) radius of curvature at any point (x, y) is given by

$$\rho = \frac{C.y(x^2+y^2)^{\frac{3}{2}}}{3(x^2+y^2)(x^2-y^2)},$$

or, with x eliminated by (1),

$$\rho = \frac{C\sqrt{y}.(y^{\frac{1}{2}}C^{\frac{1}{2}}-y^{\frac{1}{2}})^{\frac{3}{2}}}{3(yC-y^2)}.$$

Thus $y = \cdot 432\,C$ gives the point of maximum radius of curvature.

Lines of force—

$$\frac{x^2}{(x^2+y^2)} = \frac{C}{r}.$$

These curves may be obtained by giving to C the values

$$C = \cdot 05C$$
$$C = \cdot 1C$$
$$C = \cdot 2C$$
$$C = \cdot 3C$$

The points (F) are points of zero curvature.

Glasgow, January 29 JOHN BUCHANAN

ON A NEW ACTION OF THE MAGNET ON ELECTRIC CURRENTS.

THE statement that "the Mechanical Force which urges a conductor, carrying a current across the lines of magnetic force, acts, not on the electric current, but on the conductor which carries it" has often been a puzzle to students of electricity. Experiments have become at various times to prove that the statement is not correct; but have hitherto uniformly resulted in failure. Mr. E. H. Hall, working under the direction of Prof. Rowland, believes himself to have been more fortunate than his predecessors, and describes an experiment which apparently proves a permanent effect of a magnet on the distribution of currents in a system of wires. As Mr. Hall promises a more extended investigation we shall describe his experiment, as much as possible in his own words without comment or criticism.

The following experiment had apparently been formerly tried by Prof. Hochheim, but without success:—

"A disk or strip of metal, forming part of an electric current, was placed between the poles of an electro-magnet, the disk cutting across the lines of force. The two poles of a sensitive galvanometer were then placed in connection with different parts of the disk, through which an electric current was passing until two nearly equipotential points were found. The magnet current was then turned on and the galvanometer was observed, in order to detect any indication of a change in the relative potential of the two points."

No such change could be observed and Mr. Hall now repeated the same experiment substituting a piece of gold leaf, mounted on glass (Chester 23 a decided deflection of the galvanometer needle.

This deflection was much too large to be attributed to the direct action of the magnet on the galvanometer needle, or to any disturbance of the latter. It was moreover a permanent deflection and therefore not to be accounted for by induction.

Some rough quantitative experiments were tried with the result "that with a given form and arrangement of apparatus the action on the Thomson galvanometer is proportional to the product of the magnetic force by the current through the gold leaf. This is not the same as saying that the effect on the Thomson galvanometer is under all circumstances proportional to the current which is passing between the poles of the magnet. If a strip of copper of the same length and breadth as the gold leaf but 1 tenth in thickness is substituted for the latter the galvanometer fails to detect any current arising from the action of the magnet, except an inductive current at the moment of making or breaking the magnet circuit."

A. S.

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and experiment.

Scientific American.

July 2 1887

MAGNETIC PHENOMENA.

The effects of magnetism, as they are usually pointed out, are far from agreeing with those which practice is revealing at every moment; and, owing to the often inexact data that are possessed, a sometimes happens that we meet with deceptive only in the results expected. The reason is that two kinds of actions which are essentially different are confounded with each other—*static action*, that is, the action revealed by magnetic attraction, and *dynamic action*, which gives rise to the reciprocal mechanical reactions of magnets and currents. These actions are not mutually disposed on each other, although they may have a reciprocal influence, and consequently may be *interpolated*. *Dynamic action* is induced by those magnetic currents which Ampère supposed to envelop the molecules throughout in which entered and perpendicular to its axis, and may be considered as dependent upon a resultant applied to the center of the molecular bar. This resultant, then, represents all the individual actions of the currents constituting the molecular system. From this point of view the magnetic axis is the line of most energetic, exactly according to the neutral line, where, however, no action of attraction takes place. In fact, it is at this point that the effects of induction are most energetic, as said by why MM. Poggendorff, Müller, Faber, and others have advised the selling of the helices of the inductors cell like those of this cell. It is for this reason, too, that when a small (illegible) is caused to revolve on a magnetized bar, the resulting induced currents are direct when the cell moves from the neutral line, and inverse when they approach it. *Static action*, on the contrary, closely approximates to that of the electric cell by induction, which is in play in electrical conductors. Without in any way entering into the theory

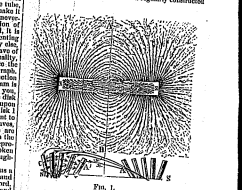
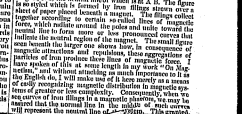


FIG. 1.

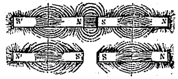
magnet, N S, the neutral line of which is at A B. The figure is so plced which is formed by two rings drawn over a sheet of paper placed beneath a magnet. The particles, brought together according to certain so called lines of magnetic force, which radiate around the poles and tend to extend the neutral line to more or less prominent curves that indicate the neutral region of the magnet. The figure shows more clearly than any one above how, in accordance with magnetic attractions and repulsions, these aggregations of particles of iron produce those fine lines of magnetic force. I have spoken of this at some length in my work "On Magnetism," and without attaching as much importance to it as the English do, I will make use of it here merely as a means of accomplishing magnetic distribution in magnetic systems of greater or less complexity. Consequently, when we say curve of force, we mean a magnetic curve, or, what is the same thing, the curve in the middle of each curve will represent the neutral line. The points *a*, *a'* will be called by their like and unlike poles.—These positions are represented in Figs. 2 and 3. The one in Fig. 2 belongs to



FIGS. 2 AND 3.

the two magnets united by their opposite poles. It is seen that the two series of filaments at the middle of the two magnets seem to have become fused into a single system, which tends to furnish but a single neutral line when the adhesion of the two magnets perfect, but which, by reason of their imperfections, gives rise to two distinct neutral lines. The character of Fig. 3, on the contrary, shows that the distribution of magnetism has been little affected on each of the two magnets, since the two systems of curves are found to merely correspond in the middle of each. When these magnets are separated by a slight space, the filamentous exhibit themselves in the form seen in Figs. 4 and 5, and which show that the magnetic field, in cases where opposite poles are in presence, behaves like a true magnet—conditions which do not exist when like poles are opposed

to each other. When, instead of two magnets, we employ a piece of iron and a magnet, or, in other words, when we employ a magnet provided with an armature (as in Fig. 6), the phantom of this arrangement shows that the neutral line of the magnet has not returned to the point of contact of the two pieces. It has slightly approached it, it is true, but the threads of filings which radiate around the pole, S, and the whole surface of the armature, P, show that, as regards static action, this armature forms only an expansion of the magnetic pole with which it is in contact. Consequently, it is polarized over its whole surface, and, nevertheless, as we have demonstrated in another article, the effects induced in this case (see Fig. 3) show that this neutral line, where the



Figs. 4 and 5.

resultant of the spirals of the magnetic helix should be applied, correspond indeed, as regards dynamic action, with the point of juncture of the two magnetic pieces. If the iron armature is far from the magnet, as shown in Figs. 7 and 8, the threads of filings of the magnetic pole bend over on the part of the armature nearest this pole, and consequently show that a north polarity has become developed at P; but the rest of the armature seems to be polarized in the same manner as S, for the threads of filings are normal at its surface and indicate no such system of neutral line as has place on the magnet. If now we examine the effects which result from the reactions exchanged between a magnet and its armature, as regards the magnetic power of the system, and which we may do by means of the apparatus represented at Fig. 9, we find:

1. That the attractive force of the pole provided with an iron armature has become considerably weakened, but that,

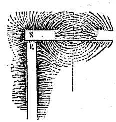


Fig. 6.

as an offset, the attractive force of the opposite pole has become greatly increased.

2. That the induced currents resulting from the addition of this iron armature have not only increased in a large proportion, but may be super-excited by the simple approach or withdrawal of the armature.

3. That the action is still greater if the magnet is provided, at its two poles, with two armatures.

4. That if the magnet is an electro-magnet, the armatures remain firmly attached to the poles, even after the current has been interrupted through the electro-magnet, and that too with the softest irons.

From these effects it follows that magnetism, considered from the standpoint of static action, behaves like electricity in a condenser. The polarities which are in presence are kept developed one by the other in a *hidden state*, for their presence cannot be ascertained externally; and on the surfaces of the magnetic pieces in contact there remains only the magnetism which has escaped condensation, and which is of the same character throughout the whole circumfer-

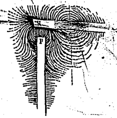


Fig. 7.

ence of the armature and on the pole of the magnet in contact with it. This is why the attractive force of this expanded polarity is found greatly weakened in comparison with what it was at first; and in fact this weakening corresponds with all the magnetism hidden at the point of contact of the two pieces. But this magnetism is none the less active on account of being hidden; it might even be said that it has become more active than it was originally, since the induced currents that are then produced are more energetic. I ought to say, however, that the expression "magnetic condensation," which I employed at the beginning of my researches, in 1858, and which other physicists have used since, is perhaps not quite proper, for it supposes an *increase* of magnetic energy in the phenomenon, and which ought to be kept up independently of the cause of the magnetism, but which, in fact, disappears with it, giving rise after this disappearance to a secondary magnetic action, which varies according to the energy of the magnetization developed, and which has this time all the characters of a condensing action. For the polarities excited on the surface of contact of two magnetic pieces having an action on each other are kept developed in consequence of their mutual reaction, even when the magnetizing cause has disappeared; and in order to annul this action it is necessary to either mechanically separate the two pieces in contact or to destroy one of the two polarities by a contrary external magnetic action, as shown at SNS' in Fig. 9. Now it is on account of this secondary magnetic action, which is evidently connected with the first, and of the increase of strength of the magnetic action itself, that I have given the phenomenon the name of *magnetic condensation*.

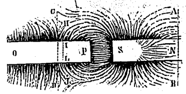


Fig. 8.

In the different notes that I have presented to the Academy of Sciences, at various periods, and especially in 1873, I have shown that these effects might be explained by the accepted theories without having recourse to a hypothesis of a displacement of magnetic fluids; I will not refer to these then, but will only say that the induced currents resulting from this magnetic condensation which M. Lallemand has said that he has obtained without any change of intensity at the end of twenty days, may be produced at the end of an infinitely longer period. I have found them not only at the end of several months, but even of several years.

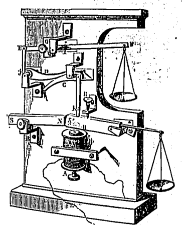


Fig. 9.

Could a charge of electricity, like a magnetic polarity, be maintained without loss on a conductor, it is probable that the charge of a condenser could be preserved indefinitely in the same manner.

Condensed magnetism is generally confounded with *remanent magnetism*; but these, however, are two very distinct actions. The first of these is a physical effect of a positive kind, but the other is only the result of impurity of the iron. The latter can be recognized only when the former has been annulled, and it only makes itself manifest when, after a first removal of the armature, the adhesion of the two pieces of iron tends to take place. One of the most manifest

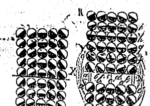


Fig. 10.

proofs of magnetic condensation is that experiment which I described in 1859, in my memoir on Induced Currents (p. 20), and which shows that when magnetization is super-excited the first time in a magnetic system composed of an electro-magnet united with its armature, the *induced currents produced by closing, and which result from this magnetization, are infinitely more energetic than when they are excited a second or a third time.* Now what proves that this weakening is due to a condensing action is, that to these currents may be given again their first energy, by separating for a moment the electro-magnet from its armature, and in remagnetizing the system after having re-established the contact of the two pieces. The influence which is exercised under such conditions may be easily ascertained by studying the difference of tension of the induced currents produced by an electro-magnetic system (with an induction coil) provided or not with its armature. When the armature is in contact with the electro-magnet, the deflection of the galvanometer which is produced by the induced current resulting from demagnetization is much greater than when this contact does not exist, and nevertheless the *perturbations that are caused by these currents are incomparably stronger in the latter case than in the former*, and that is because the demagnetizations are effected in a much less abrupt manner with the armature, in consequence of the impediments offered by the effects of condensation.

In the memoirs which I have published on these effects of condensation, I have, again, given as proofs of their existence, the enormous increase of power which a permanent magnet acquires when it is magnetized by providing its poles with an iron armature. Thus M. Jamin has been able to give a magnet placed under these conditions an attractive power of 780 kilogrammes, although he could communicate to it

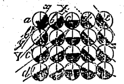


Fig. 11.

only one of 300 kilogrammes without the presence of the armature. On another hand, I explained by this action the attraction that takes place between two magnetic poles of the same kind, but of different power, when their distance is slight enough to allow the static effect to overcome the dynamic. In order to explain all of these effects, I said that the *atomic polarities* of the magnetic molecules which constitute the chains of currents of a magnet's magnetic helix assume an *arrangement which varies according to the conditions of the magnet with respect to the bodies that surround it, and to their relative positions.* If the magnet is influenced by no body situated in its vicinity, these atomic polarities arrange themselves so as to constitute among themselves such a state of equilibrium that the polarities of contrary names are as opposite to each other as possible (as seen in Fig. 10), and the result of it is different polarities with two centers of action designated by the name of poles.

If, now, we admit that a magnetic body is submitted to the action of these polarities thus distributed, the latter excite a reaction by induction, which has the effect of causing the axes of the atomic polarities to assume a new position of equilibrium and a new arrangement, which displace the centers of action or poles, and carry them toward the body induced, by producing in the attraction and in the polarities themselves an action which is so much the more lively in proportion as the bodies are nearer each other. Now this action is at maximum at their contact (see Fig. 11), but for all that the current does not the less remain in force; just as an electric current traversing a submarine cable does not any the less act as a dynamic source, although at the same time it produces laterally a static action. Finally, when we present a second armature to a magnet provided already at one of its poles with an armature, the atomic polarities are induced anew, and to satisfy the double action which is caused, they take a new position of equilibrium which can be produced naturally only to the prejudice of the first action, and that too in a degree nearly proportional to the mass of the bodies induced, and especially to their surface.

To thoroughly comprehend these different considerations, it would be necessary to enter into the theory of magnetism and diamagnetism given by M. De la Rive. Some day perhaps we will attempt to resume it; but what concerns us at the present time to fully demonstrate is, that the effects of magnetism, like the effects of electricity, are of two different natures, according as magnets act as currents or as charges in the static state.—*La Lumière Electrique.*

NEW PROCESS FOR PHOTOGRAPHIC PRINTS.

By M. A. Poitevin.*

It is well known that peroxides and salts corresponding to the higher oxides, when mixed with certain organic bodies, such as alloxanthin, tartaric and citric acids, and probably other analogous substances, are reduced by the action of light to protoxides and to salts corresponding to the lower oxides. For instance, ferric chloride (Fe_2Cl_6) mixed with tartaric acid and acted on by light, is changed to ferrous chloride (Fe_2Cl_4), a reaction that has been taken advantage of in the production of permanent prints by the powder process and in that of vitrified enamels. M. Pellet makes use of the same reaction for copying plans, etc., in blue lines on a white ground. A similar experiment may be made with corrosive sublimate (mercuric chloride, $HgCl_2$), which is reduced to the condition of calomel (mercurous chloride, Hg_2Cl_2), and then blackens on being treated with ammonia. These different photo-chemical reactions may all form the foundation of photographic printing methods.

The process which I have the honor of introducing to the notice of the society rests upon a similar reaction. Its object is to facilitate photographic printing by rendering unnecessary the use of a superior quality of paper and other costly materials, and, above all, by dispensing with the delicate operation of fixing by means of sodium hyposulphite; for the latter is substituted a few washings in rain water.

In my experiments I use common scribbling paper, though I have no doubt that a finer quality would give better prints than those which I send to accompany this communication. I coat the paper with sesquioxide of iron rendered sensitive to light by a concentrated solution of tartaric—or, better, of citric—acid. This paper after being dried in the dark, and then exposed to the light beneath a negative, has the property of reducing a solution of silver nitrate, or of gold chloride, and of turning blue a solution of potassium ferrocyanide, in every part where the light has reduced the sesquioxide of iron to the lower oxide.

In order to obtain an even layer of the sesquioxide all over the paper, I brush the surface well over with a linen cloth dipped in a ten or twelve per cent. solution of ferric chloride, and then hang up the sheets to dry in a dark room. Next, I plunge these sheets one by one into a dish containing the liquid ammonia of commerce, so that each sheet is thoroughly wetted in succession. When a sufficient number of sheets have been immersed, I pour back into a special flask the ammonia solution, and then wash them several times in the same dish. I take them out separately, and hang them up to dry; this may be carried out even in full daylight, as the iron sesquioxide alone is not sensitive. The

* Read before the Photographic Society of France.

Menlo Park Scrapbook, Cat. 1021

No. 13. "Insulation"

This scrapbook covers the years 1873-1885 and contains clippings about insulation and insulating materials. There are 139 numbered pages.

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Tel. Journal July 1, 75

INDIA-RUBBER.

The composition of India-rubber, as determined by Dumas, is 87·2 per cent. of carbon and 12·8 of hydrogen.

In its natural state it forms part of the milky sap of various species of trees, which are to be met with in tropical regions, its synonym, caoutchouc, being derived from the caoutchouc tree, which is chiefly to be found in Central America, and was for some time the source whence the main supplies of the article were drawn. The trunk of the tree is periodically pierced—in some instances as frequently as once a fortnight—and the sap as it issues is either caught in vessels placed for the purpose, or allowed to accumulate in a hole dug round the foot of the tree. The liquid may be prepared for export in two ways. Either balls of clay are inserted into it, and then poured over a fire, until the India-rubber which they have taken up hardens, re-dipped, and have the evaporation repeated upon them, until a certain thickness is obtained; or a piece of wood is employed, around which the sap accumulates as before, which is in its turn dried after a certain volume has been secured. The purest India-rubber is prepared in the latter way. With the clay-balls, impurities in the shape of sand, pebbles, &c., are unavoidable.

The first process to which the raw material after its importation is subjected has for its object the removal of all the impurities which have become mixed with the natural gum as it ran from the parent tree. This is effected by sawing it up—after being softened by immersion in hot water—into small pieces of about an inch and a-half square, passing these betwixt two horizontal cylinders, and keeping a constant stream of water flowing upon them. The irregular sheets into which they are ultimately formed are then dried by being hung where a free circulation of air can take place.

The sheets are then kneaded and heated for the purpose of rendering them perfectly homogeneous mass. This is done by means of a horizontal cylinder, along the whole length of which some strong knives, with a series of sharp pointed teeth disposed at alternate rows. Into the free space of the cylinder the India-rubber is introduced, and the entire mass assuming a rotary motion, under the influence of these teeth, is manufactured by them until perfect homogeneity is attained. The cylinder was usually formed with a double casing, heated by steam, in order to facilitate the process of manufacture, but this is now being abandoned, as the mechanical heat developed is found of itself to be sufficient for the work. By raising the temperature too much, great danger is incurred of rendering the India-rubber soft and viscous, and thereby lowering its value for electrical purposes to a very material extent.

The last operation in preparing the pure rubber is to melt it betwixt the compressing cylinders, which are hollow, heated internally by steam pipes, and arranged horizontally in couples. From betwixt these it finally issues in the shape of a smooth compressed sheet of close, texture.

Pure India-rubber is colourless and transparent. It

But the difficulty of making a proper joint has not been surmounted.

On the other hand, vulcanized India-rubber, though not affected by temperatures like pure rubber, has a great drawback which the latter does not seem to possess. In contact with copper wire, it in time assumes a friendly useless for insulating purposes. To resist this, the copper wire is tinned before the India-rubber is wrapped around it.

Taken all in all, gutta percha seems destined to hold its own, as the insulating material in underground and submarine telegraphy for many years to come; and in our next number we shall touch briefly on its manufacture and the various properties possessed by it.

Tel. Journal Dec 15 '77

Mr. Hancock has discovered, in the course of some experiments, that vegetable tar, by the addition of the oxides of lead for in a less degree by some other substances, is almost instantly solidified, and that the solid mixture thus obtained has remarkable insulating powers. In some experiments at Silvertown, it was found that a 16 copper wire, covered with a coating of gutta-percha weighing only 40 lbs. to the mile, had its insulation thus increased nearly 200,000 per cent, and that the insulation resistance was no less than 2,800,000,000 units, an insulation sufficient for any lengths possible on the surface of the earth.

Tel. Journal Dec 15 '77

CAOUTCHOUC.—In June, 1876, the English Government sent out 50,000 seeds of the Brazilian rubber tree to India, but only 4,200 arrived there in good condition. These were sown together in a plot, and in a few days had put forth shoots eighteen inches high. A number of the best plants have been sent to Ceylon, Singapore, and Burmah, for transplantation at these places.

Tel. Journal Feb 15 '77

Tel Jour Feb 15, 77

THE SOCIETY OF TELEGRAPH ENGINEERS.

PROFESSOR ABEL'S INAUGURAL ADDRESS.

(Concluded from page 51)

In addition to his investigations into the deterioration of gutta percha, Dr. Miller carried out a series of exhaustive researches into the manufacture and behaviour of India-rubber for insulating purposes. He pointed out that mastication promoted the oxidation of India-rubber, and further experience has established the fact that in this respect the two gums—gutta-percha and India-rubber are very much alike.

The application of vulcanising to India-rubber was hailed as a most important step in submarine telegraphy; but although many chemists have made this same process of vulcanising a subject for study and investigation, it remains imperfectly understood even, to the present day. The wire manufacturer had no difficulty in most important objection urged against the application of the vulcanising process. Professor Abel then proceeded to give some interesting illustrations drawn from his own personal experience of the uncertainty of our existing knowledge regarding the chemical and other conditions to be fulfilled in the application of vulcanising processes to the preparation of telegraph cables.

A number of half-mile lengths, for instance, of vulcanised telegraph cable, manufactured by Messrs. Siemens, others coated with vulcanised India-rubber, after being immersed in water for several months or three years, a period varying from eighteen months to three years, to have undergone considerable deterioration; the dielectric in some instances had become so porous

Continued.

that even the variations in the hygroscopic condition of the atmosphere on board ship, where the wires were placed between decks, caused decided differences in the results obtained with a particular battery current ; and this circulation was not distributed uniformly over a length, the porosity in some instances exceeding along a few feet only, leaving the adjacent portions in very good condition. Such was found to be the case in a length of the cast of cable which had remained submerged in cases showed precisely similar results.

The uncertainty attaching to this was still further illustrated by the fact that in numerous cables with multiple cores of this description some of the cores remain comparatively good, whilst the insulation of others had fallen off to a very great extent.

Scarcely less conflicting is the experience gained with cables prepared according to Hooper's system. This system consists in maintaining the inner portion of the india-rubber surrounding the conductor in an unvulcanised condition by means of a "separator," which consists a preparation of a metal possessing the power of arresting the passage of the sulphur beyond a certain point, and subsequent to the application of the whole of the india-rubber compound.

The difficulties, due to the alteration of the india-rubber, being caused by oxidation, the question naturally arises as to how the oxygen finds access to it? It must evidently find access to the interior of the dielectric *through the substance of the cable*—a view which is more than confirmed by the researches of Graham. That eminent chemist showed that solid india-rubber absorbed oxygen to an extent which showed the gas to be to'ce as soluble in it as in water at the ordinary temperature, and the comparatively greater porosity of vulcanised india-rubber would favour this absorption. The solubility of unvulcanised India-rubber being once established, the tendency to the absorption of oxygen by the external vulcanised layer, and, through its passage through the latter, more rapidly by the internal, and the tendency to chemical change of, and consequent annihilation of oxygen by, the lower portion, which thus acts like the vacuum by which Graham caused air very slowly to pass in oxygen to filter through a stout vulcanised India-rubber tube.

The efforts made from time to time to improve the insulation of cables, several steps necessary only to clear the ground for future experiments, but of late important success seems to have been achieved in a direction where different experimenters (including Prof. Abel himself) had failed—that direction is towards paraffin, a substance which during the last thirty years had been put from the chemist position of a chemical curiosity to the extreme rank amongst important chemical products. Dr. Frankland Fields, F.R.S., working in conjunction with Mr. Varley, the mineralogist, produced by means of a solvent, and re-crystallizing the substances together, a block chemically compact very favourably with india-rubber and gutta-percha, and would seem likely to prove very valuable for telegraphic purposes in the future.

Prof. Abel could only allude to the importance of chemical science in the proper management of batteries, and concluded after a valuable paper read before the Society by Mr. Partridge, "On Batteries and their Employment in Telegraphy," and the instructive discussions which followed, needed only to be named. Amongst other matters of importance where the telegraph engineer might derive great benefit from the fruits of applied chemistry, were the decay and preservation of telegraph poles, the preservation of fibrous

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CAOUTCHOUC.

JUST as the world was beginning to be told that the supply of this useful material was about to become short by reason of the destruction of the tree which produced it, and the thriftlessness which failed to keep up the supply by artificial cultivation, we are also informed of the fact that an entirely new source of supply has been discovered in Burmah, in a creeping plant, whose botanical name is *Chavannesia arenderia*, of the doghane tribe, natural order, *Apocynaræ*, Lindley. The plant is very common in Burmese forests, and is cultivated by the natives on a small scale of its fruit, which is said to have an agreeable acid taste, and to mature at a season when tamarinds are scarce. Mr. G. W. Strettel, of Rangoon, has published an interesting descriptive notice on this plant. In 1850, in Mason's "Burma," it was described as yielding an excellent elastic gum, and believed to be *Echites macrophylla*, Wight. Another plant, *Amblenthera tomentosa*, in Pegu produces rubber, but far inferior, and less elastic than *C. ovalenda*. Measurements of the creepers have been made, which show the thickness of the stem at 5 to 7 years old to vary from 9 to 11 inches in circumference. Assuming the trees to be 30 feet apart, the following details given by Mr. Strettel will enable us to form a fair idea of the probable financial results. Area to be cultivated, 400 acres; trees at 30 feet by 30 feet equal per acre 48, or 19,200 creepers on 400 acres. Minimum yield of caoutchouc per annum estimated at one viss (3lbs. nett) per creeper, equal 19,200, or at £20 per 100 viss, £5,760 per annum. The cost of starting this project is trifling in the extreme. All that is necessary ought not to exceed on an average of seven eight shillings per acre per annum. After the first year the creepers will have attained a sufficient height to require little or no further attention beyond, of course, protection from fire, &c. Thus at the end of seven years the cost on 400 acres would represent £1,120. At the expiration of seven years the creepers will attain large proportions, and preparing the caoutchouc, which are estimated at 12½ per cent. of the profit. According to these figures and the present market value of the india-rubber of this creeper, the net assets of the scheme may be approximated at £3,360 per annum. The milk of this creeper appears more readily coagulates than that of the *Ficus elastica*. The leathern vessels are those that yield the inspissated milk, and when packing care should be taken not to crush the sap used. Mr. Strettel says: "The cut I adopt is in the form of an arrow, and the incisions are made on the sides of the stem. The tiers of arrows are about three feet apart, so as to prevent that the cuts do not come in a perpendicular line with those below. At the point of the arrow I attach a funnel, formed of the leaves of the plant *Pandanus*, which readily attaches itself to the tree, from the glutinous nature of the milk. Any other leaves will answer equally well, if sufficiently large and proof against cracking. The season for tapping the trees is about the end of April. Between October and March circulation is slow and milk scarce, but during the rains the milk is more aqueous, and flows more freely. Chemical tests have proved that the rubber of *C. ecalenda* is purer and better suited for purposes than that obtained from the *Ficus elastica*. —*Journal of Applied Science.*

INDIA-RUBBER CONSIDERED IN REFERENCE TO ITS APPLICATION TO TELEGRAPHY.

By THOMAS T. P. BRUCE WARREN,
Analytical Chemist to the India-rubber, Gutta-percha, and Telegraph Works Company, Limited.

(*Continued from page* 189.)

Besides the application of india-rubber as an insulator for submarine cable cores, aerial and land wires, there are many other purposes for which it is used in connection with telegraphy, and principally in its harder forms of vulcanization which are known as ebonite or vulcanite.

Ebonite is now extensively used for battery cells, and for insulating supports. In fact it is now so universally employed by the electrician that there is scarcely a piece of apparatus in which it is not employed.

Formerly it was much used for pole insulators, and covering "pins" for their support. Its use, however, for these purposes has been abandoned to a very great extent, owing to its surface becoming

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THE TELEGRAPHIC JOURNAL.

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PAPERS FOR JUNIOR STUDENTS.

The Resistance of Insulators.

The resistance of the dielectric or insulator presents some of the most important problems of electrotelegraphy, and it will be impossible that we can exhaust their application until we have attained to some acquaintance with instrumental work. But there are general principles the knowledge of which will tend to the easier understanding of what we shall presently have to say. The specific resistance of insulators varies with every variation in their composition: and as their composition is necessarily subject to many more variations than are likely

[illegible] as copper, the [illegible] ees would be of [illegible] ution in the re- [illegible] ference of age of [illegible] ivalve or temperature results [illegible] ulators to a very [illegible] tion eliminated [illegible] sources of error [illegible] or much electric [illegible] sulators or dirt [illegible] adhering to the insulator. This conduction by the surface of a body it is very difficult to avoid, and for the following reason:—There is an exceedingly large quantity of common salt (or chloride of sodium) floating about, in fine particles, in the air. The precipitation of such inside contains a large proportion of this ingredient. Now a great deal of this salt is deposited or condensed on the surface of any solid body on those amongst our students who have worked with a spectroscope will be painfully aware), and as salt is, in relation to an insulator, not much a very bad conductor, a large proportion of the electricity escapes over the surface. Glass, when thoroughly warm and dry, is a very perfect insulator, but in ordinary or moist atmospheres much of the electricity finds its way to earth, and is lost. The clumsy or vulgarly insulators of electrical instruments are very quickly covered with such a conducting film, and Mr. Varley, who has studied the subject extensively, recommends the washing of the surface of the clumsy or vulgarly with very dilute sulphuric acid, then with water, rubbing until dry, when the surface may have solid paraffin rubbed over it.

The presence of this conducting film at once explains how preferable it is to reduce the extent of surface of an insulator, on the ground that by reducing the superficial area we reduce the liability of the electricity to escape. The glass insulators of our telegraph posts are constructed on the principle of exposing as little conducting surface as possible.

It should be remembered that, although there is so much difference between what is generally termed a bad conductor and an insulator, the latter does not mean a substance giving infinite resistance, through which no electricity can pass, but simply a very bad conductor. Graphite and gas-coke are bad conductors, for their specific resistance is from 1500 to 20000 times that of pure copper. The resistance of gutta-percha, however, bears very little relation to this, as we may gather from the resistance of a cubic metre of various kinds of gutta-percha employed in the undermentioned cables:—

D. A. Table of Resistance.

Red Sea	...	...	$0{\cdot}363 \times 10^{12}$
Malta-Alexandria	...	...	$1{\cdot}230 \times 10^{12}$
Persian Gulf	...	...	$1{\cdot}800 \times 10^{12}$
Atlantic (end)	...	...	$2{\cdot}280 \times 10^{12}$
Gutta-percha, at 24° C.			$3{\cdot}330 \times 10^{12}$

For the purposes of comparison it may be stated that the British Association unit of resistance would be measured by a conductor of pure mercury, 1 sq. millim. in section and 1048 metres long at 0° C. Of course a cubic metre of copper would have so prerceptible resistance.

The most useful information we can give the student as to the nature and character of the principal insulators is to describe what they are, and, as far as known, the method of preparation.

India-rubber.—This well-known substance, sometimes called caoutchouc, is the dried juice of a tree, the trees yielding the juice being known botanically as of the orders *Urticæ*, *Euphorbiaceæ*, *Apocyneæ*, the greatest of the *Siphonia cahuca* (South America) and of the *Urceola elastica* (East Indies) being known commercially. The native incises the tree and collects the exuding juice in vessels of dried clay, whence the product takes the form known as "bottle" rubber. The juice is solidified by the application either of artificial heat or of that of the sun; in the latter case the product is known as "lard" gum or rubber. In this way we obtain the immense supply of India-rubber for our cables, the purposes of waterproofing, &c.: as much as 120,000 cwts. having been produced in 1870, 60,000 cwts. of which came from the island of Java.

Pure India-rubber is white, and, when in thin sheets, semi-transparent. Its elasticity is perfect. It is non-fibrous, but it possesses the curious property of becoming somewhat fibrous and less translucent when exceedingly stretched. It is not brittle when cold, but becomes hard; but water and steam render it soft, but it suffers no chemical change from their action.

India-rubber is soluble in—

Alcohol-free ether,
Oils of coaltar,
turpentine (with heat),
Sulphide of carbon,
Persian naphtha,
Chloroform,
Benzoline.

It is insoluble in alcohol; is not decomposed by dilute acids or strong alkalies (strong acids readily decompose it). If a piece of India-rubber be stretched and then immersed in cold water it loses some of its elasticity, which it regains when placed in water at 45° C. or 50° C., and when again chilled acts as a gas pervading high illuminating power.

The chemical formula of India-rubber is C_5H_8, and no parts of this substance contain 87·5 parts of carbon and 12·5 of hydrogen.

The electrical resistance of India-rubber decreases with increase of temperature, but not so rapidly as with gutta-percha. Under pressure the resistance increases.

Vulcanite.—India-rubber immersed in molten sulphur becomes softened to several degrees—that is to say, it is vulcanised, and remains elastic (while India-rubber is then wasted, first with a dilute solution of caustic potash, and then with water. In Hancock's method hexachloride of sulphur is substituted for the sulphide of carbon. Many other methods have been advised, but they have not met with extended use.

By THOMAS T. P. BRUCE WARREN,*
Analytical Chemist to the India-Rubber, Gutta-Percha, and Telegraph Works Company.

For all the phenomena connected with insulators, silence is not one which demands more careful consideration than the changes brought about by variation of temperature; yet I am not aware that any writer on telegraphy has devoted more than the bare space required for the enunciation of the fact that the insulation of telegraph cores is increased or diminished by the rise or fall of the thermometer.

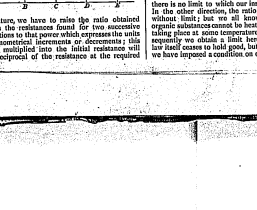
It is with the view of directing the attention of electricians and telegraphists to a few subjects in this department of the science of practical electricity, and which are but scantily dealt with, even in the print and most complete works on the matter, that I have thought the present paper a suitable one for the commencement of a series on the practical bearing which certain physical and chemical facts have upon Telegraphy.

From the circumstance that telegraph cores have a high or lower resistance according as their temperature be low or high, the lengths and thickness of the insulator remaining the same, we are necessitated to refer whatever tests are made for insulation to some fixed temperature, and for this purpose we are supplied with a table of co-efficients for this correction; so that, knowing the value of an insulating covering in megohms per nautical mile, or any similar standard length, we can ascertain what will be the effect of raising the temperature any number of degrees above that at which our observation is made, or conversely if the required temperature is below that at which our test is made.

The temperature which is now by common consent taken for this fixed reference of results is 75° F. The advantage of this temperature is, that it can always in practice be readily obtained, either for the purpose of direct observation, or for the verification of *the modulus of conversion*.

By the term *modulus of conversion*, I mean the root or radical number which expresses the ratio between the insulation resistance of any insulating covering for differences of one degree on the scale of Fahrenheit.

This modulus, from all we can tell at present, is



[illegible] structural conclusions. An extra gutta-percha [illegible] carried out [illegible] certain value, [illegible] conductors [illegible] may more on [illegible] ance of an in- [illegible] I am aware, [illegible] ig Jenkin [see Cables, &c.], [illegible] o actual pre- [illegible] Sir Charles [illegible] adian Govern- [illegible] ndian Gulf. [illegible] xamination of [illegible] mperature on [illegible] Hooper, and [illegible] to meeting of [illegible] n, in the year [illegible] this core, he [illegible] explained that [illegible] pering general [illegible] all insulators, [illegible] pleted for my [illegible] [illegible] mperature, one [illegible] es, measure on [illegible] corresponding [illegible] on the points [illegible] ders increasing [illegible] ng by dividing [illegible] erature by the [illegible] ceding or pre- [illegible] crement; con- [illegible] at any required

temperature. By this process we obtain an expression which plotted out gives a logarithmic curve.

Professor Fleeming Jenkin had before this graphically represented the effects of temperature in curves by a logarithmic curve, so that, although he did not give us a formula which admitted of general application, he at least indicated the method for its mathematical development.

A few words may be said here on the properties of this curve, and the relation of certain of its properties towards the phenomena we are now discussing.

The logarithmic curve—if on an indefinite line, AA, the parts AB, BC, CD, DE, &c., be taken equal to each other, and ordinates AF, BG, CH, &c., be drawn perpendicular to AA, and in length varying in a geometrical progression, the curve FHK, which passes through all their extremities, is called the logarithmic curve. The axis LA produced is an asymptote to the curve; for since the terms of a decreasing geometric series never can become equal to nothing, any ordinate drawn from the origin in the direction AF can never become nothing. Since, however, it becomes less and less, the curve approaches nearer and nearer to the indefinite line.

In the other direction it is also obvious that the curve may be continued *ata limite*.

To apply these considerations to the varying condition of an insulating envelope under the action of variable temperature, the initial ordinate AF may be drawn to represent either the resistance which we obtain on starting, or better still, by representing the value of this as unity make AF equal to 100 mm. if it is required to draw a large diagram. It will be necessary to keep this of small size, as, however, since its successive expansions will give dimensions far too ordinates unmanageable for a graphic illustration. We have then to draw BG, which is to represent the value at a higher temperature point. The resistance at A temperature, divided by that found at B, if this difference 1° F., is the modulus or co-efficient for 1° F., if the interval be 10° F., or any other number of degrees, will obtain the modulus for 10° F. or whatever may have been the difference in the temperatures. Multiply a this ratio into 100, and draw BG in mm. corresponding to the product; in the same way we may proceed with the results of all the observations.

In ballooning whatever low degree of temperature we may take A to represent, we can always conceive of lower ranges of temperature, consequently we can extend the ordinates on the left-hand side of our initial experiment; but however we may carry this temperature the resistance can never become absolutely perfect, for then we should obtain ordinates equal to nothing; these ordinates may become as small as we please to make them, but we can conceive of their being reduced much smaller. In the same way we may get our insulation by reduced temperatures as high as we please, but so long as we can conceive of lower temperatures so we must assume there is no limit to which our insulation can attain. In the other direction, the ratio can be expanded without limit; but we all know for certain that organic substances cannot be tested without change taking place at some temperature or another; consequently we obtain a limit here, not because the law itself ceases to hold good, but from the fact that we have imposed a condition on our insulator which

the ratio obtained between the resistances found for two successive observations to that power which expresses the units of thermometrical increments or decrements; this product multiplied into the initial resistance will be the reciprocal of the resistance at the required

* Taken from Prof. Jenkin's "Cantor Lectures."
† 10^12 should be read in words as the 12th power, that is, one with 12 noughts after it, or a million times a million.

11

Tel Jour Acc 1. '78

592. "Covering Telegraph Wires, &c." Henry Cornish (communicated by R. Weber, Weighton, Russia). Dated February 25, 1878. 2d. This consists in insulating wires, with a covering made from india-rubber or caoutchouc, dissolved by steeping bisulphuret of carbon (C S_2) over it, and is prepared in bottles with large necks, tightly stopped. The metals are sponged with this mixture, and as hone after, they are sponged repeatedly with a second solution. This solution is made by taking gutta-percha, wool, tar, and resin, and pouring bisulphuret of carbon over it, then mixing the result with the first india-rubber solution in the proportion of 4 to 1; then adding more bisulphuret of carbon. *Not proceeded with.*

"Kerite" a kind of artificial caoutchouc, is the invention of Mr. Day of New York, and is made as follows:—To produce 100 parts by weight of Kerite, 50 parts of cotton oil, and 50 parts of oil-clear are heated together in a cauldron for several hours, at a temperature of about 150° C. After this has been done, 50 parts of linseed oil, 15 parts of sulphur, and 5 of ordinary wax or of solid paraffine are added. The whole is then heated for five or six hours, at a temperature under 150° C. to prevent carbonization. It is then allowed to cool, and is moulded into blocks convenient for future purposes. The price is about 2s. 6d. per pound sterling. Mr. Day received honorable mention for Kerite insulated telegraph core, exhibited at the Paris Exhibition.

Tel Journ Aug 16. '73

3730. W. R. Lake, of the firm of Hamilton, Lake, and Co., patent agents, Southampton Buildings, London, *An improved insulating compound for telegraphic purposes.* A communication from Calmon G. Shumway, of Kenosha, Wisconsin, U. S. A. Dated December 9, 1872. This invention relates to a compositional materials producing an insulating compound by means of which a more perfect insulation of telegraphic conductors is obtained than by the ordinary methods; this compound is at the same time cheap and durable, and is not easily affected by the action of the weather. This compound is composed of one part coal-tar or its equivalent and two parts charcoal or saw-dust, tan-bark, or any other organic body having a fibre and being a poor conductor of electricity and which may be ground or cut up to mix with the tar. The coal-tar is brought to a boiling temperature, when the charcoal is introduced and thoroughly combined with it by agitating the entire mass by any mechanical means. The proportions may be varied.

3736. W. R. Lake, of London. *An Improved Insulating Compound for Telegraphic Purposes.* Dated December 9, 1872. This invention relates to a compositional material, producing an insulating compound by means of which a more perfect insulation of telegraphic conductors is obtained than by the ordinary means; this compound is at the same time cheap and durable, and is not easily affected by the action of the weather. This compound is composed of one part coal-tar or its equivalent and two parts charcoal or saw-dust, tan-bark, or any other organic body having a fibre and being a poor conductor of electricity and which may be ground or cut up to mix with the tar. The coal-tar is brought to a boiling temperature when the charcoal is introduced and thoroughly combined with it by agitating the entire mass by any mechanical means. The proportions may be varied.

Brooks' Patent Insulators not Liable to be Damaged by Lightning.

BROOKS' PATENT INSULATOR WORKS,
No. 22 South Twenty-first street,
PHILADELPHIA, Sept 29.

TO THE EDITOR OF THE TELEGRAPHER.

DEAR SIR—Of the 15th instant contains the following:—"Perhaps the gravest fault with all the wires of the Western Union Company is, that in this city were among the Brooks insulators,' and I am informed by one in an

throughout, which ought to know whereof he affirms, that the wires here never tested so satisfactorily since, from the fact that no repairs recently in the city, the 'Brooks' have not been used, for what reason I have been unable to state. The Kenosha insulators have been introduced recently on repairs here in the city. An intelligent operator of my acquaintance, who has given investigation a good deal of thought, says the Brooks is the best insulator made, that although the first cost is much more than any other insulator its insulating properties are so vastly superior to any other he has used in his fifteen years experience in line building and repairing that they are by far the cheapest insulator extant. In a letter which Mr. Brooks might remedy, an objection is that the way they are now constructed lightning leaves us through them, destroying their insulating properties of course, and it passes through the insulator in such a manner that the defect cannot be noticed by a repairer unless he climbs each pole and examines each insulator. Not being an insulation man I do not suggest a remedy, but give the information for what it is worth. Several of the Burlington and Quincy and some of the Michigan Central insulated wires are strung exclusively on Brooks' screw shank insulators, and give great satisfaction, working well in either wet or dry weather."

Your correspondent says, "The way they (the Brooks' insulators) are constructed lightning leaves us through them, destroying their insulating properties of course, and it passes through in such a manner that the defect cannot be noticed by a repairer unless he climbs each pole and examines each insulator."

THE BROOKS PATENT INSULATOR.

The advantages of this improvement in the insulation of overland lines are:—1st. It is not affected by rain or humid atmosphere; and, As a result of this quality (perfect insulation) large and expensive wire conductors are avoided; For circuits less than 300 miles in length, a wire of No. 12, or 2 B.W.G. is sufficient; For circuits varying from 300 to 500 miles, a No. 9 wire is necessary; and from 500 to 1000 miles, a No. 6, or 4 millimetres diameter—wire answers all the purposes of the larger and more expensive conductors. 2nd. Lines insulated with this Insulator are not affected inductively—a desirable quality where the double transmission system is employed. 3rd. These Insulators resist the most powerful atmospheric discharges. 4th. They are not injured by missiles. 5th. They afford a simple and secure fastening for the conductors. The foregoing qualities guaranteed.

Manufactured and for Sale by the Proprietor,

DAVID BROOKS, 722, South 21st Street, Philadelphia, U.S.A.

ALSO, BY

SIEMENS, BROS., 12, Queen Anne's Gate, London, S.W.

Le caoutchouc et la chaleur

Nous ne croyons pas sortir de notre spécialité en donnant quelques détails sur une propriété curieuse d'une substance dont l'électricien fait un usage constant.

Le professeur Tait a présenté à la Société royale d'Edimbourg quelques morceaux de caoutchouc dont M. Macfarlan de Milcham s'était servi pour isoler des fils, et qui, ayant été soumis à un allongement élastique prolongé pendant plusieurs années, avaient pris une forme définitive. Mais la faculté de reprendre la forme définitive n'avait été en quelque sorte que suspendue; car M. Maclachlan ayant on l'idée de plonger dans de l'eau chaude ces débris, on les a vus reprendre immédiatement leur forme primitive. On produisit les mêmes effets avec du caoutchouc tendu presque jusqu'à la rupture pendant qu'il était soumis à l'action de l'eau chaude et que l'on conserva ainsi tendu jusqu'à un complet refroidissement.

IMPROVED TELEGRAPH INSULATOR.

ALTHOUGH the production of an efficient form of insulators for aerial wires is a most interesting and important problem, the advances made in this branch of practical telegraphy has by no means been as great as could be wished.

The employment of a liquid repellent of moisture placed in a recess formed around the ordinary cup form of insulator, was believed, attempted some years ago; but either through the imperfect way in which the experiment was made, or in consequence of the utility of a very high standard of insulation being so apparent as it is at the present day, when economical battery power and the employment of the duplex and quadruplex systems of working are points of great importance, the idea was not carried into practice. Messrs. Johnson and Phillips, who have paid considerable attention to the production of an efficient form of insulator on the above principle, have not succeeded as to obtain patterns which have proved effective under conditions which would be fatal to those of the ordinary form.

Although these insulators require the test of continued use under conditions that exist in ordinary aerial telegraph lines, yet the success that has been obtained is so remarkable as to deserve notice.

Fig. 1, 2 and 3 show forms of these insulators.

Fig 1. This insulator is fixed above its arm or support in the manner. The lower edge of the porcelain a is turned up inward so as to form a chamber, shown at b, in which oil or some other insulating fluid is placed.

Fig. 2. In this insulator the porcelain consists of two parts, a, the head, is firmly cemented to the bolt c, which passes freely through the second part e, containing the insulating fluid b. c is held in position by the nut d, when this nut is unscrewed a may be lowered so as to expose the oil chamber b to view for the purpose of examination or for the introduction of the oil.

In both cases the insulators are easily filled with the oil or other insulating fluid by means of a long-necked oil can.

Fig. 3 shows how an ordinary porcelain insulator may have the insulating fluid principle applied to it. The cup-shaped space a is partly filled with the fluid. c is a horizontal cover resting on the insulating fluid. This cover is not fixed, but is free to move round the bolt e; a fan e, attached to the cover, causes it to rotate by the motive fluid of the action of the wind, the object being to break any spiders' webs or filaments which might cause a leakage on the surface of the insulator or its cover. Such ordinary fanning w prevents the rain from entering the oil chamber by means of the hole in the cover through which the bolt passes; it also, when properly placed, prevents the cover c from being tilted up by the wind and touching the porcelain. This form of insulator is especially adapted to districts infested with spiders or other web-spinning insects.

The following tests taken on twenty of the patent insulators and on four ordinary white porcelain insulators with a porcelain tube round each bolt speak for themselves.

The loss obtained on the four ordinary insulators is multiplied by five, to make it comparable with the twenty patent insulators, which are assumed to represent a mile of line.

The tests were taken with eighty cells, and an astatic mirror galvanometer.

The absolutely uniform insulation shown for the patent insulators is not strictly correct, but the detection obtained on them never being more than two divisions, it was impossible to detect small alterations in the insulation.

Date.	Patents.	Resistance in Megohms per mile. Old battery.	Remarks.
January 30,		about	Insulators fixed.
" 31,	4	14,000	23½ Fine morning.
February 1,	4	4	2·03 Fine rain; raining nearly all night.
" 2,	4	4	21·18 Bright morning.
" 5,	4	4	19·82 Fine; frosty.
" 6,	4	"	9·07 Dull; overcast; has rained in night.
" 7,	4	"	17·71 Dull; overcast.
" 9,	4	"	7·21 Fine, but damp, with dew.
" 10,	4	"	8·74 Overcast; windy.
" 12,	4	"	23·26 Dull; overcast.
" 13,	4	"	1·10 Shower of rain.
" 15,	4	"	10·61 Dull; overcast.
" 16,	4	"	9·03 Dull; overcast; damp.
" 17,	4	"	28·16 Overcast.
" 18,	4	"	48·98 Fine.
" 19,	4	"	5·75 Raining yesterday, and during night; snow flies.
" 21,	4	"	3·62 Dull; overcast; has been raining.
" 26,	4	"	·71 Rain and hail; strong wind; insulation was in 45 megohms shortly after rain ceased.
" 28,	4	"	1497 Fine; bright; sharp frost.

The above figures show the great effect which surface leakage has upon the insulation of an ordinary line; the test taken on February 26 when the rain was very marked, when the insulation of the ordinary line was all from 32 megohms to 1·1 megohm in a few minutes after the rain commenced. On the 26th it was equally instructive to see the rise in insulation rise, when the rain and hail ceased, and the strong wind blowing at the time dried the surface of the insulators, the change in this case took place in a few minutes.

The rain on the 26th had cleared the surface of the insulators, hence the high insulation obtained during the sharp frost on the 28th.

The tests were taken at about 7 A. M.

While all these changes were taking place in the ordinary insulators, it will be noticed that the high insulation given by the patent insulators, remained perfectly constant (as far as could be detected).

It should be noted that under the influence of frost the insulation still remained good, although it might have been expected that the coagulation of the oil would have prevented such a favorable result being obtained.—*Telegraph Journal.*

THE Western and Brazilian Telegraph Company (Limited) announce the restoration of their cable between Bahia and Rio de Janeiro, and also of the Transandine Companies' lines between Buenos Ayres and Valparaiso.

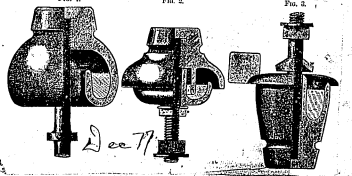


Fig. 1. Fig. 2. Fig. 3.

A NEW INSULATING STAND.

SIR WILLIAM THOMSON has frequently dwelt on the great importance of insulating, with the utmost care, any apparatus intended for researches relating to static electricity; he has shown that the atmosphere and other gases have but little effect in dissipating an electric charge, even when moist, and that it escapes mainly in consequence of the deposition of a layer of moisture upon the insulating supports which renders their surface conducting. In all Sir W. Thomson's electrometers there is an arrangement for drying the insulating surfaces by means of sulphuric acid, either free or absorbed by pumice. This method admits of very general application;—for lately, as for example apparatus constructed for the observation of atmospheric electricity, may be most perfectly insulated by supporting it on glass rods inserted in glass cylinders containing free sulphuric acid or pumice moistened with it. In order to do this the lower end of the rods must be either inserted into cylinders of lead or else fixed to the bottom of the jar by means of a substance not acted upon by sulphuric acid, for example, melted sulphur or paraffin; melted sulphur is liable, on account of its temperature, to crack the jars,

* By H. E. Roscoe, Professor of Physics, Collége de France, Paris.

URE [May 9, 1878

notwithstanding the precaution of previous heating; paraffin, on the other hand, softens in the course of time and the glass rods do not retain their vertical position. Notwithstanding these disadvantages excellent insulators may be thus constructed on occasion may require.

For experiment use it is advantageous to employ insulators specially constructed as shown in the accompanying figure; it consists of a bottle having a narrow neck,

through which passes a tubular continuation of the bottom, about 4 mm. less in diameter than the internal diameter of the neck, so as to leave a space of 2 mm. (about) between them. The top of this hollow rod is closed, in order that a brass tube may be cemented upon it, into which may be screwed any apparatus, as, for an Exner, &c., &c. In the shoulder of the bottle is a sulphuric acid may be poured, in the first instance, and renewed from time to time.

Hollow rod and the neck of the bottle is very small, the air in the bottle does not change very rapidly, and the sulphuric acid remains efficient for a long time. It is only necessary to run off a portion of it occasionally by means of a siphon, and as acid fresh; as this may be be maintained for any length of time. Moreover, for an insulator to be used occasionally, an addition is made of a vulcanized rubber cap, which slides on the glass rod to close the neck of the bottle when not in use.

A double pendulum of pith balls supported by such an apparatus maintains its divergence, after being charged with electricity, for a very long time, even in a chamber filled with an audience. One may show by a simple experiment

the great efficacy of this apparatus in comparison with insulators of glass exposed to the air, even when carefully varnished with shellac, by a pair of pith balls, suspended by a thread of cotton, is hung upon the lattice support, and the metallic foot is placed on an insulator, and connected with a charged conductor, no divergence of the pith balls occurs in the first instance, but little by little the electricity is propagated along the glass rod, and then the threads near the support begin to separate, and soon after the balls diverge and remain at a certain distance from each other.

The electrometers of Sir Wm. Thomson are sometimes so perfectly insulated that the loss of a charge of electricity does not amount to $\frac{1}{10}$th part in twenty-four hours. By means of the insulator described above, one may obtain an insulation of like order for *bodies supported in the free air*, and thus diminish to a great extent one of the chief sources of error usually met with in experimenting with static electricity.

* There may be obtained of various sizes, ree fine, lubrifiers, examiner, fine capacity, by Alvergniat Frères, 20, Rue de la Sorbonne, Paris.

BALATA, A SUBSTITUTE FOR GUTTA-PERCHA.—From a contribution of Dr. W. Riegler, in the *Wochenschrift des niederoesterreichischen Gewerbs-Vereines*, we glean the following facts relating to this new article of commerce, which bids fair to become of great importance, in view of the constantly-increasing demand for elastic gums and the rapid destruction of the trees which furnish rubber and gutta-percha.—Balata, which has only been known for a short time, is inferior in the extent of its uses to caoutchouc, but surpasses gutta-percha, and is said to have already become an important article of commerce. It is the milky sap of the bully tree that flourishes on the banks of the Orinoco and the Amazon, in South America. The operation of winning the gum is similar in every respect to that employed with caoutchouc and gutta-percha, and need not therefore be described. It resembles gutta-percha so closely in its general properties that much of it is shipped from Guiana and sold yearly for gutta-percha, although it has many points of superiority. It is tasteless, gives an agreeable odour on being warmed, may be cut like gutta-percha, is tough and leathery, is remarkably flexible, and far more elastic than gutta-percha. It becomes soft, and may be joined piece to piece, like gutta-percha, at about 120° Fahr., but requires 270° Fahr. before melting (higher than gutta percha). It is completely soluble in benzole and carbon disulphide in the cold. Turpentine dissolves it with the application of heat, while it is only partially soluble in anhydrous alcohol and ether. It becomes strongly electrified by friction, and is a better insulator of heat and electricity than gutta-percha, on which account it may find considerable application for electrical and telegraphic uses. Caustic alkalies and concentrated hydrochloric acid do not attack it, but concentrated sulphuric and nitric acid attack it as they do gutta-percha, which it closely resembles in all other properties. We have in balata, says Dr. Riegler, a body characterized not so much by the possession of new properties, but rather a new member of the group of useful elastic gums, taking rank between caoutchouc and gutta-percha, which may, under many circumstances, be found to be more valuable than either; and it is a matter of congratulation that the world has been supplied with another rapid destruction of these trees threatened to seriously diminish. Aug 78.

Gutta Percha Insulated Wires.

Clinton G. Colgate vs. The Western Union Telegraph Company.

This is an action brought by Clinton G. Colgate, as assignee of George R. Simpson, for infringement of a patent granted to Simpson, May 21, 1867, for telegraph cables insulated with gutta percha. Simpson claims to have made the invention in 1847. His final application for a patent was dated Nov. 22, 1847. This and subsequent applications were rejected, but he prosecuted until 1867, the patent was granted. Simpson assigned the patent before its issue to Dodge and Mann, and Dodge and Mann assigned to Arthur M. Eastman, and Eastman to the plaintiff, by whom the suit was brought.

Although the patent had been granted, its validity was denied by parties interested in making and using gutta-percha insulated wires, and no attempt legally to enforce it was made until the present suit against the Western Union Telegraph Company was commenced.

The case was recently tried before Judge Blatchford, in the Circuit Court of the United States for the Southern District of New York, in this city, who decided it in favor of the complainant, thus establishing the validity of the patent.

From this decision the defendant took an appeal to the Supreme Court of the United States. In the meantime the complainant applied for a perpetual injunction, restraining the defendant from using the invention.

The defendant opposed the granting of the injunction pending the appeal, on the ground that it would prove a great detriment to Government, public and private interests by stopping the transmission of messages through cables now and for many years in use by the company. It was further argued that the defendants were unpecuniarily responsible and able to respond fully for any damages that the complainant should suffer in the meantime if the final decision were in his favor. Numerous affidavits were submitted substantiating the statements of the defendant. On Jan. 5th, Judge Shiedield handed down his decision denying the injunction substantially as follows:

It sufficiently appears that at least before the time when a final decree shall be entered in the case it would not be proper to grant absolutely and unconditionally, a perpetual injunction against the further use of the gutta-percha covered wires, and that any such perpetual injunction to be granted before such final decree ought to be granted conditionally and on terms as to substituting something else for gutta percha covered wires or as to taking a license for the future use of gutta-percha covered wires. The affidavits and papers now before the Court do not enable it to determine satisfactorily what such terms should be, and it is proper that the testimony to be taken on the reference as to profits and damages should be before the Court before the question of a perpetual injunction is passed upon. But the plaintiff is entitled to a perpetual injunction against the sale by the defendant to others of any of the gutta-percha covered wires described and against the manufacture or use by the defendant of any gutta-percha covered wires or cables other than those which it now has. No security from the defendant is required, as the abundant pecuniary ability of the defendant was admitted by the plaintiff on the hearing.

WIRE INSULATING MACHINE FOR THE LATHE.

(13234.)—ALTHOUGH I designed this simple machine some years ago, I have not yet seen its use or even description, as perhaps it may interest your readers. A is a wire to be covered with gutta percha; C, rod, by winding cord with which (shown by arrow), pull, D, I suppose (as the large wheel, H, driven by another hand from the screwhead shaft),

carrying the reel of silk or other insulating material. This reel is mounted on a spindle, with a spring and cord, to regulate the tension. Nearly every part of this machine may be made of wood, and be fitted down to the bed of the lathe by a bolt.

T. D. Dale, M.S.A.

WIRE INSULATING MACHINE.

(14276.)—As some of your correspondents may not have a lathe to use with the machine proposed by E. R. Dale, (page 423, let. 13234,) I send the accompanying rough sketch of a wire insulator, taken from Routledge's "Every Boy's Annual" for 1875, trusting that it may make one they will see. Success to your paper.

Fig. 1 represents the machine. A, A pair to hold the two pulleys, B and C, the sleeve over it turns the tube, D E, through which may be seen

the copper wire C, and the reel, F on which a sufficient quantity of wire has been previously wound and placed. The end of the silk from each bobbin must be passed through the second disc, H, and is joined to the wire, and as the reel, G, gradually winds the wire off it, it pulls it through the hollow tube, D E, over the pulleys, B, and winds it on itself at the same time, the stop motion, I, preventing the bobbin from unwinding, thereby acting a tendency motion, and the silk is wound off the spools on to the wire.

Fig. 2 merely shows the way in which the bobbins are fastened to the disc; a small spiral spring prevents the bobbin turning too fast.

Xenos.

WIRE-INSULATING MACHINE.

(11038.)—In your "Ours" (dated September 25th, page 208) has replied from "Every Boy's Annual," may I warn them that the windings on reel C will not be suitable for this arrangement. The reel C is a mere bobbin, and the wire must be wound on it in a way by combining that the wire may not fall in a heap in the middle. Also, the reel C would have to be exceedingly small in diameter to admit of the first requirement, and as it gradually filled and increased in diameter the feed would accelerate in proportion, and as the revolutions of the spool also had increased in the beginning, a really very important increase would be the result. Only a very limited length of wire was to be covered.

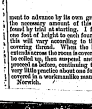
If you, Mr. Editor, think it would be worth the space in "Ours," I shall feel it a pleasure to send detailed drawing of one constructed by me a few years ago, which I think will meet the wants of our readers.

J. E. C.

WIRE-COVERING MACHINE.

(11039.)—Seeing that several notices of wire covering machines, with more inquiries for some further amount of enabling constrom to make instead of buying their insulated wire, I send you a rough-and-ready sketch of a little instrument. A correspondent sufficient for my requirements. A represents a block of wood 2 inches by 1, and 1 inch thick; B shows a piece of brass tube 1in. long; I have, the centre of the block. Right through the centre of the block and end of the tube is a brass wood plug fitting into B with a hole through its centre of each end as well enables it to revolve without shaking about the wire to be covered. Into the centre of the block at A is screwed a brass tube two inches long; this I call hole like the eye of a needle through which the thread from the reel is passed to guide it on to the wire. The reels carrying the thread are each mounted on the block by means of a pin, at which it revolves with a given to the thread by proper degree of tension, and to prevent the reel from unwinding too fast. A slip of tin-plate bent into the form of an arch, and made to press on the end of the reel in the manner shown in the sketch; or by heading these friction-springs more or less the tension can be easily regulated.

The mode of operating is as follows:—Having put the revolution on reel C, and the horizontal thickness on reel D, and fixed the end to the wall, then carry a length to the opposite side of the room, secure it there so that it forms a line stretching across the room, now pass the threads from the reels through the guide-holes and tie them to the wire, steady the wire with the left hand, and with the right turn the handle of the wheel; a couple of turns gives a twisting motion by which a rigid and continuous revolution of the instrument is easily obtained. One of the best features of this instrument is the exceedingly simple means of regulating its feed or rate of traverse along the wire so that the covering shall be even without either doublings or empty places. The rate of feed depends on the connecting rod of the wire shown fine red to which you are progressing, this causes the instru-

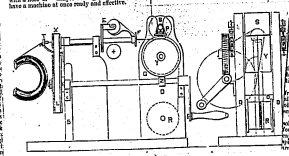


ment to advance by its own gravity as it revolves, the necessary amount of this elevation is easily found by trial at starting. I found it to be about one inch of height to each foot feet of length, but this will depend on the fineness and quality of the covering thread. When the length of wire that can conveniently run the room is covered that portion must be rolled up, then suspend another similar length, proceed as before, continuing till all is done. With very little practice about one foot per minute can be covered in a workmanlike manner.

Norwich. J. H. Cary.

HOW TO MAKE A WIRE INSULATING MACHINE.

(11005.)—By will be evident that in the construction of this machine, a lathe, a vice, and an ordinary stock of tools are necessary. With these, and a little knowledge of their use, any mechanic will find it a pleasure as they gradually advance with their work, seeing everything is so simple and easy. The first, at the finish, instead of being tempted to sell, at the finish, instead of being tempted to sell, with a host of simple mechanical movements they will have a machine at once ready and effective.



The drawing is to a scale of 1in. to the foot, and, I think, is sufficiently plain to require but little explanation. The framework is made of both batch or deal, two feet cracks and knots. Each piece should be planed on both sides, tenoned out, and mortised together, bored, morsed, and glue-pinned. The bearings should be of brass, and well oiled.

To the frame, fair and square. It is a support for standard, on which the driving shaft bracket is also fixed. Supporting the two pulleys. The following scales, S and Y, are made of gunmetal, 20in. and 6in. respectively; the lines for screws are 1in. apart, screws are of 1in. square brass; they slightly taper from the top to the bottom, and accordingly the holes are cut to split the supporting rods; small collars are then turned to proper length and thickness. The disc-spindle, K, is of 1in. hollow brass; the disc is also of brass, and soldered on. The sounds, Y, serves as a guide for the thread, and material on which to fix the speed-springs; this is made of steel, and tempered to a spring temper, should be very delicate and well tempered; they are made to press against the thread on the spool, so that the pressure is reduced as the spool continues winding a uniform drag. The worm-wheel, B, is 12in. pitch line, and has 36 teeth—an ordinary wheel could be made to suit by filing the teeth, if a worm-wheel be not to hand. The worm, A, is of steel, 1in. in length. It is screwed into hand, struck on, 3in. away be driven in to insure concentricity. This worm is keyed on. The crank handle is screwed on. The pulley, L, M, and N, are set in partial spaces, and secured with small wood washers; pulley X is driven tightly on, and fixed with the key in the disc. The pulleys are all of which the two, G, and H, are fixed on the spool, etc. and with the top part of same secured by closed hole pieces of iron, through a hole in the middle of which pass the ends, which are tightened up with thumb-nuts—very little strain is necessary to effect their purpose; they are retained in small grooves turned in the arbors. It is the bobbin which is to be the spool with it is moving round by means of the pulley, P, and the two driven into the spindle, N, and slipped into a short groove in the bobbin. A groove is made in the lower extremity of the hole in the guide, so as to admit of the spindle being drawn out, and the full bobbin removed with an empty one. The guide Y, is a piece of iron 6in. bored, bent to shape with a slot 1in. wide, and 2in. long, and fixed between two pieces of curved steel, 4in. long, the bobbin to rotate springs pressing against each other. W represents a coil of wire which is supported on a similar arrangement to that used by ordinary winding worsted. The wire should be pulled through the tube, turned over three times over the delivering roller, and held in the hand.

The driving pulleys, N and L, are 12in., and the diameter respectively; motion is communicated by a leather belt.

I shall be glad to give any further information that may be required.

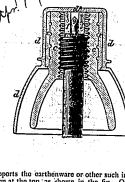
J. E. C.

OPPENHEIMER'S LIGHTNING GUARD INSULATOR.

This invention is designed to obviate the inconvenience which arises in working telegraph lines from the breakage of insulators by lightning, and a consequent making of earth contact by the conducting wires. In order to avoid this kind of fault a lightning discharger is introduced in the interior of the insulator, which is provided with a metallic covering.

The accompanying fig. shows a section of the improved insulator.

At *a* is the metallic insulator pin connected with the post, supposed in this case to be of metal, and having formed or attached thereon a screw *b* which



supports the earthenware or other such insulator *c*, open at the top, as shown in the fig. On the outside of this insulator is a metallic cup *d*, secured by means of cement *e*, and to this metallic cup the telegraph line wire is attached in the ordinary manner.

Upon the top of the insulator pin is placed a ring *f* of insulating material, and the distance to which this ring extends determines the distance between the top of *a* of the cup and an extended part *g* of the pin *a*. This distance may be varied to some extent, but that shown in the fig. which is 1 scale, may be taken as the relative standard.

By this arrangement an effective lightning discharger is obtained within the insulator, the lightning passing through the top of the cup to the pin *g*, and down thence along the pin *a*, as sketch-

(20) J. A. M. asks: Are glass insulators indispensable or not in putting up lightning rods on buildings, or need they separate the electric current? Some parties have been putting up rods here without insulators, using only strips of zinc to fasten them to walls and roofs. Our people are ignorant on the subject, and would be glad to see a full explanation in your valuable scientific journal. A. Insulators will not be needed. The rod should be fastened directly against the wall. The rod should be fastened directly against the building. But the most important precaution is to make sure that the bottom end of the rod has a large conducting surface in contact with the earth. Better have no rod than simply to strike it and a few feet down into dry earth; the proper way is to solder the bottom end of the rod to a metal water pipe or gas pipe in the ground. If there are no pipes, then make a long trench and put in some good conducting material, such as fine coal and put in some good conducting material, such as fine coal and put in some good conducting material, such as fine coal

before you we have samples of the different kinds of insulators used. The first is the cable pyramid which is composed of a very large cement in this country. The two brown earthenware ones on the lower row are also extensively used here; they were, I think, introduced by Mr. Varley about 1868.

Here is an iron-capped white porcelain insulator which is the one now largely used in England by Messrs. Johnson and Phillips. It is peculiar in this way, that between the wire and the bolt the current would have to pass through a cup which is full of oil. Oil is an capital insulator, one of the very best insulators that we have. A current in passing would have to pass through the oil which would considerably retard it, and the whole object of this the insulator is on almost perfect line. But at the present moment the practical experiences of its mechanical properties is not very satisfactory. It is still undergoing a trial, and cannot, therefore, be said yet to have been subjected to the test of time. Then we have very extensively used on the Post-Office lines, for instance, from the figures of the past three years, the average annual number of insulators used by or less here 80,000. The kind that we are now adopting is the one you see on Cochrane's Screw Insulator (Fig. 6). Its principal feature is a screw-thread on the inside of the cup. A moment of electricity has it fine over before there is escape through the bolt and pole to earth. There is its outside cup and another cup inside, inasmuch as it has been found by experience that, to insulate the insulation of a line perfect, you must keep your supports clean. Any of you who are in the habit of using the telegraph instrument will know how essential it is to wipe your pens, and keep your insulating points perfectly clean. And when you erect a line, as between London and Liverpool, and imagine that your insulators are going to keep clean for 100 miles or more, and expect to execute the same, you make a very great mistake.

The insulator is fixed to the pole by the by means of a long screw-bolt passed. It is screwed, can be cleaned, and then simply screwed on to the bolt task again, and is as good as new. So that, while the outer cup, from its large surface, has the power of insulating, the inside cup, from its position has the great advantage of being readily cleaned.

The telegraph lines of the Post-office extend, for occasionally from the breakage of insulators, caused by stone-throwing, and a large portion of the 80,000 I have just mentioned is absorbed in repairing the breakage. Stone-throwing is a thing that we have nothing to do with, and I do not know of anything more ramifying to the mind than the taking a road full of boys that to take up the line and leave a sky at one of these wilful recklessness. The result is that many insulators are broken from stone-throwing. Lightning, again, undoubtedly destroys a considerable number perhaps, not as many in England as in other countries, but, nevertheless, we do suffer to a considerable extent. (Fig. 6) is an iron-covered insulator that has been recently introduced, which also is a lightning protector. It is provided with an iron top, and the bolt screws in, so that it lodges, opposite the iron top, a piece of copper. The object of this is to prevent from insulator passing from bolt to electric worker; when it becomes charged with a little current it puts it on to the electricity which and there you have an insulator and lightning protector. It is one of the most recent inventions in the insulator, and is the invention of Mr. Appold, of the Post-office. While forms of insulators have been used and in large quantities in Australia, where they suffer from the effects of lightning, and I think it is very likely that it will be used not to other countries where similar exists.

To get at once into how essential it is to protect lines with insulators that will withstand the current, I may mention this—that one of the electric tests that we have in this country in the office is the testing of our lines in the to three storms that occur on in the winter from the south-west.

The insulator here is a variety which is said to have a double cup and a villainous climate it fits. The curious cones are also attached by the wires, for the purpose of the. They are drawn upon the rains shields of aqueous vapour. This insulator, you know, is of the kind that is known as the "petticoat" insulator, one of our little friend; it throws down in the form of a petticoat, and it is the petticoat which increases the leakage. Now, I will not for one our island that do not produce rain; but I am prepared to say that our insulators think cooling of moulders, and there are two or two days in nearly every year when the rain falls, as it were, supersaturated with moisture, which, when it comes in contact with any substance from which it is cooler by temperature, deposits the moisture upon it in the form of water, that acts as a conductor and impedes working.

We try to get our insulators to offer a resistance to the passage of the current equivalent to 100,000 miles of copper, and one megohm (or one million, which is the usual expression) is the standard of insulation that we require for a line of wire. Now, I will not for one our island that do not produce rain; but I am prepared to say that our insulators think cooling of moulders, and there are two or two days in nearly every year when the rain falls, as it were, supersaturated with moisture, which, when it comes in contact with any substance from which it is cooler by temperature, deposits the moisture upon it in the form of water, that acts as a conductor and impedes working.

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work. In very wet weather, it frequently covers down as low as 300,000m. per mile, but on the 22nd and 23rd Nov., 1877, many of our lines slotting the sea-coast fell down as low as 20,000m. per mile. The result was that there was a positive breakdown throughout the whole country. The reason was that the rain fell in such large drops that it penetrated the shed and soaked in the covering. We could trace the vapour sinking, as it were, in the South Wales district, somewhere in the neighbourhood of Neleist, and gradually proceeding on its way to England. The influence upon our wires was felt during from the central station, right across England, and extended to Ireland, and, in fact, to the Continent. It reached Paris, Berlin, and Vienna, at intervals, but there are two periods in the day at which a similar effect is experienced—viz., that is, at noon and six o'clock. Immediately before sunrise there is always a deposition of dew on our fences, and our lines test very badly, and we have a correspondingly increased number of faults caused. These two periods are manifested, and invariably, by the notice on our wires. You see, in this particular branch of insulation, experience, again, has led us to various improvements, so that, practically, with the gross-result in the days of old, the insulator of the present day stands almost perfection.

As regards the supports of these wires and insulators, experience has pointed out that, on lines of a small number, such as one or two wires, old poles in the main are sufficient. On main lines carrying a number of wires, it is necessary some-

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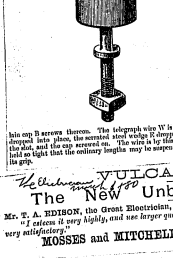
times to have as many as 21 poles per mile. In the early days the most expensive timber was used for poles. The very best Memel timber that could be procured, and creosoted, and every pole cost a large sum of money. But with experience wiser counsels prevailed, and it was found that it would be unnecessary to use creosote timber than that of the country was used, and continued to be used for many years. But it was found that these poles, in certain very moist climates of ours, very rapidly decayed, and they decayed at what is called the "wind and water mark," that is, the ground line, where the timber was in contact with the earth. There is an abnormal accumulation of moisture, heat, and cold at this point, and the growth and germination of vegetable and animal growth, and gradual decay of the timber. Despite this, wooden poles were produced in very large numbers, and, in fact, were considered the best for the road repeatable timber was used for

CROMPTON'S INSULATOR.

The insulator illustrated in the annexed Fig. 1 is of the form most used by the Postal Telegraph Department. In the porcelain cap is grooved, and the telegraph wire laid by binding wire, firmly attached to it and passing round this groove.

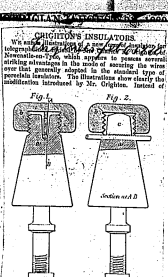
This binding takes some time, and in some districts the binding wire is rapidly corroded and the attachment destroyed. In the new insulator—the invention of Mr. C. E. Crompton of Newcastle—the porcelain cap is made in two parts, A and B, as shown in Fig. 2. The upper part of A is slotted and screwed, as shown by detached sketches, and a strong piece



loin cap B screws thereon. The telegraph wire W is simply dropped into place, the serrated steel wedge E dropped into the slot, and the cap screwed on. The wire is by this means held so tight that the ordinary lengths may be suspended by its grip.

CROMPTON'S INSULATOR

We extract the following account of the invention by Mr. Crompton of a new insulator for telegraph wires from the Newcastle-on-Tyne, which appears to possess several striking advantages in the mode of securing the wires over that generally adopted at the standard type of porcelain insulator. The illustrations show clearly the modifications introduced by Mr. Crompton. Instead of



securing the line wire by a binding wire passing round a groove in the insulator and wrapped around the line as usual, the line wire passes through a slot formed in the top of the insulator, and is held in place by a serrated steel wedge, which is pressed firmly upon the line wire by the cap which is screwed down tightly on the top of the insulator. It is believed that the device has been favourably considered by the Post Office authorities, who have adopted it experimentally on the line between Newcastle and Sunderland, with a view to subsequent extension if the present trials prove satisfactory.

RESISTANCE OF TOUGHENED GLASS.

—M. Decretet finds that toughened glass opposes a much greater resistance to passage of electricity than ordinary glass, and he has employed it in the construction of Leyden jars, which may be more highly charged than the common sort. M. Becquerel points out that this fact may be of some electrical value as leading to the construction of extremely thin condensers, giving great effects. Perhaps the glass will be found suitable to take the place of mica sheets in the construction of fine

Electrician 4-20-1880

VULCANISED FIBRE.
The New Unbreakable Non-Conductor.
MR. T. A. EDISON, the Great Electrician, says of it:
"I esteem it very highly, and use larger quantities of it than of Vulcanised Rubber, and in its present condition find it very satisfactory."
MOSSES and MITCHELL, Sole Agents, 62, Queen Victoria Street, E.C.

ENGINEERING.

FRIDAY, MAY 21, 1880.

THE DURABILITY OF GUTTA PERCHA.

There are not many raw materials which have had a history so curious and important as gutta percha. Light on the English doctor, who while travelling in the Indian Archipelago in 1843, first observed its material to be the gum of an aboriginal axe-handle, dream that in the short space of twenty years it would become the means of enabling the old world to communicate with the new by means of the Atlantic telegraph, that highest triumph of human science.

It is perhaps not generally known that the probable value of gutta percha for telegraphic purposes was first suggested by Dr. C. W. Siemens, who happened to be present at a meeting of the Society of Arts in 1845, when it was first brought to England, and he despatched a sample of it to his brother, Dr. Werner Siemens, of Berlin, to get its electric qualities thoroughly tested by the rude methods then available. About the same time Faraday examined the substance, which as our readers are doubtless aware is the juice or gum of the Isonandra tree. Faraday found it to possess excellent insulating properties, while its readiness to melt at a comparatively low temperature, and its pliability and consistency when cool, marked it out as an insulator for telegraph wires laid either under ground or under water.

It was soon found however that the exposed surface of gutta percha covered wires laid under water became soft and gummy. Moreover, underground wires were subject to decay and consequent loss of insulation, especially in the neighbourhood of oak trees; and a fungus was observed to make its appearance on these defective places, the probability being that the fungus and the decay proceeded from the same cause. The experience of cities showed that wherever the gutta percha covered wire is exposed to the air or moisture, and to changes of temperature, as at the joint-boxes for example, it is liable to decay; and hence it is the practice now to make joint-boxes as hermetically as possible. Lightning, too, is a frequent source of damage in underground wires, connecting aërial lines to offices; and in order to prevent its disastrous lightning guards are inserted at the junction of the overhead and underground wires.

Rats, mice, and "earth small deer" are in the habit of nibbling the gutta percha wires when they get into the pipes containing the latter; but quite recently a far more dangerous enemy, in the person of a minute insect, has been detected by Mr. W. H. Preece, chief electrician to the Post Office, as was recounted by him at a recent meeting of the Society of Telegraph Engineers.

For some time past the underground wires have failed in certain localities, for instance, London, South Wales between Chester and Holyhead, Dublin, and most Manchester. On examining the faulty wire, Mr. Preece found it beset by a small white insect scarcely visible to the naked eye; but which, under the microscope, very closely resembled a tiny white ant. Being provided with a kind of leaping pole or spring under the abdomen, it is able to spring about in the freely manner characteristic of its more civilised congener. Mr. Preece submitted one of these creatures for examination to Sir John Lubbock, an eminent authority in such matters, and he at once pronounced it a Termitoid, or pseudatlus, belonging to the Proderm family. This family is well-known to microscopists; since a black member of it, the water-flea, sometimes seen leaping about on roadway pools after rain, usually furnishes them with the entire which are employed as a test of the magnifying power of the microscope. Indeed the very insect in question, the crystallina variety, is a still more delicate test of microscopic powers. It is found abundantly in Kent, as Mr. Latimer Clark informed the meeting, and ordinarily lives on decaying vegetable matter, such as old leaves.

The fact that the Termitoma's organisms injure the wire at faulty places is not the only reason for believing these insects to be the cause of the faults. Examination of the wire shows it to be all bitten. Examination of the wire shows it to be all bitten and nibbled away wherever it lay exposed to their attack, and on the other hand the interstices of the wire, where it rested on the pipe containing it, is found to be untouched. Moreover, the body of the little animal is quite transparent, and it is, therefore, impossible to see the dark crumbs of gutta percha, or what seems to be gutta percha, lying in its stomach.

Fortunately the places affected by the Termitoma are as yet few and far between, and therefore it will be expedient to provide a means of stopping the ravages of the animal in future; and it may, therefore be necessary to cause the wire in a pipe of lead. Perhaps there is some truth in the suggestion of Mr. Truman that the previous decay of the gutta percha from exposure to the air or other causes incited the insect in the first place to eat it, and that were this primary cause removed the Termitoma would cease to molest the wire.

Gutta percha is so valuable in the arts, especially telegraphy, that, as the supply is ever getting scarcer, it is highly important to find means of preserving it from decay. Why it should decay on exposure to the air is not yet well understood; but it appears to suffer from oxidation. In chemical consolidation it is a hydro-carbon (85 per cent. carbon, 12 per cent. hydrogen) containing very small percentages of oxygen, resin, and impurities. For years past it has been engaged in studying the causes of its deterioration, and he appears to have solved the problem it has, for he hinted in the discussion following Mr. Preece's paper that though not at liberty to reveal the matter then, he would make bold to say that very soon we should know the

wire with clean unspun cotton be put, and insulating it in an iron tube which is kept full of purified paraffine oil by means of reservoirs giving a pressure sufficient to keep out moisture, for the oil alone will not do so. In order to get good insulation the joint should be free from vegetable acids and the oil from moisture. The wire is now largely employed by the Western Union Telegraph Company of America, for telephone and other lines underground, as laid along the road. In the latter case the wires are enclosed in lead pipes, and deposited out of sight, thus obviating the use of unsightly poles and iron wires. The insulation resistance of the wires is about 200 megohms per mile at a temperature of 100 deg. Fahr. These facts were communicated to the meeting by Mr. Brookes himself, who is now in Europe trying his system in Brussels and Paris. In the course of his remarks he mentioned a curious fact which ought not to be omitted. It is that in working these telephonic lines, centring in telephone exchanges, the induction noises so troublesome in telephony, are found to diminish the greater the number of lines in operation. That is to say, if of the total number of lines proceeding from the exchange only two are connected to the earth, and working, the induction will be far greater than if the whole lot were connected to earth for use.

IMPROVED INSULATOR.

This insulator illustrated is of the form most used by the Postal Telegraph Department in England. In this the porcelain cap is grooved, and the telegraph wire held by binding wire firmly attached to it and passing round this groove.

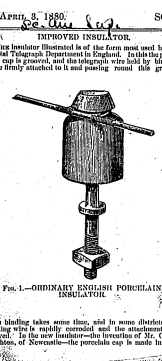


FIG. 1.—ORDINARY ENGLISH PORCELAIN INSULATOR.

This binding takes some time, and in some districts the binding wire is rapidly corroded and the attachment destroyed. In the new insulator—the invention of Mr. C. E. Crichton, of Newcastle—the porcelain cap is made in two

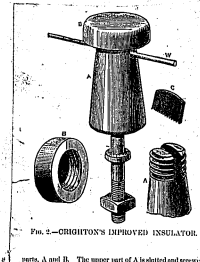
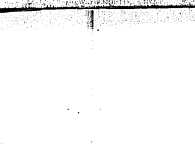


FIG. 2.—CRICHTON'S IMPROVED INSULATOR.

parts, A and B. The upper part of A is slotted and screwed, as shown by detached sketches, and a strong porcelain cap, B, screws thereon. The telegraph wire, W, is simply dropped into place, the central oval wedge, E, dropped into



Section at A B

FIG. 3.

the slot, and the cap screwed in. The wire is by this means held so tight that the ordinary lengths may be suspended by its grip.

INSULATING MATERIALS.

Aug. 15, 1857. W. Thomson

PERHAPS less progress has been made in the invention of insulating materials than in any other branch of telegraphy. Plenty of skill and science has been brought to bear upon the subject, as numerous patents of wonderful and fearful compounds testify; but the evidence of the work done in this direction has yet to be seen. Certain it is, that of all the products which have been invented, and which their inventors have felt confidence in, not one has been able to compete, with anything like success, with either gutta-percha or india-rubber, especially with the former.

Ever since its first discovery, gutta-percha has continued to prove the very best of all insulating materials in every respect, that is, both mechanically and electrically, whilst its durability for a lengthened period, under ordinary circumstances, is unquestionable.

The enormous quantities of gutta-percha which have been consumed for telegraphic purposes have naturally caused the price to increase considerably, whilst the manner in which the raw material is obtained, without thought of the scarcity which may ensue from the destruction of the trees from which the substance is drawn, is likely to cause the price to go still higher. It is possible that a systematic cultivation of the trees from which the percha is obtained may be attempted at some future date, to the great improvement of the quality of the raw material, but it would take years for all the degruation done to be repaired.

A great question of the day is cheap telegraphy, and the questions involved in enabling this desideratum to be effectually carried out are very numerous. Fast speed telegraphy is one of these. The latter question has been practically solved as regards atrial land lines; there is no difficulty in getting an amount of work out of a single land line which could only be carried on by several cables worked at the ordinary slow speed. In the case of adrial lines inductive embarrassment is but slightly felt; in the case of cables it is the one cause which keeps down the speed, and as far as can be seen, it can only be got over by an increased thickness of dielectric. This latter means greatly increased cost, and the high price of gutta-percha would be a great stumbling-block if the question of manufacturing a cable capable of a high speed of working were considered. The numerous experiments which have been made with the object of finding a cheap substitute for gutta-percha have been so unsuccessful that the public would look with great distrust upon any attempt to construct a long ocean cable of any new and, to a great extent, unproved material, even though the possible advantages were considered to be ever so great. Such an attempt, although possibly a success, would have very great chances of turning out a costly failure, in which most, if not all, of the capital invested would be lost. For underground work some new and cheap insulating material would have very much better chances of success, and, as there is an unquestionable tendency to abandon open in favour of underground wires, a really good and cheap material would prove a very profitable invention to the discoverer.

As regards the insulating property of the material for coating wires, we are inclined to think that a great deal too much importance is attached to the high degree of insulation which the substance is required to have; an insulation of 100 megohms per mile is amply sufficient for cables of a moderate length, provided this comparatively low value is due to the nature of the material and not to a defect in it. A cable with an insulation of 1,000 megohms per knot is, as regards its working capabilities, no better than one which has an insulation resistance of only 100 megohms per knot, but to such a degree of perfection has the manufacture of the insulating material been brought that the fact of the insulation being low is a conclusive proof of a defect. If a durable, sound, and cheap dielectric were discovered whose insulating properties were only a tenth of that possessed by gutta-percha, but yet whose mechanical strength was equal to the latter substance, it would be a very great mistake to reject it because it does not possess the property of very high insulation, since this is really of no practical value.

CANTOR LECTURES.*

13

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS DOLAB, F.C.S.

LECTURE I.—DELIVERED FEBRUARY 2, 1880.

Sources of India rubber—Chemical and Physical Properties—Behaviour with Chemical Re-agents—Action of various Solvents—Effects of Heat, Cold, and Light.

India rubber or caoutchouc possesses properties so widely different from those of most other substances, that it became an object of very great interest as soon as it made its appearance in the civilised world, and its industrial importance has rapidly increased as the knowledge of its remarkable characters and manifold applicability has become more extended. At the present time, caoutchouc holds such an important position with to regard the economy of modern arts and manufactures, that were it suddenly to be withdrawn from circulation, many minor industries would in consequence cease to exist; while numerous large and important branches of handicraft would languish until arrangements could be made to adapt their operations to the altered circumstances.

It is, however, during the last forty years that india rubber has enjoyed its greatest triumphs as an industrial agent; that is to say, since the art of vulcanisation was discovered and perfected by the labours of Charles Goodyear, Thomas Hancock, and others.

The earliest rumour of the existence of caoutchouc reached Europe nearly 300 years ago; the first visit of Columbus to Hayti having brought to light the fact that the natives of this island were in the habit of making playing balls of an elastic gum. Nothing more appears to have been heard of india rubber until Torquemada, rather over 200 years ago, described the Mexican Indians as not only making playing balls of india rubber, but also as fabricating helmets, shoes, waterproof fabrics and other articles of elastic gum. This writer gives some details as to the collection of the juice and the making of various articles from it, thus giving us the first view of the india rubber manufacture as a branch of industry. We do not hear, however, of samples of india rubber reaching Europe until long after this, and little more appears to have been learned regarding the substance until the celebrated French naturalist, La Condamine, made a communication to the Academy of Sciences at Paris concerning caoutchouc, he having had ample opportunities of studying the subject in Para. In the memoir in question La Condamine gives very detailed particulars regarding the Para india rubber tree, the collection and treatment of the juice, and the methods made use of by the natives for the production of various articles of caoutchouc. He tells us that the substance in question was used for making torches, these being only an inch and a half in diameter by two feet long, and yet burning for 12 hours. Again, we hear of the use of india rubber for the making of playing balls, and it appears that the natives were in the habit of using enema or injection bottles made of caoutchouc.

Soon after La Condamine's communication to the Academy of Sciences samples of india rubber frequently reached Europe, and scientific men began to make investigations regarding this remarkable body. Between 1760 and 1770 we find Fermond and Macquer studying the subject, and the last-named investigator made tubes and other articles of caoutchouc by dissolving it in ether and coating moulds with the solution, so that a solid skin of caoutchouc should remain adherent to the mould on the evaporation of the solvent.

FIG. 1.

HEVEA GUIANENSIS.

From this time until the end of the eighteenth century the india rubber industry way to considered to have been undergoing its period of gestation, and to have been born with the dawn of the present century. Among the first of the important patents regarding the utilisation of caoutchouc, is that granted in 1823 to Charles Macintosh, for dissolving the substance in coal oil, or coal naphtha, and the use of this solution as a waterproofing agent. I have here a specimen of such a solution, as now manufactured by Messrs. C. Macintosh and Co., of Manchester, together with some examples illustrating its uses.

About the same time elastic webbing was first made with threads, cut from the raw rubber, and other minor applications of caoutchouc to the industrial arts were adopted from time to time, until the great discovery of vulcanisation inaugurated a new epoch in this branch of industry; rendering it possible to so far alter caoutchouc as to make it capable of resisting to a great extent the action of heat on the one hand and cold on the other hand.

The milky sap of many plants contains caoutchouc, suspended in the form of minute transparent globules, these being frequently as small as $\frac{1}{2000}$ to $\frac{1}{4000}$ of an inch in diameter; but comparatively few plants contain sufficient caoutchouc to render them important sources of this body. The trees which yield the largest supply of the best quality of caoutchouc, consist of various species of hevea, which flourish in the northern districts of South America, especially in the province of Para, some portions of the valley of the Amazon being crowded to an extraordinary extent with heveæ. The abundance of the india rubber trees in Para may be judged of by the fact that this province alone exported 7,240 tons of caoutchouc in the year 1877; more than half of this being sent to Liverpool.

Among the heveæ most productive of caoutchouc may be mentioned the *Hevea brasiliensis*, which flourishes in Para, and yields some of the finest caoutchouc, and often attains a height of 50 to 70 feet, with a diameter of nearly three feet; the Hevea

* Reprinted by permission from the *Journal of the Society of Arts*.

As a rubber-producing tree, the *Ficus elastica* stands next in importance of the hevea. The *Ficus elastica* grows abundantly in India and the East Indian Islands, one district in Assam, thirty miles long by eight miles wide, being said to contain 42,000 trees, many of them attaining a height of a hundred feet. This tree also grows freely in Madagascar, and it is well known to us as a greenhouse plant. The slide now projected on the screen represents the *Ficus elastica* in its native regions; and I will next show you one illustrating a *Ficus elastica* now growing out of doors in the Parc Monceau at Paris. (Fig. 4.)

The juice of the *Ficus elastica* contains notably less caoutchouc than that of the American trees, the proportion very often falling as low as 10 per cent. of the juice.

A vine-like plant, the *Urceola elastica*, which grows abundantly in Madagascar, Borneo, Singapore, Sumatra, Penang, and other places, yields a considerable amount of caoutchouc of very good quality, and you will find specimens of the substance from these districts on the table.

Africa yields a considerable quantity of caoutchouc, but generally soft and of inferior quality. It is believed to be yielded by various species of lumolophia, ficus, and toxicophlea. Here are some specimens of African rubber. This specimen, representing the quality known as African ball, being tolerably firm in consistency, while the *African Bake*, which you see here, and the African tongue represent the lowest and most viscous qualities of commercial rubber. In order that you may compare the two extreme of quality, I will hand round a specimen of fine Para together with a piece of African tongue.

The commercial value of the various qualities of rubber may be estimated, to a certain extent, by noting the loss which the samples undergo during the operation of washing, which operation will be described in the next lecture; and also by noticing how far the various samples are softened by a long continued gentle heat. Here are some samples which have been heated for some hours in thin water oven; you will notice that the African tongue has become almost as soft as treacle, while the Para rubber still retains its form, and much of its consistency. The purification of caoutchouc will be considered next week, but your attention will now be called to the properties of pure caoutchouc.

Caoutchouc is nearly colourless, and when in thin leaves tolerably transparent. It, like very many other substances, contains nothing but carbon and hydrogen, but its properties differ very widely from those of other hydro-carbons almost identical in composition. It has been found to contain, in one hundred parts, 12·5 of hydrogen and 87·5 of carbon. Caoutchouc, as might be supposed, burns very readily and leaves no residue; if I set fire to a few ounces, you see how it blazes up. It is soft, and very imperfectly elastic, in the true sense of the term; that is to say, it does not return to its old dimensions after having been considerably stretched. Here is a strip of pure (i.e., unvulcanised) caoutchouc a foot long; you see that I have stretched for seconds, I relax it. It now measures, as you see, several inches over the foot. The elasticity of caoutchouc may be enormously increased by vulcanisation, as I will illustrate to you in future lectures.

(TO BE CONTINUED.)

CANTOR LECTURES.*

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Soon after La Condamine's communication to the Academy of Sciences samples of India rubber frequently reached Europe, and scientific men began to make investigations regarding this remarkable body. Between 1760 and 1770 we find Fresneau and Macquer studying the subject, and the last-named investigator made tubes and other articles of caoutchouc by *dissolving* it in ether and coating moulds with the solution, so that a solid layer of caoutchouc should remain adherent to the mould on the evaporation of the solvent.

Fig. 1.

HEVEA GUIANENSIS.

From this time until the end of the eighteenth century the India rubber industry may be considered to have been undergoing a period of gestation, and to have been busily engaged in the important patents regarding the dissolution of caoutchouc in that year by Charles Macintosh, for dissolving the substances in coal oil, or coal naphtha, and the use of this solution as a waterproofing agent. I have here a specimen of such a solution, as new manufactured by Messrs. C. Macintosh and Co., of Manchester, together with some examples illustrating its use.

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Abstract from the Journal of the Society of Arts.

CORRESPONDENCE.

EARTH CURRENTS AND SUN SPOTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR,—One of the most interesting and, perhaps, difficult studies of the present time is that of earth currents. Much attention has been paid upon the subject, but beyond the fact that sun spots are related to the probability that they have the power to affect the earth in a manner as yet unknown, nothing known concerning it. Theories have been started and continually dropped, as in vogue for a time, and then forgotten. Numerous calculations with the varying periods of sun spots, and various instance, meteorological disturbances, magnetic and electric, for to sudden faultless, epidemics, railway accidents, and the price of Consols!

Although unable to express an opinion upon the effect of sun spots upon most of these, some years ago I was regard to earth disturbances, but which I have enjoyed a much regard to earth acquaintance during the last fifteen years, may not be lost. Although I have been suggested by some and accepted by others that in past years earth current forces of considerable power have been themselves during the periods of maximum sun spot periods, as in solenoid during the years of minimum spots, but so far as I am able to trace, we have as yet no sufficiently ascertained facts to settle the question. Nor does there appear to be extant the necessary data for arriving at anything decisive one way or another. Certainly at intervals all along the years 1864-5-6 and 7, and again in 1872 and 73, many earth current storms of greater or less magnitude came directly under my own notice, but in some instances I have found earth current which appeared were proved to be entirely current from other lines, while, in other instances the presumed earth currents were probably of an insane origin; nor will this be surprising to telegraph engineers of the earlier days when the then leaky state of the wires is remembered. There is another feature, however, not to be overlooked as regards earth current data for the past. To many the earth current had no existence until it became strong enough to deflect the comparatively heavy needles of the then in use, and only questionable records of such deflections have been the chief source of information and the basis of conjecture and theory. The general result of the writer's nearly continuous observations over earth currents tends to warrant the presumption that sun spots do exert an influence upon

Waterproofing Boots.—One quart of boiled linseed oil, four ounces of mutton suet, one ounce and a half of beeswax, and one ounce of resin are melted together, and applied while the ingredients are still hot.

Engineering & Mining Journal

A New Method of Insulating Wire.—Preparations have been recently completed by a new concern in this city, the Triplex Insulated Wire and Rubber Company, to manufacture insulated wire for underground and other telegraph, telephone, and other conductors. Samples which we have carefully examined prove that the system comprised avoids the serious drawbacks hastily raised against some of the insulating devices now in use, and gives promise of obtaining a wide field of usefulness. Briefly, the principal troubles experienced in connection with the most popular methods have been that the insulating material becomes too brittle in cold weather, making it liable to flake off, and too soft in hot days. Some kinds also do not adhere to the wire, and so separate from it easily. The Triplex Company ties the wire, covers it with a layer of soft rubber, around which a strip of corked linen is wrapped, and which in turn is covered by an outer layer of thick hard rubber. For underground wires, another layer is added. The process of manufacture of the insulated wire is very simple, all the layers being put on in one operation by means of machinery, thus making it possible to furnish a comparatively cheap article. The wire is fed from a reel into a groove cut upon two steel rollers heated with steam, and simultaneously two strips of soft rubber, each more than covering one half of the wire. The excess of rubber is stripped off. The coated wire is then automatically wrapped with corked linen strips, and is carried to a second set of rolls, where two strips of hard rubber are rolled around it to a third coating. In this the central position of the wire in the insulating material is always secured, a matter in which other methods are not so successful.

...sold is ... strokes from below with a wooden hammer. To prevent ... sand from falling upon the rails, the sliding carriage, B, is provided with the box, S. During its upward movement ... the carriage is separated from this box, but by means of the ... bracket, T, it is united with it again when the carriage ... moves downward.

...s this ... To render the task of filling the casting box with sand ...ding easy, a box which holds a great quantity of sand and moves ...sprint upon rails is placed in front of the frame. When a mould ... is under pressure this sand box is removed. As often as a ...s acts new casting box is placed in the machine the dividing car- ...as the riage, B, is moved forward till plate, E, is lifted up and ...hered placed immediately upon the casting box. The sand from ...ed by the carriage can then be introduced between casting boxes ...etched and the surface equalized. The surplus of sand is removed ...ng into through the channel, V, into the chest, W, which rests ...equir- on the floor.

...upon This machine is equally convenient for the moulding of ...of the large and small objects. To be able to use it to the greatest ...power advantage, it is necessary to employ simultaneously the ...ave to use of two casting tubs (the lower mould, the other for cast- ...asted ing the upper one). Both tubs are then compressed ...ed, as against each other in a rigid central apparatus of special ...simple construction with which the machine is furnished.

...that a Objects founded in these moulds are free from faults and ...refract entirely all requirements. The machine itself can be easily ...ke, as managed; a single workman can handle it.

...ay be ...stored ...of the ...vapor

GUTTA PERCHA IN TELEGRAPHY.

By W. H. Preece.

...on the ... During the past few years we have been very much dis- ...ences, turbed by a peculiar decay of gutta percha, which has been ...g car- rather difficult to account for. Every one knows that gutta percha is a gum obtained by a tree found in the Indian Archipelago, especially in the Jaconsdra parka. This gum is a compound of carbon and hydrogen, containing about 86 per cent. of the former and 15 per cent. of the latter. But in commerce found in a pure state, and we have the material mixed with oxygen and water, manufacturing processes those impurities are removed, and others are absorbed which tend to its preservation. It is curious to note that water and is a benefit, or identical to its chemical construction, with gum is benzole, or identical to its chemical construction, ...N of the with oil of turpentine and other compounds of that class; ...Ingalls, but well known as it is to the telegraph engineer, it is quite ...ngton a child among the materials applied to science.

...Ghosts ... About 1842 Dr. Montgomerie, in the lands of a ...ed the our- native, in one of the islands of the Indian Archipelago, the ...ch by the results of a very peculiar material, ...become which he was told became plastic in warm water, and cap- ...ed to a able of being moulded to any shape. He brought a speci- ...a few men of it to England, and in 1843 brought it before a meeting of the Society of Arts, at which Dr. Siemens was present. The idea was at once suggested to Dr. Siemens that such material had a commercial value for telegraphic purposes. Experiments were made with it by Dr. Werner Siemens, in Berlin, and Faraday pronounced it as possessing electrical qualities of a high order, and a company was formed for bringing it into the market, since when it has been used in almost every conceivable form for electric and other purposes. I need not dwell on its application; my present object is to bring out its durability and behavior when applied to underground wires.

The gum is soluble in olive oil, benzine, turpentine, and other such spirits; it is attacked by ozone, creosote, and liquids of that kind. In combines with oxygen, and undergoes the ordinary process of rust, which proceeds with great alacrity in air, especially when also subjected to the influence of light. This combination by oxygen is also assisted by intermittent exposure to moisture. In process of manufacture gutta percha becomes mechanically united with water, which evaporates on exposure to variations of temperature, and leaves the gum remaining in a dry and brittle condition. This condition led Mr. Edwin Clark to coat gutta percha with tape saturated with tar, in the belief that the tar would replace the water and keep the gum in its elastic state; but, unfortunately, tar contains creosote, which acts on gutta percha in a deteriorating manner, and so the evil remained.

In the years 1852-3-4, a great quantity of gutta percha core was laid down, and some of the gentlemen now present had the responsibility and management of the work. Those wires deteriorated, and among the many causes of deterioration was one frequently brought forward for discussion before the Institution of Civil Engineers, viz., the growth of fungus upon the gutta percha wires. Mr. Highton, an old telegraph engineer, who is no longer with us, found that the wires speedily decayed between London and Manchester, especially among the coal of salt rock; and in such places a peculiar fungus, the condition of a fungus was always present, and of which I hope to say more as an active agent in the decay of gutta percha. I have reason to believe, and will presently show you why, that Mr. Highton was not quite right in his supposition. In all systems of underground wires it has been found that gutta percha wire decays in the neighborhood of joint boxes. In all cases where attacks the gutta percha core, there also the rust has led to the position, not unnecessarily followed in the streets but as near as possible, so far as possible, hermetically sealing the joint boxes and enclosing the air.

Another agent in the destruction of underground wires is lightning, or the induced currents caused by lightning. The connecting wires between the Central Telegraph Station in London and the various railway stations are laid underground, and, when a current is sent, or by lightning induced, the conventional wire to find "earth," if a weak

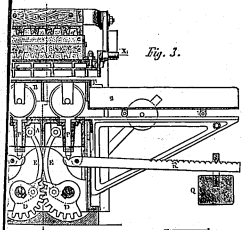
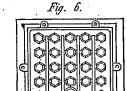


Fig. 3.

Fig. 5.

Fig. 6.



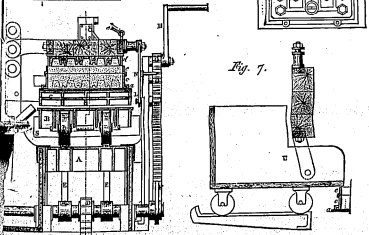


Fig. 7.

IMPROVED MOULDING MACHINE.

CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 231.)

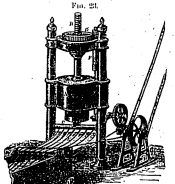
LECTURE IV.—DELIVERED FEBRUARY 23, 1880.

Special applications of Vulcanised India Rubber. Mechanical and Engineering Applications. Surgical Uses. India Rubber Steam or Streetcycles. Vulcanised Caoutchouc in The Dwelling House, the Garden, Children's Play room, and the Printing office.

Few materials have received such numerous applications in the industrial arts as vulcanised caoutchouc; and, in many instances, the applications of india rubber are of considerable commercial importance. So various, indeed, are the uses to which this material is applied, that the mere reading of a list of its applications would occupy much more than the hour allotted for this lecture—as a rough estimate, I should say it would take just about two hours and three-quarters—but I will not do it, but will rather call your attention to a few matters which either are of special interest or happen to present themselves to me to-night.

A pad of india rubber has a remarkable effect in deadening vibration or recoil, and a slab or sheet about an inch thick is a useful thing to place underneath an anvil, in order to reduce the the noise arising from hammering thereon. Again, you know that railway-carriage buffers work against blocks of caoutchouc, these having a remarkable effect in reducing the destructive action arising from the jarring and striking of the carriages against each other. In the case of rubber intended for such purposes, there is, generally, no disadvantage in somewhat hardening the material, by admixture with either one of the inert powders already referred to as being suitable for lowering the quality of vulcanised rubber.

FIG. 23.



APPARATUS FOR MAKING THREADS BY THE PROCESS OF SQUIRTING.

Here, among the articles lent by the Silvertown Company, is an arrangement for breaking the recoil of an ordinary shoulder rubber, and is intended to be attached to that part of the gun which is placed next to the shoulder.

The production of threads of caoutchouc by the process of squirting, is one of considerable interest, and I can be illustrated to you in a very simple manner. Here is a metal squirt, and I will fill it with caoutchouc which has been softened by means of a small proportion of benzole. The beak of the apparatus being placed in the focus of the lantern lens, you see that a magnified image is projected on the screen. The piston being now forced into the cylinder, the softened rubber is driven out in the form of a cord or thread, which easily descends from the mouth of the squirt; but owing to the inverting action of the lens, it appears to ascend on the screen. The threads thus formed must be exposed to the air, in order that all traces of benzole may evaporate, after which they may be cured in any of the usual ways.

The drawing now projected on the screen (Fig. 23) represents an arrangement for the production of threads by the process of squirting. a represents the main cylinder of the apparatus; while r is the rod attached to a piston which fits into this cylinder. The piston is forced down by the gearing represented towards the right of the figure, and in the lower part of the cylinder a series of fine-wire gauze strainers is fitted, in order to remove any solid impurities which may be present in the caoutchouc paste. The pressure of the piston next forces the india rubber into a horizontal tube, marked c, the lower part of which is perforated by a series of holes, out of which the material emulges, forming a row of threads, these being then led forward by an endless band of velvet, E. The threads next pass into a trough, b, which contains running water; whence they are afterwards carried by a long endless band of calico or linen, on which they become sufficiently dry to be wound on bobbins, a little French chalk being made use of to prevent adhesion.

Washers and circular valves are also employed for many purposes, and these may be cut out of the mixed rubber sheet, or they may be moulded out of the mixed rubber. In other cases they can be imbedded in French chalk during the process of curing by steam, or they may be cured in moulds, brass, tinned, or iron, being a very general material for these. The merest trace of oil on the surface of the mould prevents any adhesion to it during the curing process. It may be premised that it is generally necessary to support articles of mixed rubber during the process of curing by heat, as the material softens very considerably before the true curing action steps in. Sheets are generally supported by being wound on a drum together with a cloth, and are then cured in water, while many small articles may be conveniently cured in moulds made of baked clay or shot; these being cheaper and more easily made than metal moulds. It often happens that it is more convenient to cut small washers and discs from the vulcanised sheets, although this course naturally involves some waste of material.

The firms which were mentioned at the last lecture have placed at my disposal the extensive series of specimens illustrating the above-mentioned uses of india rubber, and you can examine them for yourself after the lecture.

FIGS. 24 AND 25.

The manufacture of the various kinds of tubing forms a very important part of the rubber industry. The usual manner of fabricating tubing is to cut the mixed rubber sheet in such a way that, when the edges are put together, no ridge shall be left presenting on the inside or outside of the tube, a matter which is very well illustrated by the diagrams which will be immediately projected on the screen (Figs. 24 and 25.)

A strip of the softened mixed rubber sheet being bent over on itself, the edges are cut off as at A. On now placing the fresh edges together, as represented at B, they fit together, forming a tube, and a loosely-fitting mandril being introduced, the joint is strengthened by being rolled longitudinally with a small roller, resembling a miniature garden roller, only slightly grooved in the middle. The mandril is generally left in during the vulcanising or curing of the tube, the so-called "cobalt cure" being adopted, as already explained. Very often the removal of the mandril presents some difficulty, and, in consequence of this, it is not unusual to employ a spiral wire instead of a solid metal mandril, this being left in the tube when sold. Machines have been constructed for the making of tubes, but with varying degrees of success. In the case of tube machines, a flexible core, or kind of rope, is generally used as a mandril. Tubes are often built up of alternate layers of rubber and frictioned canvas, in very useful in case great strength should be required. Sometimes such canvas is inserted between rubber sheets in a similar manner.

India rubber steam packing is of very great value for making the stuffing boxes of engines steam tight. It is also employed for packing the shaft holes of steamers, and other similar purposes. The steam packing generally takes the form of a cord, built up of india rubber, frictioned canvas, and lubricated or sprinkled cotton. The extraordinary number of patterns or devices into which these materials are occasionally wrought, is well illustrated by the sections which are exhibited by the Silvertown Company, and by Mr. Tuck. This gentleman has made an especial study of the manufacture of rubber packing, and you will be interested in examining the models, which illustrate the method of placing the packing into the stuffing boxes, &c. Generally, packing contains a small square core of rubber, and this is bound round with several layers of frictioned canvas. In such a case, the india rubber core gives the necessary spring or elasticity, while the frictioned canvas endures the hard wear; so tightness is secured in the stuffing box.

The use of gas bags, air pillows, beds, &c., formed of two thicknesses of cloth, separated by a layer of rubber, has now become very general, and can only appreciate the ingenuity exercised in the manufacture of such articles by either seeing them put together, or examining specimens illustrative as to exposition method adopted in building it up. Gas bags have been found very useful for carrying a supply of illuminating gas for the lighting of trains; but the use of them somewhat impoverishes the gas, as the caoutchouc absorbs several of those hydrocarbons which contribute largely towards its illuminating properties. As an insulating material for telegraph and other electrical wires, caoutchouc holds a very high place, and these specimens, kindly supplied by the Silvertown Company, and by Messrs. Rickards and Co., of Derby, will abundantly illustrate this use of india rubber, and the method of coating the wires.

Belting, for the transmission of power, can be very advantageously made of alternate layers of rubber and frictioned canvas, these being built up to the required thickness. Belting is generally cured by dry heat, and in the following manner:—An iron mould, something like a gutter, is provided, this being placed out to the same width of the belting. Into this gutter-like mould, which may be about 20ft. long, a strip of iron fits accurately; so that a piece of belting introduced into the mould is enclosed everywhere excepting at the ends. One end of a length of mould-gas, but not cured, belting being introduced into the iron mould, the necessary heat for curing is applied by means of a massive steam press (Fig. 26), which consists of two cottonguhar cast-iron chests, heated internally by steam. Generally speaking, the chests are heated to a temperature as high as 150° Centigrade, in order that the vulcanisation may proceed quickly.

FIG. 26.—STEAM PRESS FOR VULCANISATION BY DRY HEAT.

In about 20 or 30 minutes, a fresh portion of the belting is exposed to heat in the mould, and so on until the whole length has been vulcanised. The method of vulcanising in question possesses the advantage of yielding belts with very accurately square edges, so that the whole width is available for the transmission of power. The steam press is excellently well adapted for the vulcanisation of figured or patterned sheets of mouldings, intended for ornamental purposes, and the engraving (Fig. 26) represents such a one being made of the apparatus. India rubber belting should, naturally, be protected as far as possible from the action of oil, as the continual motion and consequent very much favours the destructive action of fatty substances upon it.

Caoutchouc has been largely employed in the manufacture of surgical appliances, several specimens of such lines of caoutchouc surgical appliances, several specimens of such lines of caoutchouc being now before you, as they exercise a more continuous and are of considerable value, as they exercise a more continuous and equal strain than would be the case with ordinary bandages. Messrs. Cox and Co. have provided some samples of their extra-Messrs. Cox and Co. have provided some samples of their extra-elastic bandages, made out of spread sheet—a form of rubber elastic bandages, made out of spread sheet—a form of rubber which will be considered less fragile than ordinary vulcanised which will be considered less fragile than ordinary vulcanised appliances—such as infants' feeding gear, injection apparatus, appliances—such as infants' feeding gear, injection apparatus, pessaries, &c.—are represented in the collection before you, but they require no special explanation.

(TO BE CONTINUED.)

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

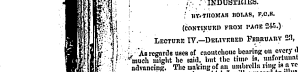
BY THOMAS HOLES, F.C.S.

(CONTINUED FROM PAGE 245.)

LECTURE IV.—DELIVERED FEBRUARY 23, 1880.

As regards uses of caoutchouc bearing on every day life, very much might be said, but the time is unfortunately, rapidly advancing. The sinking of an umbrella ring is a very ingenious and curious operation, which I will proceed to illustrate to you. A strip of the softened and mixed select rubber is cut off obliquely at each end as you see me now cut it (Fig. 27), and after it has been rubbed over with rubber solution to render it adhesive, the

FIG. 27.



obliquely cut ends (A and B) are brought in contact, so that a short tube is formed. This being next placed on a mandrill, one end of the short tube is turned over on itself continuously, so as to convert the tube into a round-rimmed ring. In practice the operation is conducted much more rapidly than I have stated it. Theirings are laid in French chalk and cured by a steam heat; but very often these articles, instead of being made of mixed rubber, are manufactured from cut sheet.

The squeegee is a well-known American origin, and consists of a slootish strip of vulcanised rubber mounted scraper fashion in a piece of wood. The scraper-like edge of the india rubber slides with very great ease over any wet surface, forcing before it any dirt or foreign matter in a manner which is surprisingly complete. No doubt you have all seen the squeegee made use of for cleansing the roads and pavements in rainy weather. The squeegee forms an admirable window cleaner, as I can illustrate to you by applying it to a piece of dirty glass; but it must always be used in conjunction with an abundant supply of water, as the friction between india rubber and dry glass is very great. Considerable use is made of the squeegee in several of the photo-mechanical printing processes, which I had the pleasure of illustrating to you two years ago, as some of you will doubtless remember.

Door mats of vulcanised rubber are now being extensively made use of. The mixture employed for their manufacture is generally of a very low quality; old vulcanised caoutchouc, fibrous materials, and mineral matters, such as whiting, being freely employed. About 20 per cent. is the quality of rubber which finds its African tongue, being often considered sufficient. The material having been calendered to a certain thickness, a very thin tin mat is laid on the sheet by means of French chalk dusted thereon, perforated zinc plate. The mats are next laid in French chalk, and cured by steam. The punchings are worked over again, the slight preliminary curing or setting being insufficient to offer any notable hindrance to this course.

A very excellent manufacturing mat, but one not adopted to any great extent in this country, is to mould them in cast-iron moulds, and then to cure by the dry heat of the steam press (Fig. 26). Other methods, such as building up the mats out of strips, are also occasionally adopted. Nearly all the door-mats are door-stops or buffers, articles of considerable utility in preventing damage to houses by a continued banging of the doors. Small blocks of rubber are often set in the door frames of railway carriages to receive and deaden the fine shock of the blow resulting from a rapid shutting of the doors.

In the manufacture of toys, the applications of caoutchouc are very numerous, and often exceedingly ingenious. Here is a small air ball, or balloon, to which is attached a wooden tube, provided with an india rubber strip, acting as a reed. The reed does not vibrate while the balloon is being distended; and by closing the tube by means of one finger, the air may be retained in the balloon; but on removing the finger, out it goes with a rush, causing an unearthly screak, calculated to delight the infant mind: Hollow playing balls are made of four segments of calendered sheet, put together balloon fashion. Here is one at this stage; it certainly does not look much like a ball, but more like a withered pear, which it would be some time in a square tube rubber too small for it. The next step is to enclose the inelegant ball in a hollow spherical mould, best made of steel, and to expose it to a vulcanising heat. The air inside the india rubber now expands, forcing the material into close contact with the mould, and when the vulcanisation is complete, a perfect counterpart of the interior of the mould is the result. As the included air contracts, the ball, to some extent, collapses, as you see in the case of three samples; but by cutting a small curvilinear hole in one of the balls, as you see, can be made to regain its spherical shape immediately. In some cases it is considered better to tightly distend the cured balls by compressed air; and this may be effected by attaching a small piece of inflated rubber to the interior of the ball, before it is made up, and this lump undergoes no change in the curing process. When the cured ball undergoes no change in the curing process. When the cured ball is taken from the mould, a sharp-pointed or sting-like tube is taken from the mould, a sharp-pointed or sting-like tube is passed through at the point where the lump is situated, and air forced in through this tube. On withdrawing the tube, the hole closes, and the freshly divided surface of the unvulcanised rubber unites again.

I do not think I told you anything about the so-called india rubber sponge, or fresh-like rubber, which may be used for toilet purposes, as pudding, or as rubbers for cleaning shoes or various other articles. It is made by incorporating with the caoutchouc in thin substances which will give off vapour or gas during the process of curing. Among these may be mentioned dewy sawdust, crystallised alum, and carbonate of ammonia. The sponge is vulcanised in moulds, which it fills during the act of expanding. An ingenious application of the sponge rubber is made in the manufacture of certain kind of playing ball. Some of the sponge rubber composition—which, by-the-by, may be compounded as follows:—

20 parts washed rubber of good value.
10 parts red lead or other pigment.
10 parts old vulcanised rubber in a finely divided state.
8 parts sulphur.
8 parts dewy sawdust finely ground.
6 parts oxydised linseed oil

100

is wrapped round a small ball of wood, and the whole is then placed in a spherical mould somewhat larger than the wooden core and the rubber envelope. The heat necessary for curing being now applied, the rubber swells and fills the mould. On taking one of these sponge balls into the hand, its softness would naturally cause one to think it was made of a fine quality of rubber, and to some it is a thing sold at the low price charged; but, on cutting it in two, the mystery is explained,a wooden core and a coating of very low quality sponge rubber being its feature. Very many hollow articles are made in moulds, in the same manner as the hollow balls; not only toys, such as dolls, being produced in this way, but also such goods as injection bottles and analogous articles; the principle of utilising the expansive force of air for forcing the rubber up to the sides of the mould being of widespread application in the rubber industry. Tin or cast iron moulds are often employed, and in such cases a compression of air into the finished article is rendered unnecessary by adopting the expedient of leaving open the article after it is placed in the mould, but before curing; the soft mixed rubber closing immediately on coming into contact with the sides sorry for this purpose.

The use of india rubber for cleansing paper and erasing pencil marks is a well-known application of the material, but its usefulness in this respect has been very much enhanced by incorporating certain gritty materials with it, such as pumice or finely-divided silica. Messrs. Wolff and Sons exhibit a collection of rubber specially prepared for thesecases; and they have adopted the plan of moulding the rubber squeegee form in wooden blocks. By this arrangement contact between the hand and the rubber is avoided. Some people of their evening studies the very dirty envelope much longer than anything yet attempted in metal; but by employing a suitable rubber composition, it is not unlikely that a thorough curing might be effected in so short a time as to offer no friction whatever. The power required to drive these articles, when working with rubber stereotypes, would be comparatively small, while impressions quite as sharp as those from metal ought to be secured. One advantage of the rubber stereotypes would be the ease with which they can be adapted to cylinders of any curvature. As regards ink for stereotypes a few words may be said. A fatty ink naturally injures the rubber; at any rate, if it is not very carefully removed after use; but an ink having glycerine as a basis answers extremely well, and may, as the specimens on the table prove, be left in contact with the stereotypes without in any way injuring them.

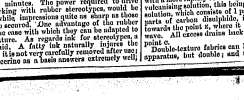
Taking rubber made of india rubber have been occasionally made use of from time to time for some years, but owing to inexperience in their manufacture and use, the results have been, until quite recently, for from satisfactory. You will probably remember that, when lecturing here on photo-mechanical printing, I showed you how a printing roller could be made with a body of the usual soft composition, covered with a thin coat of vulcanised rubber, smoothed by means of glass paper. This circumstance brought to my knowledge the fact that Mr. Robert Lanham had been very successfully labouring in the improvement of india rubber rollers. By the assistance of Mr. Lanham, I was enabled to show you some of his rollers at the lecture immediately following the occasion when I showed you my own. During the two years which have elapsed since that time, Mr. Lanham has still further developed the manufacture of rubber rollers for printing purposes, and I am indebted to him for the opportunity of now showing you the very fine selection of these articles which stand over yonder. Mr. Lanham makes his rollers from red rubber, which is, of necessity, very thoroughly cured in order to enable it to withstand the action of fatty inks; and after the rollers have been turned true by means of self-setting lathes, a fine surface is given to the rubber by means of glass paper. In order to give his rollers the sufficient which is necessary in some cases, Mr. Lanham now introduces a series of perforations parallel to the axis. For lithographic printing, these rollers have very considerable advantages over the usual leather roller, and some excellent samples of work done with them hang on the walls.

India rubber does many services in connection with the art of printing, some of these being of very great interest; but it is impossible to do more than notice the matter this evening.

Waterproof goods, consisting of a thin layer of rubber spread on a textile fabric, are very largely made use of for the fabrication of overcoats, and other waterproof garments. In the manufacture of these goods the first step is to prepare a dough or mixture of the goods as the material. If the vulcanising process is to be carried on in steam heat, as is the case with the cured rubber goods, a composition of the following the case of cotton or linen goods, a composition of the following the case of cotton or linen goods, a composition of the following the case of cotton or linen goods, a composition of the following nature may be spread on the fabric:—30 lbs. rubber, 5 lbs. sulphur, 30 lbs. zinc white, 5 lbs. sulphur, 0 or 8 lbs. of solvent naphtha. When, on the other hand, the curing is to be performed by the cold process, the sulphur is omitted. After the rubber has been softened by the absorption of the solvent naphtha, the materials are thoroughly incorporated by means of a mixing or kneading machine.

A very good illustration of the action of a spreading machine is afforded by the model which is now before you. (Fig. 29) As afforded by the model which is now before you. (Fig. 29) as afforded by the model which is now before you. (Fig. 29) consists of a trackcord, A, which is supported a rule-like

FIG. 29.



MODEL ILLUSTRATIVE OF THE ACTION OF THE SPREADING MACHINE.

bar, B. The material to be coated is placed under the bar, a quantity of the paste or dough is piled up in front of the bar, at the left hand side, and is drawn forwards, so that the rule or bar cuts off an even layer of the soft stuff. In actual use the bar cuts off an even layer of the soft stuff. In actual use the bar cuts off an even layer of the soft stuff. In actual use the composition, is passed over a heated steam chest, in order to dry off the solvent naphtha, and the cured rubber goods about six coats are given—three in each direction. Each coat is about 1-100th of an inch thick, as being about one-hundredth of an inch in thickness.

The method of applying the mixture of carbon disulphide and rubber in the manufacture of the cold vulcanisation of rubber goods, and the process for effecting the same, which would be the india rubber coating when spread on goods, is of some interest. The coated fabric, as it comes from the spreading machine, is passed into a solution (c, Fig. 30) passes round a roller (d), coated also fabric (c, Fig. 30) passes round a roller (d), coated also with a mixture rapidly revolving slate roller, A, which dips in the with a mixture rapidly revolving slate roller, A, which dips in the vulcanising solution, this being contained in a trough, B. The vulcanising solution, this being contained in a trough, B. The solution, which consists of 1 part of chloride of sulphur and 40 parts of carbon disulphide, is led upwards by the roller A, parts of carbon disulphide, is led upwards by the roller A, towards the point e, where it forms a kind of accumulator or towards the point e, where it forms a kind of accumulator or wave. All excess drops back on the fabric travels towards the wave. All excess drops back on the fabric travels towards the point c.

Double-texture fabrics can be produced by employing similar apparatus, but double; and the two textures, which are vul-

FIG. 28.

HOT-PRESS FOR THE VULCANISATION OF INDIA RUBBER CASTS OR STEREOTYPES.

the curing of small flat articles and coats. It consists of a cast-iron fish bottle, upon the bottom of which rests a shift of type, mixed an inch thick. Inside the kettle is placed a small press, like a copying press in miniature. By the side of the press handle is a small iron with a containing glycerine, and in this fluid is immersed the bulb of a thermometer, the stem of which projects through a hole in the cover of the kettle. By means of a small gas stove, heat can be applied to the apparatus, and it is easy to so adjust the gas supply, that the thermometer shall indicate a tolerably constant temperature of, say 140° or 150° Centde. Most qualities of rubber will become fairly well cured by being heated under these circumstances for half to one hour, and any tendency towards a reaction in the mould is obviated by the preparation with oil and blacklead, as described.

The apparatus is extremely well adapted for curing the india rubber stereotypes or stamps, which are now so extensively used for endorsement and other purposes. These rubber stereotypes are a reverse or mould is made from the types, this being taken in plaster of Paris, or better still, in metal. When plaster is employed it is well to harden it, by saturating it with an alcoholic solution of shellac, and again drying. The soft mixed rubber is then forced into the mould, as you now see me doing it, after which the curing may be effected in the hot press (Fig. 28).

Mr. John Leighton introduced rubber stereotypes about eighteen years ago, and since that time their use has become very general for a great variety of purposes. Mr. Leighton has very kindly sent, for your inspection, an interesting collection of specimens, illustrative of the manifold uses to which india rubber stereotypes are applicable. The principle of utilising the swelling which takes place in the rubber when it is heated under pressure in the moulds, for producing the impression, has a worldwide application in the rubber industry. Tin or cast iron moulds are often employed, and in such cases a compression of air into the finished article is rendered unnecessary by adopting the expedient of leaving open the article after it is placed in the mould, but before curing; the soft mixed rubber closing immediately on coming into contact with the sides sorry for this purpose.

The use of india rubber for cleansing paper and erasing pencil marks is a well-known application of the material, but its usefulness in this respect has been very much enhanced by incorporating certain gritty materials with it, such as pumice or finely-divided silica. Messrs. Wolff and Sons exhibit a collection of rubber specially prepared for thesecases; and they have adopted the plan of moulding the rubber squeegee form in wooden blocks. By this arrangement contact between the hand and the rubber is avoided. Some people of their evening studies the very dirty envelope much longer than anything yet attempted in metal; but by employing a suitable rubber composition, it is not unlikely that a thorough curing might be effected in so short a time as to offer no friction whatever. The power required to drive these articles, when working with rubber stereotypes, would be comparatively small, while impressions quite as sharp as those from metal ought to be secured. One advantage of the rubber stereotypes would be the ease with which they can be adapted to cylinders of any curvature. As regards ink for stereotypes a few words may be said. A fatty ink naturally injures the rubber; at any rate, if it is not very carefully removed after use; but an ink having glycerine as a basis answers extremely well,

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THE INDIA-RUBBER AND GUTTA-PERCHA INDUSTRIES.—V.

By Thomas Bolas, F.C.S.

(Continued from page 3713.)

THE ringcase laid in French chalk and cased by a sheet metal, but very often three articles, formed of being made of mixed rubber, are manufactured from the start.

The sponge case is an instrument of American origin, and consists of a slender strip of vulcanized rubber into which a sponge is put, in a piece of wood. The sponge is put in dry, and the whole case is put into water for one week or more, and then taken out and dried before being used. The sponge is then ready for use, when a saturated solution of 30 grains to the ounce of water made use of for cleansing the mouth and throat in using weather. The sponge forms an admirable window cleaner, as it will absorb a large quantity of water, and will not drip. Specimens of many articles in daily existence of the finest threads imaginable, all of which as the fabrics themselves introduced—are shown in the exhibition. Threads as fine as hairs of the head, and yet about a very great. Chemicals use 14 marks of the sequence in several of the photo-mechanical printing processes, which I feel the pleasure of illustrating to you, as some of you will doubtless be interested in the formulæ.

Door-cords of vulcanized rubber are now being extensively made use of. The makers employed for their manufactures is generally of a very low quality; all vulcanized constituents, fibrous substances, and mineral matters, such as whiting, being used in their manufacture. The use of a low quality of raw rubber, such as Adriano or Angola, being often considered sufficient. The material is generally calendered to the requisite thickness, a very partial and imperfect curing is generally effected at this stage, the sheets being exposed to a moderate heat between metal plates, these being often considered sufficient. The cords are then cut out and by means of punches and cutters, the discs having been annulled on the edges are passed through cloth coated through a perforated metal plate. The cords are next laid in French chalk, and cured by steam. The gumships are worked over again, the slight preliminary curing or salting being considered to offer any notable hindrance to this course.

A very excellent method of manufacturing mats, but one not adapted to any great extent in this country, is to mould them in cast-iron moulds, and then to cure by the dry heat of the steam-press. Other methods, such as building up the mats out of vulcanized rubber compounds, and then vulcanizing in moulds or drop steam or hydraulic presses, are of considerable utility in preventing the distortion which is continual bugging of the discs. Small blocks of rubber are often set in the door frames of railway carriages to receive and deaden the first effect of the blow resulting from a rapid shutting of the door.

In the manufacture of toys, the application of exceedingly cheap and common materials, and very highly ingenious. Here is a small air-ball or balloon, to which is attached a wooden tube, provided with a valve, and also what acts as a valve. The real does not appear, while the balloon is being distended; and by pressing the tube by means of one finger, the air may be retained in the balloon; but removing the finger, and the valve goes with a rush, causing an assembly attached to delight the latest mind. Indoor pleasures of a very different description to these, and together, are the Indian fashion. Here is one of this stamp: a small ball, which looks like a ball, but more like a silkened purse, which has sealed for some time in a square tube, prepared for it. The real stop is to imitate the instrument but in a better spherical mould, but made of some composition that is a vulcanizing heat. The air-tasks the inflated rubber now appears, forcing the material into close contact with the mould, and when thevulcanization is complete, a true counterpart of the interior of the mould is formed. The ball is then emptied of its contents, the hole, by some means, closed, as you see in the case of these samples; but then, as you see, a small piece is made to fit the hole, and is put in, and then made to regain its spherical shape immediately. Sometimes the ball is examined better to slightly dissect the mould by compressed air; and this may be effected by the ordinary hand-pump of an inflated rubber in the interior of the ball, before it is made up, and this lump undergoes an elaborate forming process. When the cured ball is taken from the mould, a sharp-pointed or sting-like tube is passed through at the point where the lump is situated, and air is forced in through this tube. On withdrawing the tube, the hole closes, and the finely-divided particles of the unvulcanized rubber unite again.

I do not think I told you anything about the so-called indiarubber sponge, or foot-like rubber, which may be used for toilet purposes, as washing, or as rubbers for cleaning shoes or various other articles. It is made by incorporating with the rubber certain substances which will give off gases when heated, such substances as bicarbonate of ammonia, bicarbonate of soda, sesquicarbonate of ammonia, alum, and carbonate of ammonia. The sponge is vulcanized in moulds, which fit the closing the act of imposing. An ingenious application of the sponge rubber is made in the manufacture of the certain kind of playing-ball. Some of the sponge rubber compositions, which, for toys, may be compounded as follows:—

20 parts washed rubber of low quality.
10 parts red lead or other pigments.
10 parts of vulcanized rubber in a finely divided state.
5 parts sulphur.
2 parts each sawdust finely ground.
6 parts of calcined linseed oil.

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The corrugated round a small ball of wood, and the whole is then placed in a mould of the exact same size, but larger than the wooden one inside. Under carriages, the last necessary for curing being now applied, the rubber swells and fills the mould. On taking the case from sponge balls in the hand, the softness would naturally cause one to think it was of a very low quality of rubber, but the reverse is at all being said as the low sum charged; but on cutting it open, it is found to be composed of wood, corn and a covering of very fine sealing sponge rubber being its factors. Very many hollow articles are made in moulds, in the same manner as the hollow balls; not only toys, such as dolls, being produced in this way, but also such articles as hygienic bottles and analogous articles; the principle of forming the articles in moulds, and for forcing the rubber up to the sides of the mould being of widespread application in the rubber industry. To or canvass manikins are often employed, and, in some cases, a suppression of air into the finished article is rendered unnecessary by adopting the expedient of forcing air into the interior of the article in the mould, but before curing; the soft mixed rubber closing immediately on the minute hole which is necessary for this purpose.

The use of indiarubber for closing paper and paying pencil-marks is a well-known application of this material, but its usefulness in this respect is not, perhaps, much increased by incorporating certain pretty materials with it, such as pumice or finely divided silica, as has been done, and thus exhibit a collection of rubber specially prepared for these uses; and they have adopted the plan of grinding the rubber, sponge fashion, in wooden blocks. By this arrangement, contact between the rubber and the rubber is avoided, and the rubber is left in their coarse-rubber gut very dirty, and then requires hard rubbing to obtain paper.

Very pretty casts or mouldings of phototypic reliefs may be made in vulcanized rubber; and I will next illustrate to you the method of making these, which is as far as the manufacturer of the results, is concerned. Here is an ordinary photographic negative, which is a typical metal cast or mould, produced by electrolytic agencies from the negative. These portions of the negative which are opaque correspond to shallow places in the metal mould, while the depressions of the mould correspond with the transparent portions of the negative.

A writer in the Providence *Journal* predicts a useful future for the milkweed, which has hitherto been considered only a cumberer of the ground. Its seeds yield a finer oil than linseed; its gum can be used in place of India-rubber; and from its fibre a fabric resembling Irish linen is woven; while the young shoots are used in the spring by some people instead of asparagus, which they resemble in flavor. Now, pertinently adds the writer, if cows can be discovered for the thistle and whitewood, they may prove friends in disguise.

WATERPROOFED CLOTH.—Cloth coated with linseed oil to which a little wax and litharge have been added, will be waterproof.

FIG. 1.—HEVEA GUIANENSIS, OR RUBBER TREE.

FIG. 2.—FICUS ELASTICUS; A SPECIMEN GROWING IN THE OPEN AIR AT PARIS.

THE INDIA-RUBBER AND GUTTA-PERCHA INDUSTRIES.

By Thomas Bolas, F.C.S.

LECTURE I.

THE SOURCES OF INDIA-RUBBER.

India-rubber, or caoutchouc, possesses properties so widely different from those of most other substances, that it becomes an object of very great interest as soon as it needs its appearance in the civilized world, and its industrial importance has rapidly increased as the knowledge of its remarkable characters and manifold applicability has become more extended. At the present time, caoutchouc holds such an important position with regard to the economy of

FIG. 1.—HEVEA GUIANENSIS, OR RUBBER TREE.

FIG. 2.—FICUS ELASTICUS; A SPECIMEN GROWING IN THE OPEN AIR AT PARIS.

modern arts and manufactures that were it suddenly to be withdrawn from circulation many minor industries would be compelled to cease to exist, while numerous large and important branches of manufacture, such as railway appointments would be made to adapt their operations to the altered circumstances.

It is, however, during the last forty years that India-rubber has become of the greatest importance to mankind; that is to say, since the year 1839, when the discovery was announced by the brothers of Charles Goodyear, Thomas Hancock, and others.

The chief source of the existence of caoutchouc received Europe merely in the shape of the vast tract of Columbia to the United States, in the habit of making playing balls of this solid wood, in the habit of making playing balls of this solid wood, in the habit of making playing balls of this solid wood

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS HOLE, F.C.S.

(CONTINUED FROM PAGE 220.)

LECTURE III.—DELIVERED FEBRUARY 16, 1880.

The powders most extensively employed for thus lowering the quality of rubber are the following:—Clay, chalk or whiting, French chalk or talc, barium sulphate, plaster of Paris, oxide of zinc, sublimate of zinc, sulphate of lead, various oxides of lead, oxy-carbonate of lead or white lead, magnesia, silica, and fuller's earth.

Some of the above-mentioned materials, specially prepared for the rubber manufacturer, are shown in the collection of india rubber chemicals kindly lent to me by Messrs. Forster and Gregory, of Streatham; and these manufacturers also exhibit some qualities of sulphur specially purified for use in the vulcanisation of caoutchouc. It is a matter of considerable importance that the sulphur employed for mixing with caoutchouc should be free from all trace of acid, and also from the moisture which acid samples of sulphur tend to absorb from the atmosphere. Ordinary flowers of sulphur—prepared by passing sulphur vapour into large chambers constructed of masonry, so that this vapour shall condense into minute crystals resembling snow—is almost invariably acid in its reaction, as traces of sulphuric acid are formed by the oxidation of the sulphur. This acid may be removed by washing the flowers of sulphur with an abundant supply of water, and then drying at a gentle heat.

Here is a sample of ordinary commercial flowers of sulphur, and here is some of the same which has been washed and dried. I will put a little of each on a sheet of blue litmus paper, and then moisten them with alcohol. You see that where the unwashed sulphur was placed, the colour of the litmus paper is changed to red, owing to the action of the acid, while the colour of the litmus paper has not been in any way altered by the washed sulphur. All samples of sulphur ought to be tested in this way before being employed for mixing with india rubber. Powdered sulphur is very often in the state of, and it has not so much tendency to be acid as in the case with flowers of sulphur.

The so-called milk of sulphur—or precipitated sulphur—exists in a very fine state of division, and as far as this circumstance is concerned it is especially adapted for mixing with india rubber; but, on the other hand, it is expensive, and is liable to be dampened in manufacture, but in order to ensure perfect vulcanisation it is necessary to employ sulphur uniformly mixed with which actually combines with the caoutchouc. This excess sometimes effloresces out on the surface, becomes acid, and leads to the destruction of the rubber. It appears also sometimes so to overcure the rubber as to make it brittle and useless. In the case of articles presenting no great degree of thickness, the greater part of this injurious excess of sulphur may be removed either by boiling them in a dilute solution of caustic soda or by means of a solution of sodium sulphide. I have found a method of producing vulcanised rubber which shall be free from any such excess of sulphur consists in employing a smaller proportion of the sulphur originally mixed with the caoutchouc by metallic sulphide.

The sulphide of antimony is that which is most extensively employed at the present time, the use of this having been claimed by Charles Hancock in a patent dated January 12, 1846; while in a patent dated February 10, 1847, he fully recognises the fact that free sulphur ought to be employed in connection with the sulphide of antimony. Sulphide of antimony for the rubber manufacturer is prepared by boiling the native sulphide in a solution of caustic soda and precipitating the solution thus obtained with a slight excess of hydrochloric acid. Here is an alkaline solution of the native sulphide, and you see that when I add hydrochloric acid to it, an orange-coloured precipitate is produced. This, when washed and dried, is ready for mixing with the caoutchouc.

The sulphide of antimony thus prepared contains, under ordinary circumstances, a certain proportion of free sulphur, but, in order to obtain the best results with the sulphide of antimony, uncombined state. This can be insured by adding the requisite proportion of sulphur to the caustic soda in which the original native sulphide is dissolved. The well-known red rubber is vulcanised by means of the sulphide of antimony, and the superior qualities of this kind of rubber over the ordinary grey articles are generally recognised by the public. The absence of any considerable excess of free sulphur renders it less liable to decay under the influence of time and light, while it is less subject to destruction by fatty matters than rubber containing an enormous excess of free sulphur. The quality of commercial red rubber is, however, somewhat variable, and I have met with samples which were scarcely vulcanised at all, the sulphide of antimony employed being probably deficient as to the amount of free sulphur present. When the sulphide contains from 20 to 25 per cent. of sulphur, it is generally not necessary to mix more than 15 to 20 per cent. of the sulphide with the rubber; but when a sulphide of antimony containing less free sulphur is employed, it is possible to add a much larger proportion to the rubber with advantage. No manufacturer should ever employ a sample of precipitated sulphide of antimony without first ascertaining that it contains a proportion of free sulphur suited to his work. Extra sulphur may be added in the form of milk of sulphur, but this proceeding is not so satisfactory as taking the right thing to start with. Other sulphides, such as lead sulphide, mercuric sulphide, or zinc sulphide, are occasionally employed as vulcanising agents; but, in order that they may act in the best satisfactory manner, it is necessary for some free sulphur to be present; and the amount of this free sulphur should always be exactly known, in order that the vulcanising may be a matter of certainty, rather than the result of a kind of guesswork process. Sulphide of mercury or vermilion intended for use as a vulcanising agent ought, in most cases, to contain as much as one third of its weight of free sulphur.

The action of these sulphides is peculiar. They have but little vulcanising action themselves, but they enable the free sulphur which may be present to exercise its full force; or, in other words, they take the place of that large excess of sulphur which remains ununited with the rubber in ordinary cases. You will, then, the use of these sulphides renders it possible to avoid the presence of a large excess of ununited sulphur in the finished goods. Some of the sulphides exercise by themselves a powerful vulcanising action; and among these may be mentioned the polysulphides of the alkalis and of the alkaline earths, or articles made of this cut sheet may be very perfectly vulcanised by Gérard's process, which consists in exposing them to the action of a solution of the mixed polysulphides of calcium, at a temperature of about 140 degrees Centigrade.

Among Messrs. Forster and Gregory's specimens are many sulphides adapted for use as vulcanising agents, some of which are mainly intended for use as colouring materials; these latter being, probably, free from any excess of sulphur. The fact of Messrs. Forster and Gregory being so well acquainted with the requirements of the rubber trade enables them to procure sulphides suited for each particular kind of work. Among their specimens may be noticed the antimony vermilion, a very fine colouring matter, but not a vulcanising agent; the golden sulphide of antimony, which is specially prepared as a vulcaniser, and is manufactured in such a way as to ensure uniformity of composition, this being a matter of the greatest importance. Again, we have here yellow orpiment, a bright yellow sulphide, to the extent of 60 per cent. to the rubber; zinc oxysulphide, a white colouring material, which is sometimes used in the best coating compound textures, as it possesses the property of absorbing sulphur, and so prevents sulphuring up, or an efflorescence of sulphur from the more highly sulphuretted layers beneath.

When articles made of thin rubber—as by my cut sheet—are imbedded in powdered sulphur, and exposed to a temperature of about 112° Centigrade for some considerable time, as much as 10 per cent. of sulphur is absorbed by the caoutchouc, and this absorption is facilitated by rubbing the powdered sulphur on the surface of the caoutchouc. This method of sulphuring cut sheets, and articles made from cut sheet, is of considerable practical utility in many cases, and the goods so charged with sulphur may be cured in the ordinary steam vulcaniser.

Parkes' cold curing process, briefly referred to in a previous lecture, is one of the most curious things existing in the whole rubber trade. Here is a piece of cut sheet rubber, which I now dip for an instant in a mixture of one part of chloride of sulphur and 60 parts of carbon disulphide; after which I lay it for a minute on a tray covered with French chalk and heated to about 40° Centigrade. The portion which was dipped is now vulcanised; perhaps not all the way through, but very nearly. This method of articles made from cut sheet rubber. In this case it is probable that the chlorine removes hydrogen from the rubber, and that the sulphur takes the place of the removed hydrogen. A study of the process in question shows us how very nearly is the

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proportion of sulphur actually concerned in vulcanisation. In Parkes' process we have one of the most perfect vulcanising processes existing, as combined sulphur alone results, and the finished articles are quite free from any trace of sulphur in an uncombined state. An after-treatment with water, or a weak alkaline solution, may be adopted to remove traces of hydrochloric acid. Light perfumes is now often employed in this process instead of carbon disulphide. Some hypo-sulphites, especially the lead salt, are capable of acting as vulcanising agents but are not very extensively made use of. Vulcanisation by hypo-sulphites is, however, interesting, as affording another instance of combined sulphur acting as a curing agent.

Other re-agents besides sulphur exercise a hardening or vulcanising action on india rubber; as, for example, nitric acid and the halogens. Warren claims the use of these latter bodies in his patent dated February 26, 1871, and he has very successfully vulcanised the insulating coating of telegraph wire by means of iodine. A piece of cut sheet rubber dipped into bromine becomes vulcanised instantly. Warren's process has been applied in America to the production of vulcanite bases for artificial teeth.

When sulphur and caoutchouc are mixed, there is a certain tendency for them to unite slowly, especially if exposed to the rays of the sun; a kind of gradual vulcanisation or curing being the result. This is very well exemplified in the case of the cork Piccadilly, to whom I am indebted for this very complete set of specimens illustrative of their manufacture. The segments of cork, out of which these helmets are made, are cemented together by means of a solution of rubber in purified camphine, but a certain proportion of sulphur is added to the solution. During the time that the helmet is in use, the india rubber cementing medium gradually becomes vulcanised, increasing in toughness and hardness by exposure to the heat of the sun. If, on the other hand, no sulphur were present, the rubber would rapidly deteriorate, and the helmet would fall to pieces if used in a tropical climate.

I have to thank several manufacturers for lending me many of the numerous specimens of vulcanised rubber which are before you this evening, Messrs. Macintosh, Hancock, Davis, and Henwood, the Silvertown Company, and others having been most kind in this matter.

The remarkable power which vulcanised caoutchouc possesses of recovering its shape after compression is well illustrated by the fact that a sphere 2½in. in diameter passes between rollers set to a distance of a quarter of an inch without suffering any permanent injury as regards form.

Although vulcanised rubber is insoluble in the ordinary solvents of caoutchouc, boiling oil of turpentine will dissolve it, and solutions of pliable liquid are employed by Dr. Stenhouse, of Rochdale, for making waterproof cloth. Some specimens of this manufacture, which will be referred to in the next lecture.

Oils and fats exercise a very destructive action on india rubber, more especially when the caoutchouc is unvulcanised, and through the kindness of T. S. Speed, engineer to the London Underground Railway Company, I am enabled to show you a very interesting specimen illustrative of this. It consists of a piece of one of the contrivances place employed to lead gas into the trains at the Hammersmith Station, and the pipe from which the specimen has been cut was placed in immediate proximity to the stopping point of the engines. You see how deeply and thoroughly the pipe is corroded and destroyed by the action of oil from the engines, while the other pipes in the station are in excellent condition.

Some of the conditions which are favourable to oil resisting powers, in the case of vulcanised caoutchouc, are as follows:—

1. The use of a high quality of rubber,
2. Thorough mixing,
3. The absence of free sulphur in the finished article.
4. The presence of such pigments as lithrage, red lead, or white lead.
5. The corporation of a trace of glycerine with the materials.
6. Curing in a glycerine bath. (Placed in an ordinary steam vulcaniser.)

On the table you will see some interesting specimens, kindly lent by Mr. Tuck; these illustrate the matter in question, and you will notice how well Mr. Tuck's special oil-resisting rubber has withstood the action of mineral and other oils.

Ordinary vulcanised rubber gradually deteriorates when maintained at a temperature near 150° Centigrade, becoming brittle and evolving sulphuretted hydrogen. This may be principally due to the reaction of the still uncombined sulphur on the caoutchouc. Exposure to the sun's rays will often produce a similar effect on caoutchouc containing free sulphur in considerable excess. Thus we see that, although both heat and exposure

to light have a curing action on mixed rubber, the ever-long continued action of either agency tends towards mischief.

(TO BE CONTINUED

Gathering Rubber in Colombia
Jun. Aug. 4. 1881,
Dept Botany No. 65

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Water-Proof Coverings.

By F. Collingwood, Member of the American Society of Civil Engineers.

Read at the Twelfth Annual Convention, May 25, 1880.

As a contribution to the general subject of the use of asphaltes, bitumens, etc., the writer would offer the following bit of experience:

As it is intended that the arches of the approaches of the East River Bridge shall be roof for mercantile purposes, it became necessary to cover the concrete over the arches with some protecting substance, which should keep out all dampness from the masonry. On inquiry among persons engaged in such work, a great diversity of material was offered, and each lauded as the best for the purpose.

It was accordingly decided to ask bids generally, each bid to be accompanied by samples for testing.

In deciding on the tests, the following requirements were had in view:

1st. That the covering should be impermeable to water at all temperatures, and

2d. That it should be permanent.

It is evident that there is little danger of failure at high temperatures, but at low temperatures cracks may develop from contraction or shocks, allowing water to pass through. The tests on this point were, to make some wooden moulds with grooves about 2 feet long, with enlargements at the ends, so as to give a shape like an ox yoke, and fill them with the mixture. These, with some flat pieces of the material, were exposed to a freezing mixture for 48 hours. Some of the long pieces cracked under this test. After freezing, the pieces were first tested with a loaded point for penetration, and then exposed a short distance to see whether they would break. In this way a fair idea of the respective hardness and brittleness was obtained, and also (by careful measurements) the relative contraction. After this the specimens were exposed to heat, to see their behavior under a high temperature.

The next tests were for durability, and proceeded upon the assumption that in process of time destruction must occur, if at all, in two ways:

1st. By the gradual evaporation at ordinary temperatures of the volatile oils contained in the water-proofing material, and which give plasticity to the mass, thus causing them to be crumbly and absorbent, as witnessed in coal tar roofs. The test for this was to weigh with delicate scales a small mass of the material, and expose it in a small bath to a temperature of 212° for 48 hours, noting the percentage of loss.

The second possible cause of failure was considered to be absorption of water, which by freezing and thawing would eventually cause disintegration. For this test carefully weighed specimens were soaked in water for 48 hours, taken out, wiped carefully, and reweighted to determine increase in weight.

A third possible cause of deterioration would be looseness of structure, causing rapid alternation under passing loads, but this would be determined by the second test above.

The various samples offered may be classified as follows:

1st. Alternate layers of coal tar and felt.

2d. A mixture of concrete, crude petroleum, and resin.

3d. Trinidad bitumen (refined) and coal tar, with an admixture of sand.

4th. Asphaltic mastics consisting of various mixtures of Val de Travers or Limmer asphaltes, with Trinidad bitumen, residuum oil, limestone, sand, etc.

5th. Trinidad bitumen, with paper or felt, in consecutive layers.

6th. Trinidad bitumen (refined), mixed with almost 10 per cent. of residuum oil, put on in consecutive layers.

The tests showed that all of No. 1 were totally unreliable for permanent work.

No. 2 is an admirable fire-proof material for roofs. There was a loss of one-half per cent. by boiling, however, and the price was too great.

No. 3 absorbed 1 per cent. of water, and was evidently poorly prepared.

No. 4. Of these the best samples were excellent, but were rather hard at low temperatures. Of the poorer ones (those most adulterated), some failed by cracking, showing brittleness, others by absorption, taking up as much as 4½ per cent. of water. The best were too expensive.

No. 5 were decided against, on the ground that no paper layers could be made continuous, and threw second as reason for inserting a foreign substance which had no protective power of its own.

No. 6. A mixture of 90 per cent. residuum oil and 80 per cent. Trinidad bitumen was found to be too soft. The residuum oil or petroleum was in that product of the distillation of petroleum which passes over at temperatures between 600° and 700° F. Reducing the oil to 10 per cent. gave a mixture neither too soft when warm nor too brittle when cold, entirely meeting the tests, and being nothing when boiled. It was therefore decided that no other was less than that of any other acceptable sample offered, the bid would be accepted, to put down three layers having a total average thickness of half an inch.

The lesson to be learned from these tests in respect to the use of such materials in road making is this, that it is possible to take a piece of material from a street (a very small piece will do if chemist's scales are used), and determine at once whether there is a reasonable probability of its being of a lasting character. All experience goes to show that compressed asphaltic cement is durable unless well compressed; and the absorption test ought to reveal the physical condition of any specimen as to porosity. A tensile test, by comparison with known mixtures, would reveal something else as to adulteration of the mixture by an excess of grit or earthy material. One bidder put in peat for some purpose best known to himself. Of course, no person would recommend the mixture adopted as suitable for road making; it can only be used where covered from the sun's rays by an external covering of some thickness, for the express purpose of keeping out water.

This experience is given as one method—in the present case a very successful one—of deciding among a lot of bids having apparently few points in common on which to base a decision.

Edward P. Nourse.—The interesting experiments detailed by Mr. Collingwood may be supplemented by a notice of the tensile strength of some samples of asphaltic mastic (No. 4, mentioned above), and of a bituminous mastic known as Filbert's vulcanite.

The asphaltic mastic was made from Val de Travers asphalte, melted in the ordinary refined Trinidad bitumen, with the addition of about 50 per cent. of clean siliceous grit of the size of a pea.

The vulcanite is identical with that tried in Fifth avenue, between Twenty-fourth and Twenty-fifth streets, in August, 1879, and is composed of 141 gallons of refined Trinidad bitumen, 7 cubic feet of fluid sand, both heated to 300° F., and 1 to 1½ gallons of a mixture of cement, limestone dust, and sulphur, all mixed in a horizontal revolving mill.

The test pieces were one inch square, and were broken on a cement testing machine that only registered to 400 pounds.

Four samples of the vulcanite were broken at 120, 140, 185, and 220 pounds. Five samples of the asphalt mastic were broken, one at 352 and one at 400 pounds, the other three stood 400 pounds for over a minute, and broke with an added weight of from 20 to 50 pounds. All the test pieces were immersed for over an hour before the breaking in ice-water; the temperature of the room was 85°.

The asphaltic mastic probably had more than twice the tensile strength of the vulcanite, and would be less liable to crack from change of temperature.

This mastic, without the addition of grit, is largely used in France for covering arches, casemates, and powder magazines, with very satisfactory results, as the mastic yields to the settlement of the masonry without cracking.

It may be doubted if the test proposed by Mr. Collingwood would be a valuable aid in selecting a paving material, as newly laid compressed asphalte would not show as well under it as the mastic, yet experience has shown that it is much more durable than the latter for wheelways—so much so that the Limmer Company, of London, are replacing their mastic pavements with compressed Sicilian asphalte, and it is doubtful if asphaltic mastic will wear better than the best of the bituminous mastics as now laid, particularly under rapid traffic in cold weather, but the asphaltic mastic would be the best absorbent of the two.

F. Collingwood.—In continuation of the discussion of "water-proof coverings," I have a few additional facts to offer.

Our work, as far as it was concreted, was covered during cold weather with the mixtures mentioned above, namely, refined Trinidad bitumen with 10 per cent. of residuum oil. It was thus expected that the stone paving would be laid early in the spring, and a thick layer of sand was spread over it. Instead of this, owing to delays, the pavement has not yet been laid, (July 31, 1880), and the whole has been exposed to the hot weather of the past few months.

The temperature has, under the circumstances, been sufficiently high to cause the bitumen to rise in places through the sand, and to flow to a moderate extent.

This experience shows that it is necessary to attend to the upper limit of temperature as well as the lower. I am now inclined to think that the bitumen would be better without any oil. With the full thickness of paving and sand we expect to put above it, this temperature will probably not be high enough to disturb it. This is, no doubt, the reason for the introduction of felt and paper in its two over roofs and sidewalk vaults.

There is a practical difficulty in applying it to the inside of domes. Where hot enough to insure thorough adhesion to the walls of the dome, the mixture is so thick that the workmen cannot see what they are doing. The warm solution would probably be the best application in such location.

Artificial India-Rubber from Coal Tar.

Referring to Ackersonn's *Caoutchouterie*, pp. 14 genuine, and substitute for India-rubber or gutta-percha, but from which, however, either alkaline or acid solutions will extract the resin, leaving a residue of pure caoutchouc, which, after vulcanization, is found to possess properties for which it is highly valued, being tough, non-sensitive to several influences on which genuine rubber is affected, not affected by pressure or temperature. The base or its compounds would possess remarkable qualities as coal tar oil, or liquid parts of coal tar oil, in quantity equal to a third part of whole mixture. This tar oil is poured into a large kettle, set with an equal quantity of hemp oil, and is heated several hours, either by steam or over an open fire, to a retaure ranging from 225° to 288° Fahr., beyond which it must not go. The mass becomes at length so ductile that it can be cast in long threads, and the remaining thirst portion, consisting of oil which has been thickened by boiling, is then added. This compound from 3 to 10 per cent. of caoutchouc and some sheet should be mixed; after which the mass is heated again one hours at the same temperature as before, and finally from 2 per cent. of sulphur is added. The composition is then cast ouide and worked up the same as India-rubber. By slightly varying the proportion of the three ats of which the substance is chiefly composed, its character may be modified in various ways dong to the practical purposes for which it is required.

Engineering and Mining Journal 1880

New Submarine Cable.

New Submarine Cable.—The cable made at the factory of Berthoud, Borel et Cie, Cortaillod, Switzerland, has a single conductor, composed of a strand of 7 copper wires. The diameter of the strand of the cable is in the insulating material used. The copper conductor is surrounded by three layers of cotton tape, so soon as the weaving of the cotton covering is finished the wire is immersed for an hour in a bath of paraffin, at a temperature of 180° C. Thus all moisture is expelled from the cotton, which then absorbs the melted paraffin. The cable is then passed through a powerful press, which covers it with a leaden tube, the smoothness between the cable and the tube being hermetically filled with caoutchouc (a resin).

Thus the insulating envelope consists of cotton boiled in paraffin and of caoutchouc. Experiments made by Messrs. Schmeckebier and Zeiler, of the polytechnic school at Zurich, show that the cable possesses very considerable electrical advantages over those insulated by other methods.

Engineer Nov 26 1880

It is announced, says the Geneva correspondent of the Times, that the electric cable constructed by Messrs. Berthoud Borel and Co., of Cortaillod in Neuchâtel, have made a highly important discovery in practical telegraphy. After a long and expensive series of experiments they have succeeded in devising a method of laying cables whereby the inductance of the electric current is entirely overcome, and thus the speed of signalling may be increased. This discovery, it is asserted, removes the last obstacle in the way of the widest possible extension of facilities for telegraphic communication. Post 29 Nov 1880

Engineer Nov 26 1880

803,—Covering Wire with Insulating Material.

No. 1 J. G. L. Lemiler, London. (1d).—The object of the invention is to provide a covering for electric wires which shall be strong in the direction of the length of the wire, and which is a non-conductor of glue or gelatine is applied to the wire, and a covering of paper is then applied to the wire, which is coated with a solution of gelatine, or such glue or gelatine as may be required, the superfluous glue or gelatine being removed by passing the wire through a gauge. (Dated 1, 1880. Not proceeded with.) Complete specification not supplied to the questioned.

1,886.—Insulating Material for Insulating Electrical Conductors. C. D. de Allen, London. (4. Revised ed *J. L. Knox, Brooklyn, New York.* [Ed. T'rpr].—Consists in making electrical conductors, more especially such as are employed in submarine cables, of a core or centre composed of a fibrous material, as hemp, or of several strands, with a waterproof coating or covering of Trinidad or other natural asphaltes, mixed with resin, drying and softening material, such as paraffine oil, petroleum

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residuum, &c. The properties of native bitumen and asphaltic material depend upon the nature and character of the bitumen and the extent to which the constituent oils have been driven off. A material found to answer well is a mixture of 50 parts of Trinidad asphaltum mixed with 50 parts of petroleum residuum. The ingredients are melted over coals with a continuous covering of thread-like material applied in any convenient manner to the conductor, which is then passed through the mixture, by means of a suitable arrangement of material kept by rest in a liquid condition. In covering a cable between conductors, the core may be covered with hemp, or other fibrous material, and the conductors, or strands, or core, previously covered with the compound, as above, or the core may be covered with the compound, as above.

Engineering Nov 11 1881

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS HOLMS, F.C.S.

(CONTINUED FROM PAGE 305, VOL. V.)

LECTURE VI.—DELIVERED MARCH 8, 1880.

Gutta percha. Sources. Chemical nature and physical properties. Applications in connection with the industrial arts. Vulcanisation of gutta percha.

Gutta percha is quite secondary to india rubber as regards the number of its industrial uses, but there are cases in which it could be used if replaced by india rubber. It differs from rubber, principally in being more readily softened by heat, in being far less porous, and in lacking that ready extensibility by tension which is especially characteristic of caoutchouc.

The *Isonandra gutta*, a fine tree, which often grows to a height of over 80 feet, and whose stem attains a diameter of three feet or more, is the principal source of the milky juice or sap which, when inspissated, forms the gutta percha of commerce. The *Isonandra gutta* flourishes notably in Singapore, the eastern part of Sumatra, Borneo, and Java. The lantern slide now projected on the screen (Fig. 31), will serve to illustrate to you the appearance of the foliage, flower, and fruit of the tree in question; and next I will show you a slide which represents the operation of collecting the juice or sap (Fig. 32).

The *Isonandra acuminata*, also an East Indian tree, yields some gutta percha; while the *Dejoda walkeri*, or South American bully tree, has of late years afforded a considerable supply of an excellent quality of gutta percha, which passes under the name of "balata."

Gutta percha appears to have been first introduced into this country by Dr. W. Montgomerie, who, in April, 1843, presented some of the raw material, and also a riding-whip made of it, to the Royal Asiatic Society. Some months afterwards, Dr. Montgomerie presented some of the material to this Society, and a man immediately took steps to prove its applicability to various industrial purposes; and the foundation of the gutta percha industry may be said to date to him.

The operation of collecting the sap of the gutta percha trees (Fig. 32) is not very different from the corresponding operation with the juice of the rubber trees. But as the gutta percha juice concreting sap into rough balls or cylinders.

On the table you will find a very interesting collection of samples of raw gutta, some of which are roughly moulded into

THE FOLIAGE, FLOWER, AND FRUIT OF THE ISONANDRA GUTTA.

representations of animals, while others are of interest as enclosing stones, lumps of wood, and other adulterating materials. For the greater part of them I am indebted to the Gutta Percha Company of London.

The essential ingredient of gutta percha is white, and appears to be identical, as regards ultimate composition, with caoutchouc. Faraday gives the following figures as the result of analyses of these bodies:—

	Gutta percha.	India rubber.
Carbon	87·3	87·5
Hydrogen	12·8	12·5
	100·0	100·0

The purification of gutta percha can be readily effected by dissolving the crude material in carbon disulphide, and after filtration, evaporating the solution. Here is some carbon disulphide, and just see how readily these parings of raw gutta dissolve in it. Let us now filter the solution, and pour some on this levelled glass plate. The solvent will soon evaporate and leave a skin or film of gutta percha. Here is such a skin, or sheet of gutta percha, which is now ready to be stripped from another plate, as the solution was poured on this glass about an hour ago. You see that it is nearly white, and when softened by heat it becomes most perfectly plastic. The method of purifying gutta percha just demonstrated was proposed by Parkes, as the foundation of an industrial process for refining gutta percha; but mechanical purifying methods have been generally adopted on a larger scale.

Purified gutta percha as now shows consists of three constituents. The most important is pure gutta, or the plastic principle; and this forms about four-fifths of the whole. Its chemical composition corresponds nearly with the formula $C_{10}H_{16}O$. Albane is valueless in gutta percha, and corresponds in composition to the formula $C_6H_{10}O$. Albane is soluble in hot alcohol, and consists, like the body which is to be next alluded to, a product of oxidation or decay. The third constituent of the purified gutta is called fluavile, and forms a yellow oxidised resin which is soluble in cold alcohol, and has a composition which may be said to correspond with the formula $(C_{10}H_{16})_2O$. It is often present to the extent of 4 to 5 per cent. in gutta percha of good quality; while the amount of albane contained in good commercial gutta often reaches 20 or 25 per cent.

Like caoutchouc, gutta percha is attacked by ozone with great energy, and when exposed to the ordinary conditions of the atmosphere it becomes oxidised and brittle with so much rapidity that old articles made of gutta percha are usually brittle and useless. Most liquids which dissolve caoutchouc also dissolve gutta percha; but in the case of the gutta there can be little doubt that true solutions, rather than starch-like magmas, are formed.

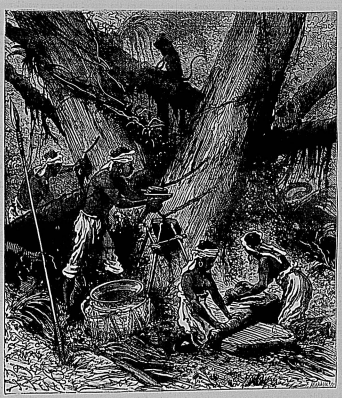
Gutta percha resists the action of alkaline liquids and of dilute acids, but strong and slightly warm sulphuric acid clears it readily, while concentrated nitric acid converts it into a yellow resinous body. Like caoutchouc, gutta percha is an admirable electrical insulator, and also a very useful non-conductor of heat.

When submerged in water, or in any way protected from the action of air and light, gutta percha has little or no tendency to change; while, on the other hand, constant exposure to light, together with alternating conditions of dryness and dampness, is

A temperature of 50 deg. Centigrade serves to soften gutta percha to such an extent that it may be easily moulded into any required form; while at 100 deg. Centigrade, it becomes adhesive and pasty; and at 120 deg. it may be said to fairly melt. The products of the dry distillation of gutta percha are generally similar to those obtained by the distillation of caoutchouc.

In the next place, let me very briefly call your attention to the methods employed for effecting the purification of gutta percha on an industrial scale, those being, in the main, due to Charles Hancock.

The first operation is to chop up the crude gutta into slices o



COLLECTION OF THE JUICE OF THE ISONANDRA GUTTA.

sharings, by means of knives or cutters attached to the face of a revolving wheel. These knives are now often made with saw-like edges, each tooth being sharpened like a lancet; and it is found that the effect of this modification is to reduce the gutta into small fragments, like raspings. The finely-divided gutta is next soaked and boiled in water, in order that particles of earthy matter may sink, while the gutta floats. During this process many particles of woody matter become so far soaked with water as to disengage themselves from the gutta and to sink, while any soluble impurities naturally become pretty thoroughly removed.

45 CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

LECTURE V. DELIVERED FEBRUARY 20, 1880.

(CONTINUED FROM PAGE 293.)

The property of ebonite just illustrated may have a practical application in this way. It is often desirable to obtain suitably a reversed reproduction of a printing block, and this may be done in the following manner:—Make a mould in fusible metal of sheet of ebonite, this being slightly warmed, so as to obtain a sunk impression; and the ebonite plate is next placed off hand or rubbed down by an abrading material, after which it is exposed to a heat of about 140 deg. Centigrade. The compressed lines now rise up and form a printing block, which is an exact reproduction of the original, only it is left-handed or reversed, and to do it for printing it is only necessary to deepen the widely-extended whites by means of the ordinary wood engraver's tools.

Ebonite forms very good printing blocks or stereotypes, there being made just as in the case of the soft rubber stamps (p. 787).

You see before you this evening a very fine collection of articles manufactured from ebonite, these not only serving to illustrate the manifold uses to which this material is applied in connection with the industrial arts, but also to exemplify the variations which may be produced in the material itself; as regards hardness and elasticity, by varying the composition of the original mixture in accordance with the principles already explained. In the case of specimens lent by the Silvertown Company you see a number of small articles of exquisite finish, and you will not fail to notice the colloquial thimble, the pen holders, &c. Messrs. Gow and Co. have lent me two extremely fine specimens of vulcanite work, one being a wheel-and-rounded pinblock shallow chuck, supported by turned columns of the same material, and the other being an inlaid stick, built up of a kind of mosaic, formed out of variously coloured pieces of vulcanite, and you will notice that some of the specimens are nearly white. The conditions under which nearly white and coloured vulcanite can be obtained will be explained further on. Mr. Falkenstein, of the Britannia Rubber and Manufacturing Company, has brought me some admirable specimens. You will notice the thin ebonite sheet, almost like paper, which this firm manufactures, and also the extensive selection of fancy and ornamental articles, these being, for the most part, made after Mr. Falkenstein's own designs. Here is a reproduction of a medal, which has been moulded in vulcanite by Messrs. Mackintosh, of Manchester.

Ebonite works very much like horn or ivory, and can be very readily turned at the lathe, but a high rate of speed is required. A finish can be given to the articles by the use of fine-glass paper, followed by the 000 emery paper used by watchmakers, after which a fine polish can be rapidly given by the arrangement to be described. A number of small pieces of ebonite, such are chessmen, draughtsmen, &c., are finished on a spindle, and this is made to revolve at a very high rate of speed—my about 4,000 revolutions per minute. This polisher being slightly charged with fine brick-dust and water, oil, or powdered pumice, the articles are polished and finished in a few seconds, when they soon receive a high degree of polish. Rotton-stone may also be used on a polisher of this kind; and one considerable advantage attending the use of the polishing apparatus is that in the case with which the ordinary charged with tripoli or rottenstone.

Many metals, especially iron, may be imbedded in soft ebonite and fixed very readily by vulcanisation; and advantages is taken of this circumstance in many cases. Thus, the handles of steel and iron screws may be first advantageously clothed with ebonite, in manner. Again inlaid rubber rollers are usually fixed on to their iron spindles by means of a layer of soft rubber serving as a cement; the ebonite and the soft rubber adhering perfectly, while the somewhat hard rubber fits the iron, especially if the metal is previously tinned before the application of the soft material.

To give anything like a list of the applications of ebonite to the industrial arts would be impracticable, but its more important uses are illustrated by the specimens before you. The characteristic properties on which its usefulness principally depends are its hardness, elasticity, electrical non-conductivity, freedom from porosity, and its inertness towards most chemical products.

Vulcanite may be obtained in a coloured form by incorporating with it a large proportion of certain pigments, such as nitre, marine, vermilion, sulphide of cadmium, sulphide of antimony, or oxide of chromium; while, if it is required in as nearly possible a white state, oxide of zinc and sulphide of zinc may be used. When these pigments are incorporated there is not the same necessity for pushing the vulcanisation to such extremes as when rubber and sulphur alone are employed, as the pigments themselves given a certain degree of hardness. In such cases the proportion of sulphur in relation to the rubber, may be very much reduced, and it is generally sufficient to carry on the curing to a point between the third and fourth stages, as already defined. At this point the rubber has a brownish or dark olive green colour, but the presence of a large proportion of pigment serves to mask this.

Dental rubber, the material used for setting and mounting artificial teeth, consists of a highly pigmented vulcanite, made to imitate the natural colour of the gums. There are on the table some very fine samples of the material in question, and for a position of them I am indebted to Mr. Sangster, the representative of the *New York and Hamburg India Rubber Company.*

Dental rubber forms a very convenient material for the making of various small articles, and is may be readily cured to the small vulcanisers which were shown you on the occasion of the third lecture. (Figs. 26, 27, and 27, p. 299.) When it is desired to have a dental rubber which can be rapidly cured, the following composition will serve:—

Washed Borneo rubber	25
Vermilion containing 25 per cent. of free sulphur	30
Powdered sulphur	5
Sulphide of zinc	30
Sulphate of strontium	20
	100

It is, however, better if colour and quickness of curing are not very primary objects, to approximate more nearly to the composition of ordinary ebonite. As for example :—

Rubber	45
Vermillion, as above	30
Sulphur	15
Sulphate of strontium	10
	100

A small portion of fine gutta percha may be incorporated with the material for dental rubber, the result being advantageous in many cases; and also it is sometimes desirable to use asbestos for ordinary ebonite.

The tensile and heat of ebonite may be compressed in hot moulds, so as to form buttons or other small articles, or these residual products may be mixed with new rubber and subjected to form a second quality of ebonite.

When ordinary vulcanised rubber is heated to 230 deg. Centigrade, or until it melts, a permanently viscous product is obtained, and this substance, if mixed with emery and sulphur to a kind of paste, forms a material out of which the so-called application emery wheels or grinders may be made, these materials being next hardened or cured by the application of steam heat. Emery wheels and bones upon this principle were introduced by Deplanque, about 23 years ago.

Thirty-five parts of old vulcanised caoutchouc having been placed in a kind of still, heat is applied to the mass, the operation being assisted by the gradual addition of about ten parts of heavy coal oil; but this latter is often objectionable, and a reduced caoutchouc is then incorporated with 200 parts of emery of the required degree of fineness, and nine parts of sulphur. These materials having been thoroughly mixed, the hones or wheels are manufactured, and afterwards cured or baked at a heat of 140 deg. Centigrade, during a period of about eight hours. Grinding wheels, made in the above manner, can be worked at a speed of 2,000 revolutions per minute, and are extremely useful for the working of hardened steel or other elaborate manufactures. Some of the wheels, and also some knife sharpeners, are now on the table before you.

The substances for inlaid rubber are of comparatively little importance in relation to caoutchouc itself. Celluloid, however, is occasionally used in the making of flexible tubes for feeding gas or for surgical purposes; indeed, I should refer you, for instances, to the small articles after they have been built up of fibrous material. Such tubes, of which several specimens are before you, are far inferior to rubber tubes in most cases, and are formed by repeatedly varnishing the fibrous hose with a mineral-oil-prepared linseed oil varnish.

Vulcanised oil is, perhaps, of more interest, and many oils, such as linseed and others resembling it, may be vulcanised by being heated for some time to 120 deg. Centigrade with 12 to 20 per cent. of sulphur. The product obtained is soft, and somewhat resembles very bad India rubber. By increasing the proportion of sulphur very much indeed, say to four times the weight of the oil, and vulcanising at a higher temperature, a hard substance, resembling inferior vulcanite, is obtained.

Soft and hard vulcanised oil have been introduced into commerce at various times and under many names, but these materials never seem to have made very much headway.

Various products, having properties or suitable application as their basis, have been introduced as substitutes for hardened caoutchouc. Parkesine, a substance made by incorporating pyroxyline and linseed oil, forms a material well fitted for the manufacture of knife handles or similar articles, and I will now hand round a very beautiful specimen, which is well worthy of your notice.

The substance now known as celluloid, which consists essentially of pyroxyline and camphor, appears, however, to have characteristic properties which will enable it to fulfil certain purposes for which vulcanite is ill-adapted.

A solution, containing about equal parts of camphor and tetrachloride of carbon, preserves or softens pyroxyline very readily, and if such a solution is incorporated with a sufficient proportion of the soluble nitro-cellulose, a dough-like mass is obtained, which hardens on the evaporation of the tetrachloride by means of alcohol, and forming the product into sheets. This substance is exceedingly tough, while it has the advantage of being free from exudation, and is capable of resisting the action of heat to a considerable extent.

Celluloid and analogous products have the disadvantage of being very inflammable, and instances have been known of these bodies igniting by spontaneous combustion.

Bottons, combs, billiard balls, and other similar articles are made of celluloid, the soft material being usually forced in iron or steel moulds. More wonderfully perfect stereotypes may also be made of the material in question. Celluloid is also coming much into use for making artificial gums or bases for teeth.

THE ELECTRIC RESISTANCE OF GLASS.*

Mr. Thomas Gray, Demonstrator of Physics and Instructor in Telegraphy at the Imperial Engineering College of Yedo, Japan, has made a series of careful experiments on the electric resistance of glass at different temperatures, with a view of finding whether the variation of resistance with temperature followed a law sufficiently definite to allow the resistance at low temperatures of highly insulating glass to be approximately calculated from its resistance at higher temperatures. The chief object was to use the law of with results obtained by the galvanometric method of measuring the resistance, for the comparison of specific resistance of different kinds of glass.

Published observations on the resistance of substances, such as glass, porcelain, marble, slate, coke, &c., as well as experiments on good conductors, have generally led him to express the law of variation of resistance with temperature by an equation of the form

$$R = \frac{1}{a + bt + ct^2}$$

where R is the resistance at the temperature t, and the constants a, b, and c are quantities depending on the material. The fact of opinion that some such law as this will be found to hold good in all dielectrics when the effects of the permanent changes produced in the glass by heating are eliminated. These changes are, however, of considerable magnitude in the case of glass, so that it is to them especially he especially calls attention in the paper we quote from, which appeared in the *Philosophical Magazine* for October.

With the exception of one experiment, in which a Thomson quadrant electrometer jar was used, the results were obtained from ordinary glass test tubes which had lain in store for years at the College. The resistances were measured by direct deflection of the needle of a Thomson reflecting galvanometer, produced by the current through the glass. The battery used was composed of ten Daniell cells; but a low temperature a battery of fifty Daniell cells was sometimes employed. Mr. Gray was thus able to measure a resistance equal to 5 × 10⁹ ohms per cubic centimetre in his test tube experiments, and equal to 16 × 10¹² in the electrometer jar experiments. The test tube glass had a greater resistance considerably below the temperature of boiling water, than the electrometer jar reached the latter fluid at a temperature of about 100° C.

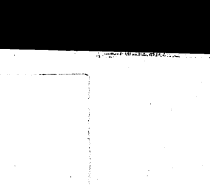
One advantage in these experiments of using this galvanometric method of measuring the resistances, rather than the method with electrometer and condenser of great capacity, was the case with which the temperature and resistance could be simultaneously observed.

In determining the resistances two methods of observation were employed. One consisted in passing the current through the glass first in one direction and then in the opposite direction, and taking the deflection in each case half a minute after the battery had been applied. The mean of these deflections was then taken as the deflection corresponding to the resistance to be measured; and the mean of the temperature was taken as the temperatures of that particular determination.

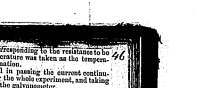
The second method consisted in passing the current continuously through the glass during the whole experiment, and taking deflections by short circuiting the galvanometer.

The first method gives the resistance before any very great amount of polarisation has taken place, at least before more than is proper to that temperature has taken place. The second method gives during the heating pretty nearly what is believed by some to be true resistance, but it also shows whether more or less polarisation takes place when the temperature is high than when it is low. It therefore gives some indication of the effect of the current flowing constantly through the glass while its temperature is being changed.

The results which Mr. Gray has obtained agree with the well-known result that the resistance of a piece of glass diminishes as the temperature is raised; but they also show that the resistance varies more slowly when the glass is cooling than when it is being heated, and that a piece of glass may have its resistance greatly increased by being slowly raised to a high temperature and slowly cooled. There seems, therefore, to be what may be called a permanent change in the quality of the glass, which takes place coincidently with a quasi-elastic change in the quality; and a comparison of the results obtained when the glass was cooling with those obtained when it was being heated, showed that some such opposition as that which has been stated above probably expresses this latter change. Whether the former change is really permanent or not (that is, whether the glass retains this increase of specific resistance at low temperatures) Mr. Gray is not yet in a position to say with certainty; but from observations which he has made Mr. Gray is inclined to think that slow changes take place in glass, tending to raise its conductivity and also its specific inductive capacity. He is not aware that any considerable deterioration in the insulating power of glass stems and electrometer jars has been detected; but in such cases the experiments start to at least a temporary cure, namely, *heating the glass at a high temperature for a considerable time.* This accords with the treatment sometimes adopted for badly-insulating ebonite.



1859.* Insulators: G. Wells, London, and A. Gibbons, Worcester Park, Surrey, &c. 2 Fig.—Our object is to secure telegraph wire, so that in the event of its being broken by any accident, it shall not fall to the ground. In the ordinary mode of fixing the wire round the insulator has hitherto had to be wound in a screw bolt *d*. The wire after being severed, is held in the groove *g* for its reception in the porcelain and the cap *c*, which has a corresponding groove, is placed thereon, and the bolt *d* screwed down, thus holding the wire in the groove. Between the two grooves is a narrow chink. The



bolt *d* is not to allow of the wire being really unplaced or removed. (April 13, 1860.

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13

BORNEO.—In 1870 gutta percha and india rubber goods to the value of 37,720 dollars was exported from Brunei to Singapore, while Labuan and Sarawak exported to the value of 47,310 dollars and 361,794 dollars respectively. The total amounts to over £91,000. Edelman Jan 8 1871

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Mowbay, Rammond Simons, and Co., Cortaillod, Switzerland, write with regard to the recently announced discovery of a way of laying cables whereby the induction of electric current from one wire to another, although the wires are in juxtaposition, is prevented, and say that the fact is that it is not by laying cables in more difficult positions that we can overcome the difficulty of induction, but by the means which we have employed. We may be gratified to hear of such efforts to lower telegraphic rates made with some of the best telephonic appointed provided, and able to be facilitous as regards industries; as that, several conducting yet into one cable, some of them may be used for telephonic and the others for telephonic purposes at the same time without any disturbance whatever in one of the lines.

FIRM CAUGHT BY AN ELECTRIC BATTERY.

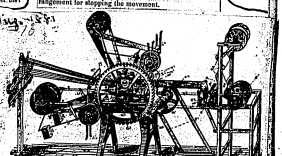
From the Tilbotts Herald, Aug. 9, 1871

Shortly after 5 o'clock last evening the cry of fire was heard on Spitalfields street, and as usual the different hose companies responded to the alarm, running to the old Exchange. Another item, that last their hose and were ready for business, but fortunately their services were not required, for the flames had been already extinguished by a few pails of water, which was all that was necessary to do so. An examination of the premises showed that in the battery room of the West. Union Telegraph Company's office, on the second floor, the fire started, and, strange to say, the origin of fires never occurred. The room is about 10 by 12 feet, and when the alarm was given it was filled with dense smoke, so much so that it was impossible to enter the room without the use of water. Upon entering the room it was found that the fire originated in the battery, and from there had communicated to the woodwork of the room, and the entire ceiling was on fire. The battery used here came from Worcester, and the only possible explanation of the fire is that the battery had become heated by a defect in the battery, which is the wonder is that more serious damage did not occur from the alarm of the fire was not discovered by one of the office boys, and by the prompt use of the water from the pails and a few pails of water the fire was extinguished. Much credit is due the office boys for their prompt action in thus saving the wires and apparatus from destruction.

APPARATUS FOR MAKING INSULATED TELEGRAPH WIRES.

The interesting apparatus for the manufacture of insulated telegraph wires, which we herewith illustrate, is the invention of Mr. Thomas J. Nygall, Reading, Mass. Without going into wearisome detail, its object and method of operation may be briefly described as follows: The strips of rubber and graphite compound are wound each on a separate drum, with a layer of muslin between the layers, to prevent sticking. From these drums the two layers are led to a pair of pressure-rollers, where they meet and inclose between them a number of wires that are drawn off from a series of reels. The two strips and the wires inclosed are pressed by the rollers into a compact band, which passes out between cutting-rollers, which trim off its edges, then through a box of powdered talc, and to a receiving roller, whereon it is wound with an interposed layer of tin-foil. An automatic mechanism stops the machine when a wire breaks.

The main features of the apparatus are, a supporting frame, driving-pulley, shaft and gears, pressure-rollers, spools, guide-bar, and guide-rollers for the wire, trimming-roll and cutters, box for powdered talc, and condensing-rolls, with levers, weights, and arms, and automatic arrangement for stopping the movement.



APPARATUS FOR MAKING INSULATED WIRES.

Aug. 7 1871

Jun. May. 4. 1871.

The Electric Light Wires.

TO THE EDITOR OF THE SUN.—SIR: In an article entitled "Fun in my Electric Light Wires" published to-day, I notice that City Electricians Smith has made some very remarkable discoveries relating to the action of electric light currents. The current under his manipulation seems endowed with many novel and wonderful powers. He makes telephone tremble that we had supposed to be quiescent, and he has found that a telephone wire, when not in use, is a receptacle of electricity, and will receive and transmit it to the end of the line. Indeed, he has found that the electricity will pass from one wire to another, and that a current will flow in a reverse direction to that which is passing through the wire. The first and only point at which the insulating covering of the wire is destroyed is at the dynamo engine, where, after the light itself is created, and then and then only can the current be properly utilized and the forces of the current allowed to act.

Electric Light Wires in Underground.

Mr. Thomas A. Edison addressed a letter recently to the New York Board of Water Commissioners, which he wrote:

"I have now that the system of electric lighting of the Edison Electric Light Company is absolutely free from any possible destruction from the operation of the Gas Company, Water Company, Steam Heating Company, or the Fire Department, unless something should occur to destroy all the buildings covered by the mains, and even in such a case the wires would be found in good order after the ruins had been cleared away. From the nature of the system it is impossible for the wires to become crossed with other wires, or to be in contact with gas, water, or steam pipes, or with the earth, and consequently serious accidents cannot occur."

Evening Mail, May 6. 1871.

LIGHT VS. DEATH.

ALLEGED INJURIES ARISING FROM THE USE OF ELECTRIC LIGHTS—THE EDISON INSULATED SYSTEM—ALL CAUSE OF APPREHENSION DISPELLED.

An article which appeared in last evening's *Post* and another which was published in the *Sun* of to-day, bearing upon the alleged perils of running the wires of electric light over houses, have produced a decidedly unfavorable impression, especially as the Board of Underwriters have considered the matter and have decided to rate all buildings into which the electric wires are run as extra hazardous, and have further decided to require the proper authorities to see that the electric wires are properly insulated.

This is understood to refer to the wires of the electric insulated conductors (subscribed for by the Fire Department) of the Edison Electric Light Company, and satisfactorily tested as to their perfect insulation. Under these circumstances, all of whom interested in the matter are applied to their wires. In conversation upon the subject the following information was had of the manner in which the wires are constructed and the precautions which are taken to prevent accidents to the operators.

"In the first place," said one of Mr. Edison's electricians, "our wires themselves are thoroughly insulated, being completely covered with a rubber coating, and then they are laid in pipes which are subjected to the constant passage through the circuit, which, should there be any more than the ordinary force of current, would open and prevent any such damage as is said to have taken place in the case already published. Another thing of great importance is the manner in which we connect instead of running our wires over the tops of houses or on poles, as our contemporary complains about, therefore we are enabled to run to lay our wires under ground next to the curb, and then connect with the houses by means of insulated rubber, and, bordering silently through the eaves of the house, to the electric current, thus causing the double covering of the wires themselves to any means should become broken or otherwise injured.

In front of the building the wires into which the current is to be conducted there will be a junction box, by means of which another and smaller tube, also thoroughly insulated on the inside, will be connected with the main tube, through which the branch wires will be conducted, into the building. You must bear

"If running our electric light wires through the air may be required in the vicinity of any inhabited street may be required in the vicinity of any inhabited street may be required in the vicinity of any inhabited street

49 Railway Engineer Nov 15, 1881

DANGER FROM ELECTRIC LIGHT WIRES.

The best means for the distribution of powerful electrical currents is a question of constantly increasing importance. The numerous accidents which have occurred have naturally drawn the attention of all interested persons to the matter, and given rise to the query, how far such currents are likely to cause fires. The burning of the Randolph Mills, in Philadelphia, which doubtless was caused by sparks from the electric lamps falling upon combustible material, has directed attention to another cause of danger, and one which must be speedily remedied if the electric light is to find any employment in interior lighting.

While it is very important to fully realize all possible sources of danger, and to take every means to avoid accidents, it is unwise to magnify the evil, and circulate reports and statements which are not in strict accordance with facts.

We have noticed many statements in print, in which the writers seemed to have no knowledge of the difference in properties between frictional and dynamical electricity.

It certainly is very essential that wires conveying these strong currents should be properly insulated; and we hope the time will soon come when wires for electric lighting, telegraphic, and other similar purposes, shall be placed under ground.

The wires employed in distributing the current for the arc lights in this city are of such size that there is no heating effect produced, and consequently no fire could occur from the simple contact of these wires with combustible material. When the wire is too small for the current it becomes heated, and, under certain circumstances, would become incandescent.

If a wire conveying a strong current should come in contact with a smaller wire, as those employed in constructing telephone lines, the latter would become greatly heated, and produce serious results. This has happened in this city several times, and some instances has caused considerable damage. This heating effect would also be produced in case the larger wire should be nearly severed, thereby diminishing its power to convey the current.

At the recent meeting of the National Association of Fire Engineers, at Richmond, the following resolutions were passed, relating to the construction of lines of wire, for electric lighting: "First—That the wires shall be distinct from all others, and protected in such a manner that firemen can recognize them at all times. Second—That they shall be thoroughly insulated. Third—That there shall be, upon the exterior of all buildings where the wires are introduced, an absolute cut-out (not to be shunt), so that, in case the firemen are called upon by cause of fire to enter there, the danger of instant death—the inevitable result sometimes of coming in contact with improperly insulated or broken wires—may be in a great measure avoided."

Electrical machines, with alternating currents, especially when of high electro-motive force, are very liable to give shocks producing death; but in the case of machines with continuous currents there is less danger of so serious results.

Engineering Jan 5, 1884

Electric Resistance of Insulators.

M. Foussereau, who recently devised the method of measuring high resistances of insulators by the time necessary to charge a condenser through them to a given difference of potential has applied the method to determining the resistance of different insulators, and his results were communicated to the last meeting of the French Academy of Sciences by M. Jamin. The resistance of porcelain is then found to be 781 million megohms at 60 deg. Cent., and 0.602 million megohms at 160 deg. Cent. per cubic centimetre. Were a cross of resistance at different temperatures thus prepared a useful pyrometer might be the result. Sulphur gave a resistance of 7.39 million megohms at 142.1 deg. Cent.; and 2030 million megohms at 49 deg. Cent. per cubic centimetre of substance. Below the last temperature its conductivity ceases to be measurable. Left to itself the sulphur takes a vitreous texture on cooling, and on cooling to an average temperature of say 17 deg. Cent. the resistance becomes 1170 million megohms after one day, and 766 million megohms after two days. An octahedral crystal of sulphur at ordinary temperature gave no sign of conductivity; but at 80 deg. Cent. conductivity begins to appear. Crystallization, therefore, seems to render sulphur more insulating. A fact which is worth bearing in mind. In passing to the liquid state sulphur becomes at once four times more conducting. Ordinary phosphorus has a resistance much lower than the above substances. Solid phosphorus has a resistance of 84,000 megohms at 15 deg. Cent. per cubic centimetre, and 15,000 megohms at 42 deg. Cent. This great fall materializes it to sulphur. The specific resistance of liquid phosphorus is 2.30 megohms at 25 deg. Cent. and 0.34 megohms at 100 deg. Cent.

Eng. Mech. + World of Science Aug. 8, 1884

Electric Resistance of Glass.

Messrs. T. Gray, A. Gray, and J. J. Dobbie, of Glasgow University, have been investigating the electrical resistance of various kinds of flint glass, as made by different makers. The object was to find out the relations existing between the resistance and the chemical constitution of the glass. The experiments made by immersing flasks of the glass in mercury and filling up the interior with mercury. The resistance was measured electrodes to convey the current through the glass cells through the glass, and the resistance measured by a bath, resistance=resistance of the glass increased with the percentage of lead in the glass, and also with the temperature. Not disdeleted as the percentage of alkali in the glass increased. The best specimen tried contained 54.46 per cent. of lead oxide, and had a density of 3.713. Its resistance, at a temperature of 15deg; Cent. was 4,000,000 ohms between two opposite faces of a centimetre cube. The experiments show that the resistance of glass is reduced by an increase of about 8deg; Cent. This may be taken for a considerable range of temperature, but for approximate resistance of glass of a certain composition may be estimated. In taking the temperature observations, the glass flasks were heated by means of a sand bath.

Engineering 8 Jan 1885

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Underground Conductors for Electric Lighting.

The Brush Electric Company in Philadelphia, made a thorough trial with buried conductors in the portion of the circuit lighting Delaware Avenue. The circuit proved unsatisfactory, and in time became open. On examination it was found that the wires had become attenuated in parts, as if subjected to electrolysis, and even wasted entirely away in places. The sand around these wires had become at intervals fused into short rods a few inches in length, similar to the fulgurites produced when a thunderbolt strikes dry sand. Gas from the street mains leaked into the conduit around a short underground system on Chestnut-street and produced a violent explosion. Whether any are formed at a poor contact was the cause, or whether it was produced by some other means, will probably never be known.

Terrestrial Magnetism in Russia.

General de Tillo has completed his researches on the intensity and distribution of terrestrial magnetism in Russia. He finds that the secular variation of the intensity is a function of the latitude and longitude of the place, and has compiled tables showing how much the horizontal intensity varies annually with the latitude and longitude. The annual variation of total intensity is always the same for latitudes from 30 deg. to 80 deg. N. on the meridian of 29 deg. E. from Greenwich; but it is different for different longitudes, diminishing as the longitude increases. Thus:

Annual Variations of Total Intensity.

Longitude E. of Greenwich. deg. deg.	
15 — 30	+ 0.0015
30 — 45	+ 0.0010
45 — 60	+ 0.0005
60 — 75	+ 0.0000

Prolable error ±0.0009

Recrushing Copper Matte.

We recently reproduced some information from the *Engineering and Mining Journal*, concerning the successful starting of a Manhès plant at Butte City, Montana. It was stated that the creation and starting of this plant were carried out by a Mr. E. D. Peters, but it now appears that this was a mistake made by the *Engineering and Mining Journal*, and that the work was really done by three French gentlemen who came over from France specially for the purpose, and who, apparently, represented the "Société anonyme de Metallurgie du Cuivre," which company we infer to be the proprietors of the patents connected with Manhès' process. As this is, so far as we are aware, the first instance of the adoption of the process out of France, the facts connected with it are of considerable interest and importance. It is also now stated that the matte which was so successfully converted into copper of 98.9 per cent. pure copper, assayed 63 per cent.

The New York Elevated Railroads.

The elevated railroads in New York present greater advantages for the use of electricity as a motive power than any other combined, and the company has approached the question in a manner as cool, energetic and businesslike. The representatives of the company in electric matters owned by Edison, Field, Daft, Brush, and Siemens, are to form a company of 1,000,000 dols. capital. Half of this amount is to be paid to the patentees in accordance with a valuation ascend by a Board, consisting of Sir William Thomson; George B. Roberts, ecting of Sir William Thomson; George B. Roberts, President of the Pennsylvania Railroad; J. H. Ralfer, President of the New York Central and Hudson River Railroad; Robert Harris, President of the Northern Pacific Railroad; and Professor Charles R. Cross, of the Institute of Technology. Experiments are to begin at once, and a third rail, weighing about 60 lb. to the yard, has been laid between the tracks of the Second Avenue Elevated Railroad to serve as an electrical conductor. It is expected that the Board will report early in March.

Engineering - Jan. 2, 1885.

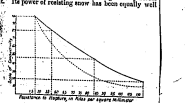
SILICIOUS BRONZE CONDUCTORS.

From time to time, articles have been published in Engineering upon the various properties of silicious bronzes. Since the subject was last mentioned in these columns, the application of wires made from this alloy has been greatly extended, while on the other hand, the method of manufacture has been considerably improved. The two types of wires employed until recently possess the following characteristics:

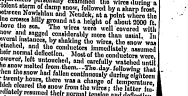
1. Telegraph wires. { Conductivity 97 per cent. Resistance to rupture, 45 kilos. per sq. mill. (28.57 tons per sq. in). Conductivity 22 per cent.

2. Telephone wires. { Resistance to rupture, 75 kilos. per sq. mill. (47.62 tons per sq. in.

Quite recently, at the request of the Eastern of France Railway Company, M. Lucien Werdin has developed a new type of telegraph wire, possessing less conductivity than the former, but having considerably higher tensile strength, which allows the wire to be more lightly suspended, so that posts may be placed at greater distances apart. This new wire has a conductivity of 30 per cent., and a tensile strength ranging from 65 kilos. to 70 kilos. per sq. mill. (41.26 tons per square inch). At the same time M. Werdin has considerably modified the characteristics of his silicious bronze telephone wire, raising the conductivity to 42 per cent., and the tensile strength to 52 kilos. (33.66 tons per square inch). He now also manufactures a special type for wire-spans with a conductivity of 24 per cent., and a tensile strength of 110 kilos. to 115 kilos. (69.84 to 85.70 tons per square inch). The annexed diagram shows graphically the different properties of these wires. By connecting the points referring to each wire with a continuous curve it will be seen how the relations of conductivity to rupture vary. The dotted lines refer to the old, and the full line to the new wires. The extensive use of silicious bronze for telegraph and telephone systems affords further experience as to its



behaviour in practice, especially as to the manner in which it resists the effects of wind and snow. The Consolidated Telephone Company has several stages in Prague, Trieste, Lemberg, Gratz, Crucovic, Cracow, Pilsen, Reichenberg, and Budin, in all of which silicious bronze is wholly used. That at Trieste has especially been subjected to the test of wind, during the frequent and violent storms known as "Bora," and which habitually levies tribute in the shape of uprooted posts and broken wires. Thanks to the small diameter of the silicious bronze conductors no damage has been sustained by them on account of these storms. A similar experience has been made at Rahon, where a very violent tempest, and where in one case the wire was subject to more than 1000 lbs. was exposed to the action of a wind blowing directly across it. No power of resisting snow has been equally well



established. Thus on the Cisalpine-Nasdale Railway, belonging to the Austrian Local Eisenbahn Gesellschaft, the engineer at the head of the telegraph department personally observed the wires during a violent storm of damp snow, followed by a sharp frost, between Newbildau and Neuhaus, at a point where the line crosses hilly ground, at a height of about 2000 ft. above the sea. The wires were well covered with snow and ragged considerably more than usual, and in several instances, by shaking the wires, the snow was detached, and the conductors immediately assumed their normal deflection. Most of the conductors were, however, left untouched, and carefully watched until the snow melted from them. The day following that when the snow had fallen continuously during eighteen or twenty hours, there was a change of temperature, which loosened the snow from the wires; the latter immediately resumed their normal location and deflection. Resistance to the effects of cold has been carefully observed on silicious bronze conductors in Hungary, Scotland, Sweden, Norway, &c. The Austrian company of local railways above mentioned has a telegraph circuit, in which the distances between the posts vary from 328 ft. to 720 ft. across flat country, but in hilly countries these distances range from 200 ft. to 1312 ft. During the last four years the Dallas General Telephone Company has employed silicious bronze wires, and spans as large as 1000 ft., without any accident having occurred. In Vienna telephone posts are frequently placed at the same distance apart, and carry as many as seventy-eight parallel wires. Those important advantages explain clearly the reason of the rapid extension in the use of silicious bronze as conductors for telegraph and telephone systems.

The Engineer - Nov. 5, 1886

HOWARD'S ELECTRIC LEAD MOULDINGS.

The accompanying engravings illustrate in section and elevation a few of the forms of simple and special mouldings, made by Mr. Charles Howard, at the Cleveland Works, Cleveland-street, Fitzroy-square, for carrying and housing electric lighting leads and wires in buildings and ships. They are all of elastic design, and are made in many sizes and of different woods, as

Fig. 1.

Fig. 3.

may be best suited to their situations in use. Figs. 1, 2, and 3 are simple mouldings, the base half of which is fixed to the wall, and is provided with a couple of grooves, in which the leads or wires are placed. The face of the moulding is fixed by a few tenon pins. Fig. 4 shows a form in which the cover-strip, forming part of the face of the moulding, is let into the bat-

Fig. 2.

Fig. 4.

strip, as seen in the section. There is, however, not much advantage in this arrangement, as pin points or heads of some kind, more or less, after all, be used, but the cover-strip on the base, with which there is the disadvantage, that with the same width of moulding the wires cannot very well be quite so far apart. Fig. 5 shows a section of a moulding for fixing round a room

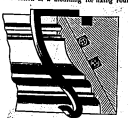


Fig. 5.

immediately below the lowest member of a cornice, if one exists. The groove along the top is made to take the end of a hook, which is of neat and good form, not quite as shown in our engraving, from which pictures may be hung, thus dispensing with picture-rods or nails, the hooks being movable in any required position.

The Engineer - Nov. 19/86

ON PERSONAL SAFETY WITH ELECTRIC CURRENTS.

By Professor A. E. DOLBEAR.

The serious accidents which have occurred within the past four or five years from the contact of persons with wires carrying strong electric currents have served to call attention to the necessity of providing safeguards against such accidents. It is probable that carelessness has been the cause of most of the accidents reported, and it is true that if weak currents only were used nobody could be hurt. It is, however, worth while to consider the conditions of illness of the human body in order to learn where danger lies. I have noted in various places the opinions of different persons as to what constitutes a safe current. In one of the old books it is stated that a spark from a Leyden jar is not dangerous, and in another place one says that a difference of potential of 600 volts is too high an electro-motive force for individual safety.

Now a difference of potential of 1000 volts will not give a jumping spark the hundredth of an inch long. The electro-motive force developed by the Holtz electric machine may be as high as 50,000 volts, and the spark from it will at most give a spasmodic jerk to the hand. The current which passes through the body depends not upon it, so that more than difference of potential must be considered in determining what is dangerous about electricity. The ability of electricity to do work of any kind, destructive physiological work as well as any other, depends upon both difference of potential and current strength, and the amount of work is proportional to the time also. Now the discharge from a Holtz machine through a short wire may give a very strong current

for example, let $E = 50{,}000$ volts, $R = 001$ ohm, then $\frac{E}{R} = 50{,}000{,}000$—fifty millions of amperes but the very short time so size of being injured, for the time of the current passage was very short, probably less than the millionth of a second. If the discharge had continued for an appreciable part of a second the wire would have been vaporized. The discharge is probably equally quick when taken by the human body, and the body can receive energy in just anything. Again, the amount that will traverse the conductor, with a given difference of potential between its ends, will vary between its extremes, and for the human body it may only roughly be calculated. The resistance of the body is very great. Many measurements, made with different individuals and with the fingers and hands, gives a resistance varying between 5000 and 50,000 ohms, and it is quite safe to assume that upon the moistened skin of the skin when under water. Mr. Preece says ordinarily dry have a high resistance; the same hands moist, perspiration or purposely wetted may lose half their resistance. Dr. Stone, of London, has made many experiments, and finds that the resistance of the body may be reduced to 500 ohms or less, by leaving the skin soaked.

If we take 1000 ohms with forty lamps the difference of potentials will be about 2000 volts. If a man with a dry, thick skin were to grasp the terminals at the dynamo, the amount that would go through his body would be $2000 \div 2 = 1$ ampere, and in one second two-tenths of a coulomb would have traversed his arms. If the same hands were soaked, the current might be $\frac{2000}{500} = 4$ amperes, or 4 coulombs per second. In the first case there would be $1 \times 2000 = 2000$ units or joules of energy equal to $2000 \div 7 = 286$ watts, or more than half a horse-power, and in the second case $2000 \times 4 = 8000$ joules, or $8000 \div 7 = 1143$ watts, or 1½ horse-power second. Now, any electro-motive force above about 1·5 volts is sufficient to decompose water, and it has been shown that the fluids of the body are better conductors of electricity than any of the tissue, even the nerves; it may fairly be inferred that such a current will such an electro-motive force might produce a notable quantity of the fluids of the body into their constituents.

To determine the highest limit of safety would require experiments which no human beings would be willing to submit to. Animals might be employed perhaps; but if 600 volts have at any time proved to be dangerous, one may set a lower limit to the resistance of the body and determine the current strength $\frac{600}{1000} = \frac{6}{10}$ amperes. That result looks threateningly large, but it is probable that the resistance of the body is rarely as low as 1000 ohms, then $\frac{600}{1000} = \frac{6}{10}$ amperes. But that represents 1123 watts—a quantity of energy no one would care to have exert in him. After all, what would be safe for one would be entirely unsafe for another, so that each individual would have his own factor of safety, or the difference of potential which he could work with, with impunity. From what we now know it would seem that 100 volts is a safe limit, and that 200 volts is not safe. One could safely have tungsten lit body for one second. But, for fear his resistance, the product of the two will give him the electro-motive force which is very feel terribly safe with. Thus, if one's resistance with wet hands is found to be 6000 ohms, then $6000 \times 1 = 600$ volts; while if his resistance was only 1000 ohms, he could only venture to touch wires having a difference of potential of $1000 \times 1 = 100$ volts. The ordinary incandescent light circuit would be on his limit.

originally intended to be an underground line; and it was actually so laid, along the side of the Baltimore & Ohio Railroad from Baltimore, as far as the viaduct over the Patapsco River—about one-fourth of the entire distance. The insulation in this case also was so imperfect that the wire failed to work satisfactorily, and the plan was abandoned in favor of the wire carried on poles.

Besides the difficulties of insulation, which were finally overcome by the successful application of gutta percha to this purpose, underground conductors have to be provided with a covering that will protect them from damage and breakage, and the insulation from destruction by chemical action or otherwise. Wooden troughs or boxes were early employed for this purpose, but were soon abandoned on account of their liability to decay, and because they afforded no protection against the attacks of rats. Pipes and tubes of various materials—such as glass, earthenware, lead, brass and iron—have also been tried both in this country and abroad. Some of these have continued in use, while others have been rejected for lack of durability, or other defect. When lead pipes, for instance, are laid in a soil in which much decayed organic matter is present, as is generally the case with soil of cities, the lead is acted upon by the carbonic acid, which converts it into carbonate of lead, causing the pipes to disintegrate and perish, and leave the wires exposed.

In England glazed earthenware pipes have been largely used where underground wires are laid, but at road crossings and other places where there is heavy traffic, or where the earthenware pipes would be liable to breakage from any cause, iron pipes have been substituted. Whenever it is possible, advantage is taken of a railway tunnel, and protection by wooden boxing, which can be readily opened for making repairs. After the pipes are laid, the wires, which for underground service are of copper and separately insulated, are carefully arranged in bundles and drawn into the pipes, in lengths of about 400 yards, by means of a coarse wire which is threaded through the pipes for this purpose as the latter are laid. The separate bundles are then carefully soldered wire by wire, and the places of junction covered with insulating material.

This plan of laying wires is attended with several inconveniences. It is difficult, in making so many soldered joints, to have them all perfect and thoroughly insulated. And when it becomes necessary to increase the number of wires in a pipe, or to withdraw and replace one that is broken or faulty, all the wires in the pipe have to be drawn out, as the dragging of a single wire over the others apart from the difficulty of threading it through, is sure to result in damage to the insulation of the wires already in. The pipes, too, are liable to occasional breakage and leakage, from which faults in the wires result, and though means of gaining access to the wires is provided at every 100 yards, the pipes have sometimes to be broken for the purpose of reaching faults and making repairs.

On account of these inconveniences the German engineers, after a trial of pipes of various materials, abandoned them all in favor of an underground cable, which was adopted by the German Government a number of years ago. The cables are made of seven wires, containing from one to seven conductors. On account of the impossibility of obtaining great lengths of copper wire entirely free from flaws and defects, each conductor is composed of several fine wires twisted together. The conductors are separately insulated by means of Chatterton's compound and gutta percha, but then bound together so as to form a single core, which, after being wrapped with tarred hemp, is incased in an outer covering of thick galvanized iron wire, twisted round in the form of a rope. The cable is then completed by a coating of asphalt, followed by a wrapping of yarn and a layer of Clark's compound. The laying of the cable is accomplished by paying it off from a reel into a trench, about one metre deep, prepared to receive it, and filled as fast as the reel with the cable is drawn over. The cable is laid in a depth averaging about five-eighths of a mile (one kilometre) in length, which, like the separate wires drawn into pipes, are united by carefully soldered joints.

In France wires have been laid for short distances, as in cities, between the main office and the exchanges, directly in a bed of asphalt, placed at a convenient depth beneath the pavement.

Dr. Schellen, whose account of the construction of the cable used in Germany has served as a guide in the description here given above, quotes from Dr. Stephan the following particulars in relation to the underground systems in that country. [*See Zietschrauppeteleks Telegraph*, p. 208.] Two hundred and twenty-one German cities, the writer states, are now connected by means of 3,400 miles of underground cable, containing 32,000 miles of wire. All the large rivers in Germany are traversed by river-cables, which number seventy in all, and have a collective length of 12,000 yards. The entire work of constructing this system was accomplished in a little less than five years, at a cost of about $7,000,000.

Experience has shown, since the underground cables have been used in Germany, that they last nearly most with accidents or interruptions; so that, apart from the convenience to the general public in getting rid of poles and wires from the thoroughfares, the underground system possesses several other advantages. It is free from many special sources of damage, such as breakage from

armored, and of sufficient tensile strength to guarantee successful wear and long service.

THE Gold and Stock Telegraph Company threatened some time ago to remove a "ticker" from the office of Ellis Morris, No. 47 Montgomery street, Jersey City. Morris obtained in the Supreme Court here a preliminary injunction restraining its removal. The company sought to have this injunction dissolved on affidavits setting forth that it had leased the "ticker" to Morris on condition that he would use it only for his own business; that he kept it in a room in Jersey City occupied only by a telegraph operator, and that from this room a private wire ran to New York. The inference from these facts was that Morris furnished to "bucket shops" in New York the stock quotations, etc., received by him in Jersey City. The company's attorney also claimed that it had a right to take the "ticker" because Morris had not paid the rent for it. Judge Van Hoesen decided that there was no legal evidence of a violation by Morris of his contract, but only a mere suspicion, on which a legal judgment could not be founded. He therefore denied the motion to dissolve the preliminary injunction on the first ground, but said he would dissolve it on the second ground unless Morris paid the overdue rent of the "ticker" within five days.

Burying the Wires.

Next January, according to Councils' mandates, the overhead telegraph wires come down. Next January, and a good many Januarys afterward, according to the telegraph men, the wires will stay exactly where they are. There is no such bitter war as that between the municipal authorities and the telegraph companies. The councilmen are merely anxious to keep their promises to perform an impossibility, while the telegraph men are equally anxious to demonstrate the axiom that an impossibility cannot be done. The telegraphers, so far, seem to have the best of the argument.

The impending conflict is the result of Councils' diligent effort to abolish the nuisance of wires overhead. They commenced it away back in 1876, when householders and business men grew vigorous in the protests they had been making for years, and as the plans developed up till 1882 an ordinance was at last put upon which it was thought would give complete and equitable remedy. The idea was to give nearly three years' notice that the wires must come down, and then enforce the law to the letter. The presumption, of course, was that, in the three years of grace allowed, underground conduits would be perfected, and the changes from above to below made practicable. Whether they have been or not is the second question which is worrying Councils and which the telegraph men are willing to argue in the negative. The city wires, which should have been given the same place in the ordinance as the others, were thoroughly omitted, and consequently the Police and Fire departments are now troubling themselves about them. If they had been instructed, Superintendent Walker says, it would be impossible to make the change as matters stand at present.

COUNTING THE COST OF THE CHANGE.

The whole subject of taking down the wires, since it has been so thoroughly discussed, has developed some phases that Councilmen thought nothing of when getting the ordinance readied. The heavy cost was wonderfully under-estimated. For the city wires alone almost the whole value of the present poles would have to be abandoned, and other telegraph companies would nearly equal loses in proportion to the amount of their material that could be re-used for service in other places. After that heavy direct loss, and then connections and fixtures and necessary changes in the approach to buildings would run up the amount to a remarkable sum. None of the present wires could be used for the conduits, and poles and cross-arms, equally useless within the limits of the prescribed by the ordinance, from 35 to 50 feet. Superintendent Walker estimated that the removal of the city telegraph property at 1,000,000, and President Henry Bentley, of the local companies, which own a large proportion of the wires, thinks that

Systems of Underground Conductors for Telegraph Lines.

BY CLAYTON C. HALL.

The many inconveniences occasioned in large and crowded cities by the mass of overhead telegraph wires, which, with their numerous poles, encumber the streets, and the hindrances which they frequently present to firemen in the discharge of their duties, have aroused the attention of the public to the necessity of some less cumbersome and dangerous plan being adopted for the overhead location of telegraphic systems. Chicago has led the way in this country in requiring telegraph wires to be placed under ground, and more recently the Legislature of New York has enacted a law bearing upon the same subject. The time is not for distant when, in all our large cities at least, underground telegraphic systems will be generally adopted.

In anticipation of this event it may not be without interest to examine some of the forms of underground conductors that have been tried and are now in use in the older countries where underground systems have been adopted.

In England and Germany, where the telegraph is conducted by the Government as a part of the Post-Office Department, there is not the same multiplication of poles and wires as in this country, where the business, being in the hands of spasmodic and competing companies, involves the construction of an ever-increasing number of parallel and duplicate lines. But even in those countries the necessity of putting the wires under ground in the cities was long ago recognized; and in Germany the wires connecting different cities are in many instances laid in the same manner.

Experiments with underground conductors were begun many years ago, and as early as 1847 the Prussian Government undertook to introduce the system on an extended scale. But the methods used for insulating the wires at that time were very imperfect, and the political disturbances of the period interfered with the work, and so the project failed of success. It was not until many years afterward that the system now in use in the German Empire was successfully established.

It is noteworthy in connection with this subject that the first telegraph wire in this country, that constructed by Professor Morse between Baltimore and Washington, was

portion. These machines require very delicate adjustments of vibration of sieve, and strength of air current.

Countering machines are now very largely used instead of the old hexagonal reels, which simply allowed the fiber to sift out through the silk meshes as it rolled, of its own weight, down the sieveling silk cover. The centrifugal machine is formed of a slowly revolving cylinder, covered with silk gauze. Within it revolves at a faster speed, in the same direction, a number of beaters, which, striking the material being dressed against the silk, evenly and speedily dressed fiber.

At the conclusion of the paper a cordial vote of thanks was accorded to Mr. Corbett, and a long and interesting discussion took place, in which Messrs. Stannard, Sexton, Bennett, Bell, Hamilton, W. Schlesinger, Muir, F. J. Bucklow, and Jones, took part. Mr. Stannard, a practical miller, spoke in favour of the roller system, and Mr. Sorsey took exception to the remarks which roller milling was making in this country, and quoted statistics to show that if as much material still were ground by milling by stones as was given to rollers the former would be the richer sum of extraction. It was also stated that the American milling papers were declaring that the stone gave better and produced it cheaper. A stone miller of the Midlands said that the stone milling was being overwhelmed by the roller milling, and he stated that it was within his knowledge that 500 sacks of flour were produced on by roller system with the same steam power which only produced 250 sacks on the stone system. Mr. Muir spoke in favour of both systems, and said that the stone milling had no advantage in producing a good character of flour, and he was in favour of roller milling.

ELECTRICAL CONDUCTORS.

At the meeting of the Institution of Civil Engineers, on December 4, Mr. Sreenford Newbould, in the chair, a paper was read on "Electrical Conductors," by W. H. Preece, C.B., F.R.S. The author stated that the first aerial conductors were made of iron wire, and the first gutta-percha-covered wires of copper, and in both the positions were soon abandoned, the one universally used for aerial conductors, and, until lately, for overland lines, Sir William Thomson determined great velocities in the working of copper, and Mattheissen detected the causes, and established a standard of purity. Such improvements have been made in the quality that copper wire was now twice as good as it was in 1858. Increased speed of working, improved efficiency of apparatus, and reduced waste of energy had followed the substitution of steel wire for copper. Tarnishing was a disturbing agent in the conductivity of the wire. Resistance increased more than 20 per cent. between winter and summer temperatures. Copper had recently been much used for aerial lines, it was less affected by wind, and had great durability. Hard-drawn wire was now produced which, while had a breaking strain of 28 tons on the square inch, was wire giving only quality, one did not appear to be influenced by the currents of electricity employed for telegraphic purposes. The conductors of all cables contained steel wires. Lightning was supposed to rather it latterly. The ultimate strength of the proposed composite conductor for electric lights was 20 tons per square inch. The size of conductors was controlled by mechanical considerations. Sir William Thomson had laid down the law that should control the size of leads for electric lighting, that the cable shall allow of electricity flowing at cost to waste. The best copper for electrical purposes came from Japan, Chili, Australia, and from Lake Superior; but until now the copper was obtained by electro-deposition, either directly from the ore, or by using impure copper cast into plates for a depositing bath. Electro-deposited copper had not the electrical conductivity of rolled copper. The electrical resistance of commercial iron was from six to seven times that of copper, and variable, due to the presence of impurities. Steel was greater. The weight of a cylindrical wire one mile long, and giving one ohm resistance at 0° fahr., was found called an ohm-mile. While the first iron wire was found to give only an ohm-mile 5,000 lbs., it was now obtained as low as 1,320 lbs., and the maximum resistance was specified at 1,760 lbs. The ordinary best publish, was specified at 1,760 lbs. Bronze used only for fencing purposes, but a very flexible conductor was supplied used for railway telegraphs and for stays; however, the resistance was very high, and in the presence of impurities.

The wire used by the Post Office was made from Swedish charcoal iron, with an ohm-mile resistance of about 1,320 lbs. Bessemer, or a specially prepared basic carbon English, Bessemer, or a specially prepared basic Government, with ores selected by the Indian 1,000 lbs. Cast-iron-silicide resistance of about about 90 lbs. Make up with a breaking-weight of Continent for telephone currents, with an ohm-mile resistance of 2,000 lbs., while in England, where speed of wires was not so important, and length of lines not so long, 1,000 lbs. was considered sufficient. The breaking-strain of 22 tons on the square inch was specified with a view to wires long spans were essential, and speed of working was not so important, the specification of 20 tons on the square inch was considered sufficient. The wires were harmonised with the percentage of pure iron, except where the percentage of manganese was high, as increase in the percentage of manganese augmented the electrical resistance considerably and then an increase in the percentage of silicon or phosphorus. The durability of iron wire was to be measured by galvanising. When the galvanised wire was to be suspended in smoky districts it was advisable to protect it by a bright coat of tin, and in those districts where the atmosphere contained sulphuretted hydrogen, this precaution was placed on simple lines, resorted to, by Siemens. Such a wire was erected in North Belfast and London and Crewe, but the result was very unsatisfactory. More recently (1883) the experiment had been repeated with a similar result. In this climate galvanisation was unsatisfactory. But it was not alone in smoky districts that iron wire decayed. It suffered much along the seashore. The salt spray decomposed the zinc coating, and the chemicals, which were washed away and left the iron exposed, and this was specially noticeable on telegraph lines. Where external decay was not evident there seemed to have no apparent effect on iron wire. Thirty-one years of incessant service in conveying currents for telegraphy had not apparently altered the molecular structure of the iron wires in the open country, as instanced by the North-Western Railway. Swedish charcoal iron was found either in blister or in rods, principally in rods. Each rod was a rolled down to about 0·25 inch in diameter, and weighed on the average about 56 lbs. Each rod was then rolled and drawn into 0·172 inch in diameter, weighing 30 lbs. and measuring 1 mile; less 10% was allowed for the test piece left for transport and use. The Swedish iron owed its purity to the low phosphorus purity, but to the fact that it was smelted and puddled entirely with charcoal. The best-conducting iron stations of various ores, and they were known by various brands, the numbers corresponding to the brands being accurate.

The operation of testing was a most important one, and included not only for the user, but for the manufacturer. Flaws, impurities, faults, notwithstanding the greatest care, would occasionally be found in the material by the most rigid examination and tests. Tests were mechanical and electrical. The mechanical tests embraced one for breaking strain, another for elongation, and a third for resistance to torsion. For hard steel wire, in place of the tension test, it was usual to specify that the wire should bear wrapping round its own diameter and unwrapping again without breaking. The electrical test was simply that for resistance—that a mile of the wire to be examined was wound round a dry wooden drum, and its electrical resistance was taken in ohms by means of a Wheatstone's bridge. Galvanisation was tested by dipping in sulphate of copper, and by bending or rolling round a cylinder of a given diameter, according to the size of the wire. Special machines were constructed for the mechanical tests, the condition to be fulfilled being that the breaking-strain the increasing load or stress should be applied uniformly, without jerks or vibration. For hard steel wire machine should correctly register the actual breaking-weight of the wire slightly. The resistance of the wire was determined by an ink spark set in motion by a weight on the wire, and recording the number of spires indicating the number of tricks taken before breaking. The perfection to which the manufacture of iron had been brought was very much due to the care bestowed on the selection of the charcoal varieties of Dr. Percy, C.B., F.R.S. The standard had been gradually raised, until it had attained a very high size. Great improvements adopted in the expense of thorough inspection, with the result that the wire did rightly inspect. The best results of this wire did rightly inspect. One break in the wire cost for the men in the field, and last one extra per mile effected in the carding capacity of the wire in inverse proportion to the size. It was necessary to remark that the mechanical quality of electrical-wire sometimes changed without any change in the quality rendering unaffected. Tests repeated at some subsequent period might therefore be valueless. Similar allowance were made for the effect of temperature. Homogeneous iron wire as a rule improved in the mechanical properties by being kept in stock. The Post Office authorities had decided to abandon a gauge in favour as applied to conductors, and to define size by diameter and weight. In future, all copper wires would be known by their diameters in "mils," A mil was a thousandth, and all iron wires by their weight in ft. per mile. Steel wire was used for long spans, where its greater tensile strength was needed; but it was for the external strengthening of cables. Steel wire cables that steel was originally adopted, and was first employed in the Atlantic cable of 1858 for the purpose of strengthening the conductor, and for deep-sea cables. The usual diameter was 0·099 in., and it was specified to have a breaking-strain of 1,000 lbs., which was equivalent to 81 tons on the square inch. Steel wire had been produced having a much higher tensile strength. A compound wire of steel and copper was introduced in America about 1874, and it had been extensively used in both hemispheres, but without success. Iron-silicide wire had been tried, but without success. Clark and Chirgin, a discovery of 1,000 miles, giving only 17 ohm resistance per mile. It had a steel core of 0·125 inch in diameter, and was coated with copper electrolytically to a diameter of 0·25 inch. It weighed 700 lbs. per mile, had a breaking-strain of 4 tons, and was of a much lighter diameter, would be equally efficient.

Copper, Bessemer, the hard insulating qualities and their resisting powers of which were well known, was introduced for telegraph purposes about five years ago. Several lines were erected by the Post Office. Two of these crossed the channel that separated the Scottish Highlands from the mainland near Seamens. The object of view was to obtain great tensile strength with a low resistance, especially active where the wire was to be used to span. This was done in 1870, and in 1874 and for 1883 and the highest strength was noticeable in the wire. But phosphor-bronze was considerable in the high electrical resistance, though exceptionally soft, but per cent. that of copper. The conductivity was only 20 supplied was irregular in dimensions and brittle in character. It would not bear knocking about. A new phosphor-bronze, had recently been introduced to remedy these disadvantages. Phosphor-bronze and phosphorised copper wire, and had been much improved by silicious made material, and was specified at such a size that it was strength all equal to that of copper, but its mechanical qualities rendered it eminently adapted for telegraphic purposes. If overhead wire was erected of such a material, upon slightly supports, and with some method, there would be an end to the meaningless crowds now made in

A NEW INSULATING MATERIAL.—The immense strides which have been made in electrical discovery, particularly in practical applications, have created deficiencies in very far new and cheaper insulating materials than those already in use. Hitherto they have been limited in glass, porcelain, stoneware, gutta-percha, indiarubber, and ebonite. Owing to the greatly increased demand, the price of the last three named has risen very much, and is likely to rise still more, and, while the quality has deteriorated, it is found that in the existing sources to supply what is required, not only for telegraph and telephone work, but for the immense field opening in electric light work. Now, everything, safety in the use of electricity, and there is a correspondingly demand for a cheap insulating material, the qualities of which shall be equal to the demand likely to arise. This desideratum has been met by the invention of a material called Insulite, which, instead has been discovered by which wood, sawdust, cotton waste, paper pulp, and other fibrous materials can be converted into a material perfectly impervious to moisture, acids, easily moulded under pressure into any shape, and capable of being worked or cut after solidifying. This material is a excellent non-conductor of electricity, and can be used for all forms of battery-cells, telegraph insulators, supports for electric light leads, and telephone work. It obtains the name of being perfect insulation at a very much less cost than obtained by gutta-percha. As it is perfectly impervious to moisture, it can be made of it cannot oxidise or warp. It supplies exactly what it is wanted in practical work, in which ordinary wood cannot be used because it absorbs moisture and electric is inhibited on account of its cost.—Engineer.

THE IRON AGE

Underground Electrical Conductors.

The attention now being given to the important question of the conveyance of wires underground in large cities, is illustrated by the number of devices for this purpose which are displayed at the Electrical Exhibition in Philadelphia. The *Public Ledger* of that city refers to them as follows:

"The question of underground conduction depends upon the use of of an air insulator of the kind used on telegraph wires it is proposed to place underground. An iron tube like a gas-pipe is laid, with proper manholes and branches, within which are run the telegraph and telegraph wires, each separated from its neighbors by a covering of cotton. When the system is completed, a heavy hydrocarbon prepared from petroleum by a special process is pumped into the line. Every precaution is taken to exclude moisture or foreign substances from the pipes, and the system is kept constantly under pressure, to make sure of no leakage. In the exhibition the system is shown in active operation, the lines being under the hill down, by the Pennsylvania Railroad, and connecting 50 telegraph circuits in such operation, besides the telephone wire used.

The American recitational underground system is exhibited in active operation. This system consists of a cast-iron conduit laid underground, with arrangements for carrying wires through them without endangering insulation. At intersections and other convenient places manholes are arranged, and there are large enough for a man to descend and arrange wires and make connections without difficulty. Where a large number of wires are to be carried the conduit is arranged with a series of trays, one above another, on which may be arranged any number of wires. This system has been in actual operation on Chestnut street, from Third to Broad, for about six months, and is stated to have been so far perfectly successful.

The Edison system of underground conduction, shown at the present entrance, is adapted not merely to the Edison system of incandescent lighting, but to all purposes of electrical conduction. For the purpose of system of lighting, a large number of wires are necessary, on account of the very large currents which are employed. It consists of a rectangular iron gas-pipe of ordinary character, through which is run the necessary copper. Inside the pipe it is built special insulating material, which hardens on the outside into a very hard compound by the action of the air. The pipes so prepared are laid under the ground, and are screwed together like ordinary gas-pipe.

One novel feature of this system is the method of the throwing off of the wires from the conductor. In this system the current is carried from the lamps of equal power in parallel circuits, rather than in series, instead of four. The positive wire passes through a dynamo to connection with the negative pole of the other, and from the centre of the dynamo to the middle wire, as it is termed, of the system. The remaining negative and positive wires pass from the dynamo to the two ends. If the wires are working equally, there will be no current over the middle wire, the two opposing currents exactly neutralising each other.

The current over the two outer wires, if they were connected, would be doubled in quantity—that is, it would be carried on volume instead of one, as is usually carried. Connection is however, made with the middle wire from each side wire, and then the current is reduced to half its volume, so that the current is higher in intensity a smaller wire can be used. In practice, the upper wires were the current of the normal four-sixty volts, with a danger of about 120 volts. The insulation the wires seem to inside one-fifth of an inch, and the total wiring is represented to be 6,000 miles.

The Continental Underground Cable Company have a system of their own. The system consists of a tube from the use of dry 2 p as an insulator—that is, it would be useful to valve single insulation and connections" and by means of a steam engine and a pump a current of dry air is forced into the tubes. A proper system of protection from induction is provided for telephone wires. In the interior of the conduit is arranged a small railway with an arrangement by which a small electric motor may be used if every wire down the conduit. It is pointed out that the arrangement of conduits was sufficiently extensive that a branch line would make an efficient perch pipe in addition to its principal one. Nassi Fed Continental is shown Woodward's combination curb conduit. This is a conduit arranged along the curb, where it can be more easily examined than under the street. Arrangements are made by which steam-heating pipes may be arranged with the conduit, so that the wires may not freeze. The Philadelphia and Reinhard Telegraph and Cable Company exhibits a system which consists of a number of square tools in suitable lengths in which the underground wires are placed and covered by a special insulating compound.

The Orion Electric Underground Company exhibits in the annex a sample of their conduits, which consist of iron tubes, together with their method of insulating the wires as they are passed through them. The National Underground Conduit Company exhibit their conduit and a manhole. The conduit of the latter is embedded in an artificial stone. Examples of terra-cotta, asphalt, and artificial-stone tubes are also shown. The Electrical Conduit Wire Underground Telegraph, Telephone and Electric Light Company also exhibit a system for laying their underground conduits. It consists of a terra-cotta pipe, along which is set at suitable intervals a series of perforated plates of some non-conducting material, and through these holes are drawn the wires it is designed to protect. Models of manholes are shown in the gallery, labelled respectively the Anderson conduit and the Dudley conduit, built of W. Hewitt, Washington, D. C. The models are of wood, and no description of their design or use are submitted."

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Re Manufacturer & Builder
August - 1882 -

Underground Electric Wires.

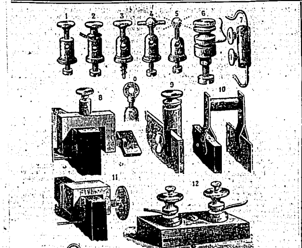
The rapid multiplication in all of our cities of overhead wires for all descriptions of service, constitutes what all parties agree in pronouncing a nuisance, and in a number of localities has called into existence municipal ordinances looking to its suppression. Chicago, we believe, was the first among American cities to take a decided stand on this question, and some years since decreed that all electric wires located after the 1st of January, 1883, should be placed under ground. Other cities have followed this example; but the outcome has apparently been, up to the present, an almost absolute failure to comply with the law. The alleged reason urged by the various corporations affected by the laws in question, is that thus far no satisfactory system has been devised which could be relied upon to warrant them in risking the disturbance of their business.

Meantime, likewise, there have been announced a host of inventions for underground conduits, each professing to fully meet all the requirements of the various forms of electric service.

We have always advocated the underground system for electric wires on general principles, and on the strength of the very general adoption in foreign countries of some system of this character not only in the streets of cities, but in some notable cases also even hundreds of miles of country have affirmed the entire feasibility of the underground system.

The extensive introduction of private telephone lines, and of electric lighting wires in all our cities, to say nothing of the constant increase in the number of telegraph wires, complicates the situation very materially by adding largely to the difficulties in the way of placing the wires for all these forms of service in one and the same conduit. It seems to be necessary to keep the electric light wires separate from the rest, in a special conduit, so as not to interfere with the practical working of the telegraph and telephone wires. The provision of separate conduits means, of course, additional first cost in the adoption of the underground system; but the indefinite increase of overhead wires in our cities simply cannot be tolerated, for reasons that all are familiar with, and sooner or later the change from overhead to underground must be made, either with or without the assent of the companies.

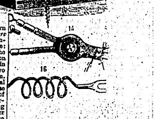
The difficulties of the situation may hasten the adoption of the system of subways in all our large cities, which would solve the problem completely.



ELECTRICAL CONNECTIONS.

THE collection of electrical connections shown in the annexed engraving, is from *La Nature* and may be found useful by those who are unacquainted with the devices already available: Fig. 1 shows an ordinary terminal to be fixed to the base of an apparatus. Fig. 2 shows a modification of the former that allows the wire to be either in the eye when it is large enough, or between two flat parts when it is fine or has a flattened form. Fig. 3 shows a terminal provided with a conical screw, and designed to be fixed to apparatus whose under part is not accessible and does not permit of Nos. 1 and 2 being used. Figs. 4 and 5 show terminals that permit of a secure fastening being effected through a lever. This latter consists either of a small bar fixed permanently to the head of the screw (Fig. 4), or of a nail that may be introduced into apertures in the head (Fig. 5). This is especially adapted to cases where the space is limited, and where there is no need of changing the wire attachments often. Fig. 10 shows a flat terminal head that permits of a secure fastening through flat clamps. Fig. 6 represents a terminal with flat clamp employed especially on telegraph apparatus. It is fixed to the apparatus by means of a screw, as in terminals 1 and 2, and is prevented from turning by means of a snug at the lower part. When two wires are to be united, the clamp shown in Fig. 7 is used. This consists of a brass cylinder containing an aperture that runs lengthwise through it, and into which the two extremities of the wire are inserted, and held in place by means of two binding screws. Figs. 8 and 11 represent clamps that are used on Bunsen piles for connecting the carbons with the copper plates. Fig. 11 shows an ordinary clamp, and Fig. 9 a terminal for a zinc plate. Fig. 10 represents the clamp employed by Mr. G. Trouve in his bichromate of potash piles for simply and quickly connecting the elements. In certain cases there is need of often substituting one apparatus for another, and of establishing two communicating wires. In electric measurements, for example, the galvanometer is common to several combinations, and it is convenient to have a means of easily making the substitution. To effect this, the two wires of the galvanometer (which is not always easily accessible) are connected once for all with two terminals arranged upon a smaller block of paraffined oak or ebonite (Fig. 12). This latter is itself fixed against a wall, or upon a table, within reach of the experimenter, and it is to the two terminals thus arranged that are successively attached the wires which, at every measurement, must be connected with the galvanometer.

Connections between a movable apparatus and fixed terminals are effected by means of flexible cords or of connecting cords such as the ones shown in Figs. 13, 14, and 15. Fig. 13 represents a flexible cord whose extremities are connected with plugs when perforated terminals (Figs. 1, 3, 4, and 5) are used. Fig. 16 shows the Radiguet attachment, which is especially well adapted for flat clamps (Figs. 2, 6, and 9). Fig. 14 represents the mode of fixing telephone cords. Accidental tractions that may be exerted upon the wire do not act upon connecting rings, but upon a cylinder of wood held



between the two cords and kept in place upon the block by means of a screw. When communications of feeble resistance are to be established, use is made of notched strips of metal like that shown in Fig. 15.

ON PERSONAL SAFETY WITH ELECTRIC CURRENTS.

THE serious accidents which have occurred within the past four or five years through accidental contacts with wires carrying strong electric currents have served to call attention to the necessity of providing safeguards against such mishaps. It is probable, says the *Electrical Review* (London), that carelessness has been the cause of most of the accidents reported, and it is true that if weak currents only were used nobody could be hurt. It is, however, worth while to consider the electrical relations of the human body in order to learn where danger lies. Prof. A. E. Dolbear, in the *Electrical World*, says:—

"I have noted in various places the opinions of different persons as to what constituted a safe current. In one of the old books it is stated a 'spark 18in. long begins to be dangerous.' In another place one says that a difference of potential of 800 volts is too high an electromotive force for individual safety.

"Now a difference of potential of 1,000 volts will not give a jumping spark the hundredth of an inch long. The electromotive force developed by the Holtz machine may be as high as 50,000 volts, and the spark from it will at most give a spasmodic jerk to the elbow, and no manner of hurt come of it or of repeated shocks from it, so that more than difference of potential must be considered in determining what is dangerous about electricity. The ability of electricity to do work of any kind, destructive physiological work as well as any other, depends upon both difference of potential and current strength, and the amount of work is proportional to the time also. Now the discharge from a Holtz machine through a short wire may give a very strong current; for example, let E = 50,000 volts, R = ·001 ohm, then $\frac{50{,}000}{\cdot 001}$ = 50,000,000 — fifty millions of ampères; but the wire may show no sign of being injured, for the time of the current passage was too short, probably less than the millionth of a second. If the discharge had continued for an appreciable part of a second the wire would have been vaporised. The discharge is probably equally quick when taken on the knuckles, but there is not enough energy to hurt anything. Again, the amount that will traverse any conductor, with a given difference of potential between its ends, will vary inversely as its resistance, and for the human body it may only roughly be calculated. The resistance of the body is very great. Many measurements made with different individuals taking wires in their fingers and hands, gives a resistance varying between 6,000 and 15,000 ohms; but this depends in a large degree upon the moisture of the skin when contact is made. Hands which are ordinarily dry have a high resistance; the same hands moist with perspiration or purposely wetted may lose half their resistance. Dr. Stone, of London, has made many experiments, and finds that the resistance of the body may be reduced to 500 ohms, or less, by having the skin soaked.

"On an arc light circuit with forty lamps the difference of potentials will be about 2,000 volts. If a man with a dry, thick skin were to grasp the terminals at the dynamo, the current that would go through him would be $\frac{2000}{10000}$ = ·2 of an ampère, and in one second two-tenths of a coulomb would have traversed his arms. If the same hands were soaked, the current might be $\frac{2000}{500}$ = 4 ampères, or four coulombs per second. In the first case there would have been spent in him an amount of energy equal to 2,000 × ·2 = 400 watts, or more than half a horse-power, and in the second case 2,000 × 4 = 8,000 watts or $\frac{8000}{746}$ = 10·7 horse-power. Now any electromotive force above about 1·5 volt is sufficient to decompose water, and it has been shown that the fluids of the body are better conductors of electricity than any of the tissues, even the nerves; it may fairly be inferred that such a current with such an electromotive force, might decompose a notable quantity of the fluids of the body into their constituent gases.

"To determine the highest limit of safety would require experiments which no human beings would be willing to submit to. Animals might be employed, perhaps; but if 800 volts have at any time proved to be dangerous, one may set a lower limit to the resistance of the body, and determine the current strength $\frac{800}{1000}$ = ·8 ampères. That result looks threateningly large, but it is because the resistance is made so low. I have never found one less than 5,000 ohms., then $\frac{800}{5000}$ = ·16 ampères. But that represents 128 watts—a quantity of energy no one would care to have spent in him. After all, what would be safe for one would be entirely unsafe for another; so that each individual would have his own factor of safety, or the difference of potential which he could work with, with impunity. From what we now know it would seem as if one-tenth of an ampère current body was as much as anyone could safely have traverse his body for one second. If then he fixes his minimum resistance, the product of the two will give him the E.M.F. which he may feel timidly safe with. Thus, if one's resistance with wet hands is found to be 8,000 ohms, then 8,000 × ·1 = 800 volts; while if his resistance was only 1,000 ohms, he could only venture to touch wires having a difference of potential of 1,000 × ·1 = 100 volts. The ordinary incandescent light circuit would be on his limit."

Character of article *Rep*
From the *Herald*
Published at *N.Y.*
Date *July 21 1883*

Influence of Storms on Buried Wires.

Some years ago, when the great underground telegraphic lines now connecting the principal cities in France and Germany were constructed, it was supposed that their conductors would be entirely uninfluenced by storms. M. Blavier, in a recent scientific paper which appears in the *Comptes Rendus*, states that it has been observed "that there are sometimes produced in stormy weather in telegraph offices connected by underground wires electric discharges which fuse the fine wires of the lightning guards." Thus, for instance, during a violent storm which burst on March 9 ult. over the middle of the telegraph line connecting Belfort with Besançon, sparks were observed at the two extreme stations, though the existence of the atmospheric disturbance was scarcely suspected in the two towns. But M. Blavier clearly shows that it is "only in exceptional cases" that the influence of storms is observed on underground wires. In fact he asserts, with good reason:—"These accidents are much less frequent and less severe than in the cases where the wires are aerial."

It would seem desirable, if the storm cloud effects are to be fully obviated, that the telegraph wires should not be buried at a very slight depth. For when this is the case and the soil is badly conductive, as it often is, the metallic coating of the wires on the approach of a storm takes an electric charge even when the internal wire remains in a neutral state. The phenomenon is of interest as probably due to electro-dynamic induction. But the effects on the wires, as M. Blavier says, "do not seem to be of such a nature as to interfere with the transmission of despatches." It is certain that telegraphic communication would be much more free from interruption by storms if the wires were placed under ground, as they would no longer be exposed to being prostrated by violent winds and hurricanes.

Character of article *Ed*
From the *Times*
Published at *Chicago, Ill.*
Date *July 24 1883*

THERE is a diversity of opinion among experts as to the comparative value, cost, and the like, of overhead and underground wires. London many years ago placed all its telegraph wires under the streets, and at the same time American cities ran them over head on poles. Here in Chicago, within a year, the various companies are taking down their overhead wires and placing them in conduits beneath the surface of the streets. At this same time the London people are asking parliament for permission to run their wires above the roofs. This difference of action would indicate an equal difference of opinion as to the advantages of the two systems.

It may be the fact that this divergence is due to the imperfect construction of the cables which are carried under ground. Many methods of enveloping the wires carried in conduits are in use, and there is a wide difference in their action, some of them securing small and some of them very great insulation. In the matter of induction there is also considerable variation; and it is quite possible that the prejudice against the underground system is due not to the system, but to the faulty character of the cables. *Science* gives some figures showing the extraordinary variations in the insulation and induction of various cables which are employed in this country. With reference to the former, the figures given prove that there is a difference of 100 to 1 between the maximum and minimum qualities of certain cables, and of 5 to 1 in the matter of induction. With such wide variations in value, it is not surprising that companies are found who are opposed to underground cables. If it can be established that the system is less expensive than the overhead one, the objections which have arisen from faulty cables can be overcome, and thereafter there will be no difference of opinion concerning the two methods.

It is asserted by the electrician Jaques that the underground system is far cheaper in the long run. He estimates the cost of stringing over head three hundred miles of wire at about $14,000, and that of the same under ground at $24,000. The annual expense of repairs of the overhead wires he places at about 30 per cent. of the cost of construction, including roof-rentals; and adds that the wires would have to be renewed once every twelve years. No repairs are needed for the underground cables, and they will last for at least thirty years. These data permit the conclusion that, while the underground cables are the more expensive at the outset, they are much less expensive when long time is taken into account. Such being the fact, it only remains for companies using telegraphic and telephonic wires, and who are anxious to secure the highest economical results, to employ the underground system, being careful, however, to use only the best class of cables.

It is of much importance just now that these facts should be known. There is a disposition to reject the underground system in the belief that it is radically defective; and should this conclusion gain much further strength, there is a likelihood that all the efforts being made to relieve cities of the nuisance of overhead wires will be abandoned. Let it be understood that the faults of the underground system are not in the system, but in the methods of carrying it into effect. When this is generally known, and it is further comprehended that it is far more economical to bury the wires, and that when placed under ground they give far better results than when over head, there will be no hesitation to secure our cities immunity from the curse of wires and poles.

Menlo Park Scrapbook, Cat. 1022

No. 14. "Gas"

This scrapbook contains clippings about gas; many are from The Journal of Gas Lighting, Water Supply, and Sanitary Improvement. The book covers the years 1879-1880. There is also one clipping for 1878. There are 142 numbered pages.

1022

Gas

14

RUTGERS BOOK BINDERY & BLANK BOOK MANUFACTORY,
JOB & MERCANTILE PRINTERS.
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777 Broad St., Newark, N. J.,
STATIONERS and BOOKSELLERS,
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MIDLAND ASSOCIATION OF GAS MANAGERS.

At the Sixth Quarterly Meeting of this Association, held at Birmingham on Thursday, the 1st inst.—Mr. CHARLES HUNT, of Birmingham, in the chair—a paper was read by Mr. C. E. MEDHURST (Chesterfield)

ON PUBLIC LIGHTING, WITH SPECIAL REFERENCE TO STREETS, ETC.

The paper commenced with a few remarks on the use of artificial light in the past ages. It then proceeds: But we pass on to treat more particularly the branch of our industry selected for the author's consideration—viz., public lighting, the discussion of which I hope may interest and benefit each one of us. It is a subject that calls for careful consideration at much attention, and perhaps its discussion at the present time may lead to the adoption of some improvements in the development; but even this consideration is not deep or keen enough to lead to perfection in the answer to every branch of our profession.

The chief requirements of public lights are—(a) steadiness of flame, not susceptible to atmospheric commotion; (b) uniformity of intensity; (c) great penetrating power; (d) great economy per unit of cost, with the least preparation, and easily lighted; (e) non-liability to any sudden or subconflagrations; and (f) great durability and strength.

The first of these I consider to be that of burner used, and the form of glass employed to shield the light. Upon the selection of the one or the other in a measure the light depends, as, of course, the question of interruption in supply or mechanical defect, prefers to the form of support and the attention of the lantern; I we will consider collectively.

In the wide range of materials from which artificial light can be produced, that which fulfils most of the above requirements is undoubtedly coal gas, hence public lighting in most towns becomes a question of the cost of coal gas in each locality. Having assumed this, the light-givers may be briefly separated into those which require a shelter compartment, being reflectors—i.e., Candles and all have been tried over and over again, both economically and usefully, with the result of leaving coal gas the leader of the situation. To coal gas, then, the public returns, being won back to the old time by the very many excellent and unique qualifications; and if we this day advance the just claims of coal gas, and bring out more prominently the claims hitherto unsettled and specific features of, we have every cause to think that, however imperfectly the subject may have been put forward,

To consider a successful realisation of the above conditions may be considered by some to be practically impossible, the nature of the service demanded being of such a varying character, depending upon the nature of circumstances exceedingly difficult to effect; but if we cannot ensure thereabouts, we must strive to secure a position as near to it as it is possible in our particular and individual cases.

By the diversity of the forms of burners which I have submitted in your consideration, and carried through in a series of daily applications, the question of steadiness can be effected in public lighting without any very great outlay. Some may be found better adapted than others on the ground of ignorance; but that cannot apply to ourselves in the present day, when knowledge is universal. The ancients cry out, "Where shall wisdom be found?" Now the answer is, "It rests on the housetops," and knowledge, and consequent strength," so that if any one burner be found strong, the increase of our knowledge makes us stronger, so far forward as the application of the burner is concerned. The strength of knowledge," let us repeat, makes the foundation of our practical facts to be carried out public which is the right path to tread, the right way to use the light they yield, and if they refuse to follow our advice or to accept our direction, we shall still possess the consciousness of having done our duty.

Before the introduction of gas lighting, very little sound knowledge existed generally of the extraordinary power of the atmosphere in its action upon flames, and much of the extraordinary power of the atmosphere in its action upon flames, and much of the extraordinary power of the atmosphere in its action upon flames, and much

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emphatic in the expression of an opinion that Local Authorities could do just as they please with roadways under their own jurisdiction; but these are, we think, decisions against him, which are not completely answered by the cases that he quoted. His evidence, however, was a triumphant defence of the rights of Gas Companies, and as such we receive it with much pleasure. It was a fortunate thing that such an important witness was kept back till the last, so as to leave an impression on the minds of the Committee, which, however, we fear, will be swayed by the opinions of the Chairman.

But what, after all, has been done as regards the real points at issue? Mr. Michael showed that Corporations and Gas Companies alike have power to break up the streets for the supply of illuminating agents. This, we think, is indisputable; but it only touches the threshold of the question. How, in the case of Independent Electric Light Companies, shall their capital be limited? How can the illuminating power of the light they are to supply be fixed? How are the charges to be made? And what are to be the limits on profits? These are questions which ought to have been put before the Committee, but which were not, although coming within the scope of the inquiry they were directed to make. To Mr. Michael's evidence, of course, we must return when it is published. In the meantime, we have to thank him for his able vindication of the rights of Gas Companies, and all concerned in the supply of the commodity. As we have said before, this inquiry is happily coming fast to an end. It has, we believe, been utterly abortive, and what report the Committee can make is at present to us quite a mystery. A writer like Dr. Lyon Playfair can, no doubt, make much of it; but what practical ends may be suggested, it is very hard to guess. Most certainly the inquiry has been wide of the mark. It is not, perhaps, the fault of the Committee, for really so little is known at the present moment about the electric light, as regards its application to street and domestic illumination, that we cannot blame them for their meanderings.

At the last meeting of the Metropolitan Board of Works a report submitted stated that the Committee of the Board had, in reply to the communication from the Board of Trade, written to the effect that they entertained certain objections to the scheme for the amalgamation of the South Metropolitan and the Surrey Consumers Gas Companies; but it does not appear that any active opposition will be raised. The fact is that the amalgamation promises to be so beneficial to the consumers in the Surrey district, that we fail to see what objections can possibly be urged against the combination. That the Company affiliated to the South Metropolitan Company will be subjected, after twelve months, to all the pains and penalties imposed by recent legislation, ought to be sufficient to satisfy the most exacting member of the Metropolitan Board, and we are astonished that any remonstrance should be made against a scheme which involves so many benefits to a large section of the consumers of of gas on the south of the Thames.

There is, we are happy to know, a possibility of a much larger combination, into which the Phœnix Gas Company will enter. It is unfortunate that this Company has not been more prompt in responding to popular demands. A few years ago they might have taken the lead in a scheme intended to consolidate the interests of all the Companies south of the Thames; but they followed the opportunity to slip, and now have to take what may be called a secondary position. Nevertheless, the combination cannot, if elected, prove of great value to the Shareholders. The undertakings worked together would yield profits which would fall short of the sum of a reduction of price, and consequently an increase of dividend. The fact is gratifying to both Consumers and Shareholders. The combination we speak of is only in posse; but we entertain an opinion that it is certain to be effected, sooner or later. Every kind of amalgamation we regard with favour. We have had no hesitation in expressing an opinion that it would benefit all if the gas supply of the Metropolis were under one management, and we have constantly urged that if this could not be effected, the northern Companies might all be consolidated, and the southern Companies be in a similar manner constituted into one united body. The objections of the Board of Works will probably have no weight with the Board of Trade, who favour amalgamation, and therefore we take it that the scheme is certain to receive their approbation. As to the Phœnix combination, we shall probably soon hear more. We only hope that it will be proceeded with and soon carried out. A meeting of the Shareholders of the Surrey Consumers Company is called for to-day, to sanction the arrangement for amalgamation. We cannot suppose that any one would be so stupid as to raise an objection. The Company urgently require new works, and the infusion of new blood. They have not, at the present moment, any opportunity of increasing their storage, although they have facilities for the erection of new carbonizing apparatus and the reception of coals. The combination, as we have said, will assist them in both particulars, and we cannot believe that any Shareholder will be led into the folly of opposing an amalgamation so desirable.

Mr. Thomas Bridge Simpson, the late Chairman of the Directors of the South Metropolitan Gas Company, who died on the 18th inst., deserves a passing notice. He joined the directorate of the Company thirty-two years ago, and for the last twenty-two years was the Chairman. Before the districting arrangements in the Metropolis were made in 1855–60, Mr. Simpson rendered essential service to the Company by inducing the Authorities of Southwark to admit the mains of the Company within their limits. Under the arrangements made by Mr. Sotheron Estcourt's Committee, the South Metropolitan Company lost the Borough district, but the temporary possession of it was of much value. Mr. Simpson was of a kindly disposition, and on disputed points loyally accepted the decision of the majority of his co-Directors, and earnestly endeavoured to carry them out. His mode him a great favourite with his colleagues, and it is to be regretted that he has died at the juncture at which the South Metropolitan Company have now arrived. At the great age of ninety, Mr. Simpson, after a short interval of rest, consequent upon an attack of paralysis, has quietly passed away; but his memory will be long cherished by those with whom he was associated.

The sixteenth annual meeting of the British Association of Gas Managers will be commenced, at Newcastle-on-Tyne, on Tuesday, June 10, and the proceedings and festivities will be continued over four days. The programme is of a somewhat attractive character, the papers to be read embracing matters which are of extreme interest to Gas Managers, and which will command the attention of all the members. It would be invidious to select for special reference here any of the communications which will be presented; but we may speak of them in their entirety as all well worthy of notice. Under the able presidency of Mr. J. J. Warner, of South Shields, everything is certain to go well, and we anticipate a most agreeable and instructive occasion. The lecture will be delivered by Mr. C. A. Lebour, F.G.S., and his topic will be "Practical Notes on Coal and Coal Getting." The North of England Association of Gas Managers display great hospitality on this occasion, and we are perfectly certain that the parent Association will derive much enjoyment from the liberality of their descendants.

In another column we publish a paper contributed by Mr. C. E. Jones, of Chesterfield, to the proceedings of the Midland Association of Gas Managers, who held their sixth quarterly meeting at Birmingham on the 1st inst. Mr. Jones's topic was "Public Lighting, with special reference to Streets, &c." There is no matter which deserves more important consideration from Gas Companies than the lighting of public streets. As a matter of fact, it may be said that the reputation of a Gas Company largely depends on the efficiency with which public lighting is performed. Unfortunately, the supply of public lights is not very profitable—indeed, in some instances, it involves a Gas Company in a positive loss; but it must be borne in mind that public lights, after all, constitute a sort of advertisement. The ratepayer who sees a brilliant illumination in the streets, and notices how small is the impost he has to pay for it, naturally concludes that to have gas in the house would be comfortable and economical. Mr. Jones goes into full details of the various requirements for effective lighting, and even the ornamentation of the pillars, and the exact position of the burner. On all these points we perfectly agree with Mr. Jones, and so also with respect to the use of more than twenty-candle gas, which he very properly says is of no advantage to the public. It only blackens ceilings, and causes careful housekeepers, at all events in the South, to anathematize the gas as impure. We wish, with the author, that Parliament would decide on some universal standard of quality. We have for many years insisted that fourteen-candle gas fulfils with efficiency all necessary requirements, and we are happy to see that, year by year, parliamentary sanction is given to this quality. The consumption of six feet per hour per lamp, recommended by Mr. Jones, is unnecessary, and it would not, we think, meet with the approval of many Local Authorities, who would consider it excessive. Inasmuch as the Gas Company would have to add to their charges. We are sorry to find that Mr. Jones is not in favour of the "average" meter system," the adoption of which we strongly advocate. It is not that extra profit results to the Gas Company when it is employed, but, as a Member of the Association very pertinently remarked, it saves squabbles. But we have remarked on this above, and need say nothing more here. We have no doubt that Mr. Jones's paper will be perused with much interest, and we are certain with considerable profit.

PARIS GAS COMPANY.
The Annual General Meeting of the above Company was held in Paris [illegible] the following report on the Company's affairs.

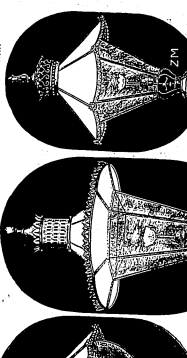
602 THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT. [May 6, 1879.

IMPROVED REFLECTING STREET-LAMPS.

D. HULETT having had numerous inquiries for an Improved Street-Lamp, has to call the attention of Gas Engineers, Local Authorities, and others to his Improved Reflecting Lamps, which are constructed to give the greatest illumination with the smallest consumption of gas.

They are strongly recommended for Railway Platforms and large open spaces, or any places requiring a good light without the use of large burners.

The 14-inch square Lamp is made to fit the ordinary Lamp-Cradle now in use, and is fitted with a 24-inch Reflector.



Special attention is called to our Diaphragm Governor, by the use of which the Governor-by his arrangement-is placed in the most convenient position of the gas consumed is obtained.

They are made in various sizes and also with Governor, Lamp-cock, or square.

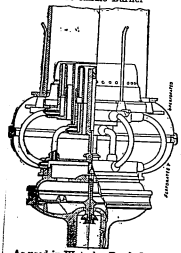
Further Particulars upon application to

D. HULETT, 55 and 56, HIGH HOLBORN, LONDON.

WILLIAM SUGG'S
IMPROVED SYSTEM OF STREET LIGHTING,

SUITABLE FOR EITHER CANNEL OR COMMON GAS.

SECTIONAL ELEVATION of 80-candle Burner

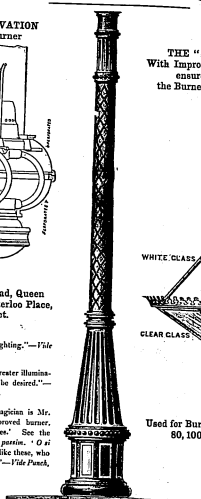


As used in Waterloo Road, Queen Victoria Street, City, Waterloo Place, and Regent Street.

"The perfection of street gas lighting."—*Vide "Times," Feb.* 1, 1879.

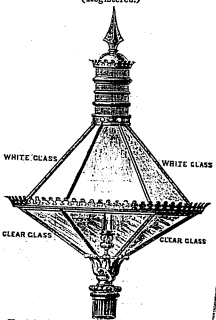
"For all practical purposes no greater illumination than is hereby supplied could be desired."—*Vide "Daily News," Jan.* 13, 1879.

"The real modern Aladdin's magician is Mr. Sugg, who, by means of his improved burner, gives us 'new lamps for old ones.' See the Waterloo Road and Waterloo Place *passim*. '*O si sic omnia!*' If all gas light were like these, who would ask for Edison and electricity?"—*Vide Punch, Feb.* 15, 1879.



THE "WESTMINSTER" LAMP-COLUMN,
Of Improved construction,
8 feet and 9 feet from ground to top of Column.

THE "SHADOWLESS" LANTERN,
With Improved System of Ventilation, which ensures steadiness of the flame of the Burner, even in very windy weather.
(Registered.)



Used for Burners giving the light of either 80, 100, 150, or 200 Spermaceti Candles.

Other Patterns of Lanterns and Columns are in course of construction, and will be shortly Published in this JOURNAL.

WILLIAM SUGG,
GAS ENGINEER,
VINCENT WORKS, VINCENT STREET, WESTMINSTER, S.W.

gases all the information they may require as to the price of the apparatus, the cost of fitting them up, the economy resulting from their employment, the cost of fitting them up, the economy resulting from their employment, and so forth. The show-room continues to be visited by large numbers of persons, and the service they render is found to be fully as great as was anticipated.

Principal Results of Working.—The following table gives the quantity of gas manufactured from Jan. 1, 1855, to Dec. 31, 1878. It shows that during the first 23 years of the Company's existence, the annual consumption, starting from 1,435,150,000 cubic metres (51,435,150,000 cubic feet), or from 1855 was 49,771,000 cubic metres (1,910,101,000 cubic feet), or 4·19 per cent. With regard to the average annual increase, from 1855 to 1878 it has not been strictly constant at about 2,060,000 cubic metres (72,810,000 cubic feet); but from 1871 it has advanced considerably, reaching 12,750,000 cubic metres (450,375,000 cubic feet):—

Year.	Annual Consumption. Cubic Metres. (1 c. m. = 35·315 c. ft.)	Annual Increase. Cubic Metres. (1 c. m. = 35·315 c. ft.)	Annual Increase. Per Cent.
1855	49,771,493		
1856	47,345,470	6,561,975	13·01
1857	52,907,445	5,561,975	11·75
1858	58,043,000	5,135,555	9·70
1859	67,938,185	9,895,185	17·05
1860	75,518,922	7,580,737	11·16
1861	82,730,070	7,211,148	9·55
1862	94,670,220	8,941,150	10·81
1863	100,813,215	6,142,995	6·49
1864	102,930,963	2,117,748	2·10
1865	116,171,727	13,240,764	12·86
1866	122,345,782	6,174,055	5·31
1867	128,587,701	6,241,919	5·10
1868	145,195,421	16,607,720	12·91
1869	154,470,969	9,275,548	6·38
1870	147,491,316	16,979,653	12·99
1871	167,471,316	20,000,000	13·56
1872	177,221,316	9,750,000	5·82
1873	184,221,316	7,000,000	3·95
1874	194,221,316	10,000,000	5·43
1875	207,221,316	13,000,000	6·69
1876	220,221,316	13,000,000	6·27
1877	234,221,316	14,000,000	6·36
1878	251,315,577	20,752,260	8·86

Manufacturing Power.—The manufacturing powers of our works, which, on Dec. 31, 1877, was 228,500,000 cubic metres (8066 million cubic feet), or 8·86 per cent. more than in the previous year, were sufficient to meet the demand, including that of the reserve plant intended to meet cases of accident, or of any unexpected increase in the consumption, was raised during the year 1878 to 250,000,000 cubic metres (8831 million cubic feet). The total capacity of the works is provided for by the end of the current year, upon the completion of the works in progress at the various stations, the manufacturing power will be raised to close at the various stations (9611 million cubic feet), and be capable of 272,500,000 cubic metres (9611 million cubic feet), and be capable of supplying, for the consumption, after deducting reserve, about 225 million cubic metres (7750 million cubic feet) of gas, thus giving every security cubic metres (7750 million cubic feet) of gas, thus giving every security for a supply during next winter.

Localization.—During the past year our main-laying operations have not been so extensive as in previous years. Our mains establishes have, however, increased by 26,250 metres, apportioned as follows:—

	Metres.	Yards.
In Paris and its environs	23,852	26,250
In the outskirts	22,998	24,997
Total	46,850	50,997

Or nearly 29 miles. Consequently, the total length of mains laid under the public roadways has been increased to 1,925,072 metres, apportioned as follows:—

	Metres.	Yards.
In Paris and its environs	1,278,867	1,391,741
In the outskirts	629,717	679,190
Total	1,925,012	1,971,435

Or close upon 1122 miles, which represents very nearly the distance from Paris to Lisbon. The greater portion of the main-laying work was done during the year in the outskirts, at the request of the Municipal Authorities, or in accordance with the outlying consumers. The remainder was, after consultation with the Municipal Authorities, to meet the demands for a diminution, undertaken with the view of securing to the advantageous to the supply of light which it appeared to us would be advantageous to the Company.

On the 22nd of June last, the *Administration Supérieure* gave their approval to the lighting contract which we had a few months previously entered into with the communes of Ville-d'Avray. The communes have since been lighted by the Company in the districts lying beyond the fortifications, in the departments of the Seine-and Seine-et-Oise, it thus brought up to 822—one.

The Universal Exhibition.—The Exhibition of 1878 furnished us with an opportunity of showing the successive improvements that had been effected in the arts and manufacturing processes, and of calling the attention of the enlisted men of all countries to the results of our labours in the scientific sphere.

The special pavilion which we had erected in the Champ de Mars contained, in a comparatively limited space, a very complete collection of all the various articles and appliances connected with our industry. The various articles and appliances connected with our industry. The drawings there exhibited, rendered the visitor able to take in at a glance the whole process of gas manufacture, as well as that of the treatment of the various by-products, the collection of the numerous products which we obtain, for instance, by extracting from tar, not from which we obtain, for instance, by extracting from tar, not from which we obtain as they are, dyeing of fabrics, a series of colouring matters, and arrangements for isolating gas varied; our improved gas-cocks; our regulating by valve, the gas-engines mains; and, lastly, the appliances for using gas indirectly—all these things attracted and the refractory products of gas manufacture—all these things attracted

the banks of the Seine, and alongside the Western Railway, are undoubtedly exceptionally well placed for carrying on their operations to the greatest advantage.

The other works carried out at our other stations have been undertaken with the object of completing the distributing plant, perfecting the methods of condensing and purifying, and bringing the capacity of the coal and coke stores, as well as of the apparatus for the treatment of the coke, tar, and ammoniacal liquor, more into keeping with the manufacturing power of the ovens.

The total amount expended on works of first establishment during the year 1878 was 2,110,716 fr. (£84,288), apportioned as follows:—

ACCOUNT OF EXPENSES OF FIRST ESTABLISHMENT FOR THE YEAR 1878.

Expended in the Purchase of Land, &c.

	Francs.	Sterling.
Land acquired for the erection of a coke shed	70,421	2,257
Land acquired for extension of coal and coke stores at Billette	24,000	1,120
Ditto for enlarging the coke yards at Ivry	66,961	2,709
Legal and other expenses in connection with above	51,164	2,027
	236,576	43,953
Less value of land acquired by the Municipality for street improvements	11,260	453
Total	225,316	43,500

Expended on Works and Plant.

La Villette.—Completion of two gasholders; erection of two exhauster-engines and tanks; erection of two steam-generators; enlargement of pipe conduccers; sundry works	189,833	25,231
Ivry Terrace.—Repair of gasholder and tank; completion of additional gasholder of 20,000 cubic metres (706,000 cubic feet) capacity	529,762	14,791
Passy.—Enlargement of pipe conduccers; construction of water reservoir	21,612	865
Vaugirard.—Construction of boundary walls; enlargement of coal store; erection of a coke-crusher	88,476	3,539
Ivry.—Completion of two settings of retorts with Siemens's regenerator; completion of steam-engine, condenser, station-meters; construction of site for new coke shed	605,289	21,212
Billette.—Conversion of two ordinary settings of retorts into Siemens's ovens; new station-meter of 20,000 cubic metres (1,000,000 cubic feet) capacity; new steam-engine	25,027	1,024
St. Mandé.—Erection of four water-condensers on Siegen's system; completion of exhauster-house, buildings, and apparatus	53,993	2,116
St. Denis.—Erection of an additional setting of three through retorts; paving coke shed	19,221	722
Boulogne.—Erection of two of Pelouze and Audouin's battery condensers; sundry apparatus; completion of coke-crusher	13,227	529
Maisons-Alfort.—Enlargement of coal yards; improved tar-well; construction of a boundary for crane of coal shoot	12,191	495
Clichy.—Boundary and other walls; earthwork and masonry of three gasholders; foundations of new retort and purifying houses, and other works	1,095,717	13,810
Tar-Works at La Villette.—Construction of a fourth tar-well and a water reservoir; new steam-power steam-generator	71,398	2,864
Sundry works at the other stations, offices, &c., of the Company	189,253	7,238
Total	2,710,201	£160,636

Expended on Mains, Services, Fittings, &c.

	Francs.	Sterling.
Main-laying.—New mains laid during the year (26,250 metres or 50,997 yards), and replacing (20,596 metres or 22,438 yards)	676,313	27,052
Services.—Expenses of laying on	729,822	30,266
House Services.—Expenses of laying on	826,693	13,467
Branch-pipes and Fittings.—Of 1878	1,261,826	52,993
&c., let out on hire during the year		
Meters.—Purchase of meters let out on hire		
Tubulures.—Increase in the number of keeps and valves for the conveyance of coal, coke, and ammoniacal liquor, &c.	41,230	1,768
Ditto for increase of material	113,215	4,530
Tools and Material.—General increase in stock		
Establishment Expenses.—Miscellaneous expenditure	933,870	6,215
Total	5,457,000	136,351
Total expenses of first establishment	5,467,753	£219,700

The general position of the account of expenses of first establishment may be thus stated:—

	Francs.	Sterling.
Amount expended to Dec. 31, 1877	165,660,448	25,791,145

[illegible] the [illegible] of the Seine, and [illegible] in the [illegible] In the explanations which you have hitherto given us, the state- [illegible] of very great interest. Cer-

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, APRIL 28.

The Examiners reported that no further Standing Orders are applicable in respect of the following Bills:—Glasgow Corporation Water, Ravenarde Local Board, Portsmouth Water.

The Birmingham Gas Bill was brought from the Commons, read the first time, and referred to the Examiners.

The Westgate and Birchington Water Bill was read a second time, and committed.

Bills read the third time, and passed:—Bury St. Edmund's Gas, Nottingham Inclosure, New River Company.

The Dudley Sewage Bill was referred to a Select Committee, consisting of Earl Sidney (Chairman), Viscount Powerscourt, Viscount Canterbury, Lord Sudeley, and Lord Foxford; to meet on Thursday, May 1.

TUESDAY, APRIL 29.

The Birmingham Corporation Water Bill was brought from the Commons, read the first time, and referred to the Examiners.

Tenterden Local Board Bill, Sleaford Water Bill—read a second time, and committed.

Petitions against the following Bills were presented:—Glasgow Corporation Water, from (1) Wilson, Patten, Bolton and others, (2) Charles Tod and Highcliffe, and Alexander Harvey and Son, (3) Trustees of the Clyde Navigation; Ravenarde Local Board, from the Corporation of Rotherham.

THURSDAY, MAY 1.

Dudley Sewage Bill.—The Select Committee reported that they had not proceeded to the consideration of the Bill, no parties having appeared in opposition thereto.

The Bromley Gas and Southend Water Bills were brought from the Commons, read the first time, and referred to the Examiners.

Glasgow Corporation Water Bill, Ravenarde Local Board Bill,—read a second time, and committed.

The Brighton and Hove Gas, Manchester Corporation Water, and Glossop Gas Bills were referred to a Select Committee, consisting of Earl Shelley (Chairman), Earl Manvers, Lord Clifton, Lord Lovel and Holland, and Lord Hemphill; to meet on Tuesday, May 6.

FRIDAY, MAY 2.

The Examiners reported that no further Standing Orders are applicable to the Birmingham Gas Bill.

Portsmouth Water Bill.—read a second time, and committed.

The Glasgow Corporation Water and the Ravenarde Local Board Bills were referred to a Select Committee, consisting of Lord Cheylesmore (Chairman), Lord Wharncliffe, Lord Clements, Lord Kenry, and Lord Norton; to meet on Tuesday, May 6.

HOUSE OF COMMONS.

Gas and Water Orders Confirmation Bills.—For confirming certain Provisional Orders made by the Board of Trade under the Gas and Water Works Facilities Act, 1870, relating to Cleethorpes Gas, Dewsbury Gas, Dronfield Gas, Ecclesfield Gas, Enfield Gas, Havant Gas, Longridge Gas, Northampton Gas, Rhyl Gas, Southend Water, Tunbridge Water, Ilkley and Esset Water, Maldeton Water, Mansfield Gas, Peckenham and District Water, Upnortemouth Water, Rhyl District Water, Shoreham and District Water, Stonebridge Water, Thirsk District Water, Aldershot Gas and Water, Vendover Gas and Water, and Yatton Gas and Water,"—was brought in on Friday, the 25th ult., by Mr. J. G. Talbot and Viscount Sandon, read the first time, and referred to the Examiners.

MONDAY, APRIL 28.

Republications to withdraw their petitions against the Mirfield Gas Bill were presented from (1) Joe and Gulliver and Calder and Hebble Navigation Commissioners, (2) Thornhill Local Board.

TUESDAY, APRIL 29.

Bromley Gas Bill, Southend Water Bill,—read the third time, and passed.

The Examiners reported that the Standing Orders not previously reported upon had been complied with in the case of the Colwyn Bay Water Bill.

The Houghton-le-Spring District Gas Bill was reported.

The Crystal Palace District Gas and the London Gaslight Company Bills were referred to a Select Committee, consisting of Lord Henry Lennox (Chairman), Mr. Dundas, Mr. Cates, and Mr. Fremantle; to meet on Tuesday, May 6.

The Mirfield Gas, Woodhouse Local Board, Ilkley Gas, Nottingham Corporation Improvement, Otley Improvement, Otley Burners Corporation, Queensbury, and Stanford-upon-Avon Corporation and Local Board of Health Bills were referred to a Select Committee, consisting of Mr. S. S. Allsopp (Chairman), Mr. Hardy, Mr. Kavanagh, Sir Arthur Hodgson, Mr. J. Maitland, and Sir John Duckworth (Reserve); to meet on Wednesday, May 7.

WEDNESDAY, APRIL 30.

The Llandudno Improvement Bill (Lords), as amended, considered; to be read the third time.

A resolution to withdraw his petition against the Alliance and Dublin Consumers Gas Bill was presented from the Postmaster-General.

THURSDAY, MAY 1.

Colchester Water Bill.—Petition for additional provision referred to the Examiners.

A resolution to withdraw their petition against the Mirfield Gas Bill was presented from the Heckmondwike Gas Company.

FRIDAY, MAY 2.

The Standing Orders Committee reported:—"That in the case of the Knutsford Light and Water Bill, petition for additional provision, the Standing Orders ought to be dispensed with; that the parties be permitted to proceed with their additional provision if the Committee on the Bill

A petition the petitioners not praying to be heard against the London Gaslight Company Bill was presented from Manchesterians, gas fitters, and traders in the Metropolis.

Republications to withdraw their petitions against the following Bills were presented:—Lancaster Gas, Mirfield Gas, and Morecambe Gas, from the Postmaster-General; West Kent Main Sewerage, from Dartford Local Board.

THE SELECT COMMITTEE ON LIGHTING BY ELECTRICITY.

FIRST DAY—FRIDAY, APRIL 25.

The first meeting of the Select Committee appointed "to consider whether it is desirable to authorise Municipal Corporations or other Local Authorities to adopt any schemes for lighting by electricity; and to consider what conditions and regulations such authorities, if at all, Gas or other Companies should be authorised to impose on any supply of electricity," was held on Friday, April 25, the Right Hon. Sir Stafford Northcote, Bart., M.P., and other members of the Committee present were Mr. Alfred Cave, Mr. Hardy, Mr. Hardcastle, Mr. Mitchell-Henry, Sir Upfurd Kay-Shuttleworth, Lord Lindsay, Mr. Arthur Moore, Earl Percy, Mr. Polexfen, Mr. Spencer-Stanhope, and Mr. Christopher Talbot.

The Chairman said we had

Professor James Thomson, LL.D., LL.D., F.R.S., &c., Professor of Natural Philosophy in the University of Glasgow, in reply to the Chairman, gave at some considerable length a history of electric light, from the time of the discovery of electricity by Galvani to the present day, illustrating his remarks by numerous experiments with electrical machinery. He pointed out that the voltaic battery had been proved to be too expensive a mode of producing electricity, as the waste of zinc plates and consumption was so great. Oersted, Ampère, and Arago followed with important discoveries, by which electricity and magnetism was demonstrated. Professor Faraday had, with great care, up the subject, and his efforts, in the main, had led to the great discoveries of the present century, but he had not applied his discoveries to the practical purposes of producing electric heat and light on an economic scale. Like a true man of science, he predicted that those results, which were exceedingly feeble in the first instance, would receive their full development hereafter. Witness then described and explained the different machines by which electric currents are, in the present day, generated.

The Chairman asked the witness if he could say as to the practical point as to how electric currents are applied in the process of electric lighting?

Witness. They require to be regulated, and I think I cannot do better than exhibit an example of a regulator—I think it is Foucault's. This is what we call an electric lamp, and the light is formed by causing the electric current to pass between carbon points made of carbon artificially compressed. The points are made from powdered gas coke, re-compressed enormously. The current is brought to them by means of the regulating apparatus, and is led to keep the two carbon points at the proper distance apart, for, as you are aware, they waste, and of course, as they waste away too much, the interval between the carbon points would finally become so great that the electric current could not leap over it; but, in order to keep them together, such an apparatus as this is used. It has a small electro-magnet, and when the current is strong this electro-magnet draws the carbons together, and, as long as the current continues strong, it keeps the carbon points at a certain distance. The consumption of the carbon goes on; the interval increases, and the current becomes weak; the resistance to the passage of the current augments in like manner. The current thereby becomes enfeebled, and finally a spring, which acts against the magnet, overcomes the magnetism of the electro-magnet. When that is done the two points come together again, until they are arrested by the path of thorough-put. So that you have a series of alternations between the carbon points. You have not continuous action; you have the carbons wasting away, and then the mechanical contrivance sets them apart again, but still, of late years, great improvements have been made in the electric lamp. We have for many years had these electric lamps in lighthouses at Souter Point, at the South Foreland, and elsewhere, and they act admirably; still, they are somewhat complicated, and in order to do away altogether with the necessity for these regulators, we have the device of Mons. Jablochkoff—what he calls the "electric candle." It is in use at the Grand Théatre Lumineux and in other places. It consists of two rods of carbon separated from each other by a more or less insulating substance, and the current passes from the carbon between these two rods by a little bit of carbon placed horizontally over the top of one rod to the top of the other; and the current passing up one of the rods goes through the bit of carbon and down the other rod. The bit of carbon at the top is very soon dissipated, and you have then the electric light established between the two carbon points. I would here remark, that in the Jablochkoff candle it is essential that the current should be alternated, and that is accomplished by a small piece of simple machine, for instance, and other machines of the kind, the current flow in a certain direction. When that is the case, one pole, as it is called, a one piece of carbon, wastes away more rapidly than the other. In order to make the waste equal, which is absolutely essential in the case of the Jablochkoff candle, you must have alternating currents. That makes all waste of both equal. The candle melts away without adding at all to the light. The candle is made of kaolin, which is pipe clay, and plaster of Paris, basically, inasmuch as it does not at all add to the light. But, by reason of the alternation of these currents, the carbons burn down equally, and you have always the two points at the same level. Where the current is direct one pole burns away nearly as fast as the other, and, therefore, the two poles must be kept at equal heights and equal distances, the rate is very large or candle no doubt the great source of the light, is the incandescence of the solid carbons; they are raised to a degree of almost solar intensity. But you sometimes see remarks made in the newspapers that the solid carbons are volatilised, and that is the source of the light; that is not so this. The bluish tinge is due to the arc—that is to say, to the state of the air between the two carbons, for they must always be separated by a given interval. There is a blue light there, and inasmuch as the earth magnetism usually acts upon it so as to bend the flame, it is called the "voltaic arc." The light is undoubtedly due to the incandescence particularly of the solid carbons and partly of the little particle of solid carbon passing from one point of the other; but I do not entertain a doubt that by far the greater part of the light is due to the incandescence of the solid carbon points themselves.

In the explanations which you have hitherto given us, the electric current is also a single field of very great intensity. Can

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, should be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 6, 1879.

Circular to Gas Companies.

As our readers will see in another column, the Select Committee of the House of Commons on Lighting by Electricity have begun their sittings, and commenced with the examination of Professor Tyndall. We have mentioned this as likely to be the preliminary statements of the Professor, in which he described the discoveries of Volta and the earliest practical application of electric light, and then brought it down to the days of Faraday and Wheatstone, would, as it did, embrace. Something more might have been said about the production of the light by a metal battery, the cost of which was gone into so fully by Liebig. Our continent friends, however, carried us back to the days when we obtained the light by means of Wollaston's batteries, and generally succeeded in getting inflamed ayes. This state of things has, however, greatly altered, and the dynamo-magnetic machines now produce the light at much less cost, while improved lanterns obviate the ill effects on the eyes which resulted from the employment of open carbon points. So far as Professor Tyndall's evidence went, the actual object which the Committee are sitting to investigate can hardly be said to have been advanced. We have not been told anything of importance which was not known before, by those who have studied the question of electric light anywhere but in lighthouses, and not much about that. We should have been very glad to have been told more, because, if we remember rightly, it has never been settled to what extent the electric light will penetrate a fog. It must be remembered that the intensity of the light cannot be increased, whatever may be the condition of the atmosphere; on the contrary, when Mr. Wigham's burners are employed, as on the coast of Ireland, two, three, or four rings may be used, according as it is necessary to increase the intensity and penetrativeness of the light. Professor Tyndall was not closely examined as to my opinions he may or may not entertain regarding the applicability of the electric light for public and domestic illumination. With the discretion of a scientific man who has a knowledge of the blunders of his predecessors, he avoids the dogmatism of Sir Humphry Davy and Sir Joseph Banks, who laughed to scorn the idea of illuminating streets and houses with coal gas, and wisely admits the possibility that some day electric lighting may come into more general use; but he acknowledges that the electric current cannot be established without interruption, and that even if it were, within a comparatively short distance, renders it worthless for illuminating purposes. This is a highly important fact; for all the grand schemes which have been devised have been derived from the brains of geniuses who have dreamt that the electric current could be carried any distance, and subdivided at any number of intervals. There was once an idea that gas might be made in the Dunbar coal-fields, and sent up to London to be distributed. There was some sense in the proposal; but, of course, it was never carried out. The idea, however, of a large centre for the production of electricity, such, for example, as has been projected for the supply of a city of the magnitude of Liverpool—that is to put it fairly according to our present knowledge—is now shown to be absurd, while it is likely to be done in the first place is to effect an improvement in the steadiness and colour of the light. It seems not even to be well understood, what occasions the fitful flickering of the electric light, which now causes so much discomfort. It may be impurities in the carbon points; it may be the want of efficient regulating. In any case, the result of the imperfections in the carbons and regulators is the production of undesirable annoyance, which if will, no doubt, be soon overcome.

The most valuable evidence was the well-known Electrician and Engineer, Dr. C. W. Siemens, whose practical knowledge of the matter is perhaps unsurpassed. It cannot be said that the learned gentleman's evidence was calculated to encourage Corporations and Gas Companies to go into the electric light business. We are candidly and faithfully assured that the light is capable of many special applications, and Dr. Siemens appears to believe in the possibility of setting up great centres of electric force, from which large subdivisions—copper mains, or three inches in diameter—shall convey the electric energy necessary for the generation of the light as a large source of points. It is acknowledged, however, that every subdivision of the stream of force greatly reduces the energy beyond the point of division. It is like diverting the water of a river into numerous channels, by which the main current is specially reduced to an infinitesimal proportion.

Up to the present time very little has been said by the witnesses which has suggested any ideas relative to the necessity for legislation. When the Committee met the projects of Corporations and Gas Companies with regard to the distribution of electric force were mentioned, but in all probability, the Postmaster-General would be found to be the strongest objector to their schemes. This has turned out true. In the evidence of Mr. Preece, the Electrician to the General Post Office, which we shall publish in our next issue, it will be seen that objections are raised to the use of the wires for the conveyance of electricity for illuminating purposes, in contiguity to telegraph wires. We can see many reasons for this; for induction from large cables might seriously disturb the currents passing along the telegraph wires. Mr. Preece thinks that the two systems should be placed at least six feet apart, and here is a case for legislation—the first we have met with; and whenever a Bill comes before the House of Commons for the purpose of sanction for the application of electricity for illuminating purposes, this point is certain to be borne in mind. For the rest, nothing that can be considered to call for legislative interference has been brought up; but more will have to be said when we have the complete evidence before us.

The Gas and Water Companies Association, have, in conjunction with the Chartered Gas Company, resolved to watch over the proceedings of the Committee, and to tender evidence. For this purpose they have selected a number of eminent scientific men and engineers, the London Gas Engineers, together with Mr. Michael, Q.C., the latter to give evidence on the legal bearings of the case as it is presented to the Committee. As stated above, the proceedings have, up to the present, been possessed but little interest to Gas Companies. Next Friday, the Agents of the Société Générale d'Electricité will be examined, and, after them, some witnesses from Local Authorities will be heard.

The scheme for the amalgamation of the South Metropolitan and the Surrey Consumers Gas Companies has been submitted to the Board of Trade, and in the course of a few days will be in the hands of all interested. Taking a cursory glance over its provisions, we see nothing to call for any serious opposition. It will, of course, be challenged; but we cannot think that many valid objections against it can be adduced. In the first place, it

Gas in Paris.

Hoag 79

In consequence of the influence associated with the Universal Exhibition at Paris, that highly progressive undertaking, the Parisian Company for Lighting and Heating by Gas, made a still further advance last year, and a very large advance into the bargain. The political history of Paris is reflected rather curiously in its gas consumption. The Second Empire was, at any rate, a period of material prosperity until the fatal moment in 1870, when Napoleon III. and M. Emile Ollivier went to war with a light heart; and accordingly we find that the consumption of gas in Paris experienced a rapid progress year by year—a progress which was not only rapid, but also unchecked. In 1855 the consumption of gas made by the company under notice stood at 60,771,400 cub'c metres, in 1860 at 75,618,-022 cubic metres, and in 1865 at 116,171,727 cub'c metres. In 1869 there was a further advance to 145,199,624 cubic metres. In 1870, however, came the terrible Franco-German w.r, and the encircling of the French capital by the armed hosts of Germany. The result was that in 1870, the Parisian Company for Lighting and Heating by Gas, sold only 114,470,969 cubic metres of gas in that year. In 1871, the siege of Paris, and the communist revolt which followed it, still further affected the business of the company, and its sales declined in that year to 87,481,916 cubic metres. But in 1872 there was a rapid recovery, and ever since that year the business of the company has been developing itself with remarkable rapidity. In 1875 its sales had grown to 175,858,241 cubic metres. In 1876 they had further expanded to 182,209,726 cubic metres, and in 1877 to 191,197,-228 cubic metres. Last year there was a still further advance to 211,919,-617 cubic metres.

It is rather curious to observe that the day consumption figured in last year's total for 46,877,003 cubic metres. These figures were 6,203,167 cubic metres in excess of the corresponding total for 1877. This consumption which arises exclusively out of the use of gas for industrial and domestic purposes, has made great progress of late years. Thus since 1875, it has increased to the extent of nearly 50 per cent. The company's receipts for gas, which amounted in 1877 to 1,998,223l., rose in 1878 to 2,161,026l. The number of public lamps served by the company last year was 46,001 showing an increase of 2,300, as compared with 1877. The productive power of the company's works, which stood in 1877 at 228,500,-000 cubic metres, was carried last year to 230,000,000 cubicmetres. The company's system of pipes was increased last year to 736½ miles, a length very nearly representing the distance from Paris to Lisbon.

The Universal Exhibition of 1878 afforded the company an opportunity of illustrating the successive improvements introduced into its plant and into its processes of manufacture. A special pavilion was constructed for this purpose in the Champ de Mars, near the Porte de Seine. This pavilion comprises in a relatively limited space a very complete collection of the models, specimens, and products associated with the company's industry. These drawings and plans were exhibited, showing at a glance the manufacture of gas for lighting purposes, as well as the treatment of various sub-products, and the distillation of coal, coke, gas tar, and ammoniacal liquor. There was further shown a collection of the numerous products which science has succeeded in extracting from gas tar, and from which industry has derived for the coloring of fabrics a series of material of tones as rich as varied. The collection further comprised the company's improved gas furnaces, its special exhibition junctions, its coke warming apparatus, its gas engines, and its refractory products. The pavilion attracted a good deal of attention on the part of the public, and the International jury recognized the value of the company's efforts by awarding it a grand prize—that is to say, the highest reward accorded to exhibitors. The company does a great deal of work, and realizes its r. ward in a handsome r ofit. In 1874 its 50l. shares received 2l. 6s. per share; in 1875, 2l. 8s. per share; in 1876, 2l. 10s. 6d. per share; in 1877, 2l. 8s. 6d. per share; and in 1878, 2l. 12s. per share. It is not surprising with such dividends as these to find the company's shares standing at about 66l. each.

Circular to Gas Companies.

The Committee on the electric light, of course, continues their sittings. To say the truth, very little turns up which is of special interest to Gas Companies, or really bears on the question referred to the Committee. The reference was for them to consider under what circumstances it is desirable to "authorize Municipal Corporations, or other Local Authorities, "to adopt any schemes for lighting by electricity, and to consider "how far and under what conditions, if at all, Gas or other "Public Companies should be authorized to supply light by electricity." No evidence affecting this reference has been offered; no suggestions of any necessity for legislative interference with the supply of the electric light, other than those we mentioned last week, have yet been put forward. It is given in evidence that cables conveying electricity for light must be kept far apart from telegraphic wires, and it is also in evidence that Electric Light Companies can make large profits. Here we have ground for that interference of legislation; but these are the only two reasons shown for such interference. To-day, we shall have that evidence of Sir J. McGael Hogg and Mr. Norner, the latter of whom will, of course, give us the views of the Board of Trade on the subject. Here the question will begin to get interesting. Hitherto the mere description of the various systems of electric lighting, the photometrical results, and all that, have possessed but little interest to those who have followed the question through all its phases. The photometrical value of the electric light, as compared with gas, is not easily ascertainable, and we place very little reliance on what has been said on the matter. What we know is, and what is placed beyond a doubt is that gas burnt in sufficient quantity can fairly compete with electricity, and, indeed, beat it out of the field. The report of the Engineer and Chemist to the Metropolitan Board of Works, relative to the experiments on the Thames Embankment, shows conclusively that electricity employed for lighting purposes is dearer than gas. It is stated, in the report of the two gentlemen we have mentioned, that the cost of the electric light is 9·73d. per hour, and that for gas equivalent to the electric light in an opal globe is 2·00d. per hour, and in a frosted globe 3·50d. per hour. Hence, on the score of economy, nothing can be expected to result from its adoption for public lamps.

As to return, however, to the necessity for legislative measures, we may remark that, whatever may be said by the eminent witnesses who will be examined to-day, nothing has been shown up to the present time which could possibly militate against the supplying of the electric light by Municipal Corporations and Gas Companies, supposing that the light was ever to be made a useful institution. We have always regarded the withdrawal of the Bills promoted by Corporations and Companies as rather illusions to their interests. It was, however, rendered advisable by the action of external influences. It is quite clear now that no legislative interference will be necessary with regard to the electric light, further than what we have referred to above. Mr. Farrer may possibly have his particular views, but we are certain that they cannot differ from our own. Limit the profits of the Electric Light Companies, and protect the Postmaster-General, and everything is accomplished.

The improved gas lights in Waterloo Place have been removed earlier than we expected, by request of the Vestry. Comparisons, as Mrs. Malaprop observes, are "odorous," and probably the Vestry of St. James's did not like to see the brilliant light in proximity to the dull glimmer they ordinarily furnish. We have repeatedly said that Vestries will not pay for good illumination. They are not bound to gas, which affords them the best light they can get; but whatever system of lighting may be recommended, it is certain that it will not be adopted if it involve any additional expense. We cannot say that the parish of St. James is the worst lighted in the Metropolis, but the illumination certainly might be improved, and we are sure that the respectable inhabitants of the district would willingly pay their quota towards the cost of the additional light. The Gas Company, of course, do not deplore the decision of the Vestry, for they supplied the gas gratis, and Mr. Sugg is not inconsolable, seeing that he quickly disposed of all his lamps. The action of the Vestry is, at all events, reprehensible, and it leaves us with little hope that any great improvement can be effected in the public lighting in the Metropolis.

THE STRONG FUEL-GAS IN SWEDEN.

GEORGE S. DWIGHT, Esq.:

DEAR SIR: A furnace for producing gas through the decomposition of water, according to the Siemens method, having been erected by me during winter, according to this Works, Stockholm, we, the undersigned, do the last winter in the Atlas Works obtained in the manner; that the above herewith that the results hitherto obtained in the said furnace with the assistance made with the employment of the gas, fully agree researches hitherto made with the employment of the gas, fully agree with the statements previously given by you, as well verbally as in a printed pamphlet; and that we are heartily convinced, through the progress and usefulness of the gas already employed, of the large future success of this gas as well for metallurgical and technical as for domestic purposes. Thus we confirm the statement that fuel-gas has been produced in this furnace by employing as well English coke, coals from Hogarna in Sweden, and anthracitic coals from Wales, in the generator, and coal-dust or peat-powder in the hopper; that the composition of the gas, by employing these different fuels, has been exactly the same as shown by the analysis; that the gas has by us been employed for welding wrought-iron, for smelting in crucibles as well pig-iron as steel; and that the results of these three different experiments have been very satisfactory as to the heating power of the gas; and that the economical results obtained by these operations, though made on a small scale, are such as to fully satisfy us of the superior economical results that must be obtained when the operations come to be executed on a larger scale in furnaces better adapted to the purpose. Thus we are convinced that fuel-gas has been the problem solved.

And in this furnace by employing as well English coke, coals from Hogarna in Sweden, and anthracitic coals from Wales, in the generator, and coal-dust or peat-powder in the hopper; that the composition of the gas, by employing these different fuels, has been exactly the same as shown by the analysis; that the gas has by us been employed for welding wrought-iron, for smelting in crucibles as well pig-iron as steel; that the results of these three different experiments have been very satisfactory as to the heating power of the gas; and that the economical results obtained by these operations, though made on a small scale, are such as to fully satisfy us of the superior economical results that must be obtained when the operations come to be executed on a larger scale in furnaces better adapted to the purpose. Thus we are convinced that fuel-gas has been the problem solved. This furnace will be the best, both effectually and economically, for most metallurgical purposes.

On the other hand, we can confirm the statement that the employment of the gas for cooking purposes causes extraordinary economy in the household department, and that the cleanliness and convenience of its use must make it a favorite with all housekeepers. Of which we are induced to you for the construction of a similar small baking and cooking stove, of the dimensions inside of 2' 2" × 18" × 18", giving, at a gas consumption of only 110 to 115 feet an hour, a constant heat of 250° C. And in the above dwellings, we have not yet made any experiments; but we have fully convinced of the usefulness, cleanliness, and cheapness of this gas for this as well as for the above-mentioned purposes.

In reference to the adaptation of the gas for illuminating purposes, we have as yet made only one experiment, by conducting it through a vessel filled with cotton moistened with benzine, and by this simple process we have found the gas acquiring a satisfactory illuminating power.

In inviting our gratitude that you have introduced a method that we are convinced will be most important to our country, at the same time we sincerely acknowledge the expert, straightforward, and gentlemanlike manner in which you have conducted the work.

We are, sir, with the highest esteem, yours sincerely,

LUDOVIG NORDL, of St. Petersburg, Russia.
OTTO TORELL, Director of Geological Survey of Sweden.
C. A. DEBAVE, Director of Metallurgic Dep't of Iron and Steel Masters' Association of Sweden.
E. FRAENCKEL, Manager of Atlas Works, of Stockholm, Sweden.
ANDELL, Engineer Stockholm Gas-Works.
OLOF. WITTENSTROM, Metallurgical Engineer.

STOCKHOLM, SWEDEN, May 8, 1875.

Gas Engines.—During the year 1873 we sold two horizontal engines on Lenoir's system, 10 vertical engines on Otto and Langen's system, and 30 of Otto's horizontal engines; making the total number of 320 engines—horizontal and vertical—that have left our works during the past 16 years. The two latter kinds of engines, which, unlike the former, do not require the employment of electricity, are susceptible of a tolerably large number of applications, and, for small manufacturing operations, might be used with considerable advantage.

We may estimate at 1,000,000 cubic metres (35,300,000 cubic feet) the amount of gas consumed in 1873 by the gas-engines usually working in Paris.

THE NEW GAS-LAMPS IN QUEEN VICTORIA-STREET.

ALMOST all the necessary information for making accurate estimates of the illuminating power and cost of the electric light, as compared with the ordinary street gas illumination and its cost, have been set forth in our columns in our notices of the reports of Mr. William Haywood, the City engineer and surveyor, and the assessment report of Sir Joseph Bazalgette and Mr. Keates. We have now before us the report of Mr. Haywood on the new gas lamps in Queen Victoria-street. In January last the Gaslight and Coke Company applied to the City authorities for permission to show experimentally what could be done in street illumination, by means of improved gas burners in Queen Victoria-street, between the Mansion House Station of the District Railway and the Poultry. The company received permission to make this experiment at its own cost. The company therefore commenced the removal of the common burners and lamps on the 21st February last, and the substitution therefor of Sugg's argand governor burners and lamps. Since the 4th of March the whole of the lamps in the length of the street have been so fitted and in use. The burners are of two sizes, the smaller consuming 22 cubic feet of gas per hour, and the larger 30 cubic feet. The smaller burners have two rings, as illustrated in THE ENGINEER of the 7th February last, at page 106, and the larger have three rings. They are provided with a main light, a very small burner, burning about a quarter of a cubic foot of gas per hour. These are constantly burning, and by their aid the large burners become self-lighting by merely turning the gas on. These burners and lamps are fixed on the common lamp standards, there being thirty of the smaller and five of the large burners, the latter being on the standards at the large entrances, or resting places. Fifty-five of the different reliugos or resting places. Fifty-five of the ordinary burners are suspended by the thirty-five referred to. The total illuminating power of the thirty-five lamps is estimated, by photometrical comparison with the Gas Referees' standard burner, to be equal to 580 candles, the double-burner lamps to 24 sperm candles, and the treble-ring 200 candles, with the consumption above stated. The thirty-five smaller self-lighting burners of the temporarily displaced lamps should give a light equal to 210 standard candles, each being equal to fourteen candles, with a consumption of 5 cubic feet per hour. The ratio which the estimated quantity of light given by the thirty-five experimental lamps was likely to bear to 1, as compared with the estimated light given by the ordinary lamps, the ratio of the consumption of gas being respectively as 2·25 to 1. The relative cost of the two systems is given as £177 2s. 6d. per annum, and £208 2s. 6d. per annum, the former cost being furnished by the gas company to Mr. Haywood, while the latter is by the gas company to Mr. Haywood, while the latter is by the London contract price paid by the City Commissioners. The relative cost of the new and old system is thus as 850 to 1. Thus the report result roughly stated is that the new system gives four and a-half times the light given by the old system, and costs approximately three times as much.

On the Thames Embankment the electric light cost 1·73d. per hour, while gas to produce light equivalent to that of the electric light cost 1·92d. per hour. On the Holborn Viaduct the relative cost of electric and gas light was as 7·5 to 1, the gas-light being 7·5 to 1; Under present conditions, therefore, the cost of improved gas illuminating power is quantities of light, materially cheaper than the electric light. It may of course be urged that the electric light is steadier, and can be made in the use of electricity are now obvious; but much may also be said in the same way as the result of the experiments with Sugg's large burners. The experiment in Queen Victoria-street does not, however, show, as Mr. Haywood says in his report, that the public ways may be lighted in a very ample and satisfactory manner by means of gas. Mr. Haywood, however, evidently looks upon it as doubtful whether the increased quantity of light is, in the opinion of the general public, worth the increased cost involved, for he says that "the question to be considered, before the increased cost is incurred in street lighting, is whether the public necessities are such as to render specially necessary a more expensive mode, than that now ordinarily in use."

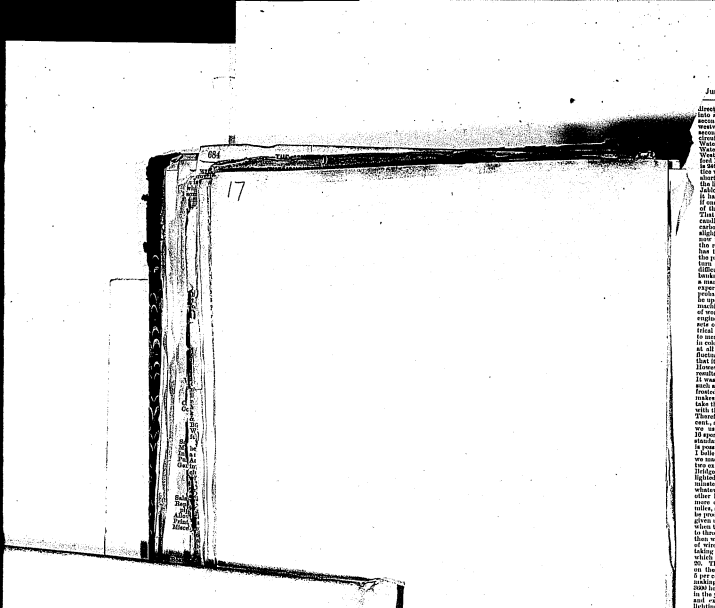
It seems to us that though the public would be pleased to have the good bright light, that it will not care to pay extra for it, when a very fair amount of light can be obtained for £208. Those prices are, on one side, those charged by the company, while the others are from the estimated consumption. It would be advisable to wait a while ere for the adoption of any of these new lights. It might be worth, while to pay a little more for better lamps on some such plan as Mr. Sugg's, but improvements as yet to be made both in the burners and glasses for the large burners, and in the methods of lighting by electricity. One experiment with the electric light must be necessary. The electric light, at present, is only to have been first placed at the ordinary height of gas lamps, at the side of the street, within a waterfall opal globe. To be efficient, and to give the greatest duty, the electric lamp should hang over the centre of the street at a considerable elevation, under a large reflector, and with a small opaque shade immediately beneath it. The lamp thinks for burning for a long time, and in such a position, has not yet been devised. When it has been it would seem then time to make a definite test of comparison between the old and the new systems.

THE SELECT COMMITTEE ON LIGHTING BY ELECTRICITY.

(Members present: Dr. Lyon Playfair, in the chair; Mr. Alfred Guillemard, Mr. Macdonald, Mr. Monsell-Bruce, and Mr. Russell. Mr. Arthur Moore, Earl Percy, Mr. Puleston, Mr. Spencer-Stanhope, Mr. Chichester Fortescue, and Sir Henry Woodward.)

Mr. Thomas William Keates, examined by the CHAIRMAN.

I am Fellow of the Chemical Society and of the Institute of Chemistry, and am the Consulting Chemist to the Metropolitan Board of Works, and to the Commissioners of Sewers, and to the Corporation of the City. In conjunction with Sir Joseph Bazalgette, the Engineer of the Board, I have been employed in carrying on the experiments with the electric light on the Thames Embankment since the 15th of December last. We recommended a trial of the Jablochkoff candles in preference to any other mode of electric lighting. I may say that in about October of last year many applications were made to the Metropolitan Board of Works for permission to make experiments for the introduction of electric lighting; and Sir Joseph Bazalgette and I were instructed to report upon those various applications. We considered the question, and came to the conclusion that the best system to be applied in an experimental in street lighting was the Jablochkoff; and I may state very broadly what led us to that conclusion. In the first place, that system had been in operation in Paris for more than a year previously, and it had taken something like a settled form there. There is at the present the only system by which the light was produced without the intervention of a mechanical regulator. All the other systems that have been employed a mechanical regulator or lamp of some kind, but in the Jablochkoff system that is entirely done away with. Besides that, it was the only system which offered us a division of light. The Siemens machine of Siemerick offered to give us 20 lights on the Embankment, and that appeared to us to be a matter of much importance, that it should subdivide the question. However, taking those three matters into consideration, we thought that the Jablochkoff system was the best to serve for the practical experiment. We also thought that was put on the Embankment to work the Gramme machines was nominally a 24 horse power engine. The maximum power that has been applied from the engine has been 23-horse power for the 22 lights. The exact cost of the motive power was 21·9d. for the 22 lights per night of 6½ hours. The cost would be 17·8d. per electric light per night; or, bringing it down to the cost per standard candle, it would be 0·95d. per night. The cost of the machinery was as follows:—The engine complete, with the governor, £162; the two Gramme machines, the exciter and the distributor, £262; the driving-bands for the engine and electrical machines, £35; and 2000 metres of conducting cable, £200; making a total of £1260. That is the cost of the machinery as it stands; that is to say, with the 24 horse power engine; but it is understood clearly enough now that a smaller engine is powerful for the purpose. If we had had a 10-horse power engine instead of a 24 horse, we should then have the cost of the engine, £250; the Gramme machines, as before, £262; the driving-bands would be lowered to £35; and the conducting cable would be £200, as before; making a total of £996 altogether; and it has since been that we have calculated the interest and wear and tear in finally working out the cost of the electric light. On the Embankment there are two electrical machines —the smaller in which the current is generated as a continuous or



direct-coupled to an engine driving current and distributed. Passing away from the second machine, the current is led to four distinct circuits; and those proceed, one Westminster Bridge and taking in five lamps eastward; the second takes in the Victoria Embankment and Waterloo Bridge; the third circuit goes eastward from Hungerford Bridge, taking in five lamps towards Waterloo Bridge; and the fourth circuit leads off from the same bridge to Westminster Bridge, making altogether 20 lamps.

The distance from the engine-room to Westminster Bridge is 3,000 feet; the circuit between that and the nearest lamp is 3,015 feet; and the circuit from there onwards to Waterloo Bridge is 3,030 feet. The distance from the engine-room to Waterloo Bridge is 3,030 feet. In practice, the current of 3,015 feet. There is no perceptible difference between the lights on the two circuits. I think one of the great advantages of the Jablochkoff system of electric lighting was (I say "was," because, I believe, it has been corrected) that, as every lamp was part of the circuit, if the resistance of those lamps could always be lightened, the five lamps would cost, and the light would be increased. That defect, I believe, has been remedied beginning entirely afresh. candle, which, by altering the character of the materials used for making a carbon, they are able to change the resistance of the medium between the two slightly conducting material, I believe, is introducing, and extinguished. Some now the candle, if it becomes extinguished, can be lighted again by the passage has to be passed from one candle to another by switching; and, up to the present time, I believe, it is impossible for a man to go to every lamp and turn on the current from the exhausted candle to a new candle; but that difficulty has now been overcome. I saw a very simple arrangement on the Embankment, the switching is done from one central point near Waterloo Bridge; a man switches all the new candles as they are required, and the whole light as experimental lighting up of two of the circuits was accomplished, and perfectly to-night the four circuits will be lighted up, and then the dynamo machine. The individual lights worked by two additional Gramme machines. I think there is no doubt whatever that the engine is capable of working 80 lights each, and I am very much surprised from the maker of the sets of Gramme machines. We have used the power of working 60 lights from three trial experiments as to the value of the light. It is a very difficult thing to measure the electric light, for two reasons; first, the light is difficult to compare with the standard light, and there is no standard I know of that at all approximates in colour; then, besides, the electric light is very fluctuating, and some experiments in effect give the idea is changing, or that it requires more experience before you are able to measure it at all. However, we finally did measure the light, and were prepared to give you the results. There were three conditions under which we prepared to give you the It was measured as a naked light; then it was measured as the light was measured. Then as are on the Embankment generally, and it was measured in the frosted globes. All the measurements were taken horizontally, which is not the usual practice, but it appeared to me it was the fairest way to take them. The principle of the naked light is equal to 1791 sperm candles; with the opal globe 1570 candles. Therefore, the loss of light with the frosted globe 240 candles cent., and with the frosted globe to 22 per cent. We used for the standard one of our lamps, giving a light equal to 16 sperm candles. I am quite of opinion that the loss by the frosted globes is possible, because the disproportion is so great that I do not think it I believe it is the best method hitherto. On the 14th and 15th of March we made, I think, a very interesting experiment. We joined together the two extreme circuits, the Westminster Bridge circuit and the Waterloo Bridge circuit, making the length of wire up to 7,345 feet, and when we lighted up the lamps on the extreme parts of this circuit, that is, at Westminster and here at Waterloo Bridge, there was no apparent difference whatever; every one agreed that the lights burnt just the same as the other lights were burning. The next night we put in 1752 feet more of wire, making altogether a length of wire of 9015 feet, or 750 miles, and no effect whatever in the intensity of the lights appeared to be produced. We are intending to carry on that experiment further; it was given up at the time, because there was not sufficient time to do it, and when the new arrangement is complete to Blackfriars Bridge, we intend to throw the Westminster circuit and the Blackfriars circuit into one and shall have an opportunity of testing the effect to about 21 miles of wire. The cost of producing the electric light on the Embankment, taking all the charges for management, repairs, &c., is about 4½d. per light, which would be reduced to a certain extent if we had 80 lights instead of 20. Those figures are obtained from the accounts of the Board.—The interest on the amount of capital expended to establish the machinery, £2,000, at 5 per cent., is £10 10s.; and the wear and tear, at 10 per cent., is £21, making a total of £31 10s. I assume that the light may be burned about 3000 hours in the year. I find the gas-lamps are burned about 4300 hours in the year; but, of course, considerable time is taken up in lighting and extinguishing the gas lamps, which would be saved in electric lighting, which I have already explained is equal to 2½d. per light per hour; 80 lights would represent the time fairly enough. That brings the cost of the interest and wear and tear down to £12 10s., and the cost of the light at 2½d. per hour. Then we have to add the cost of working the steam-engine, which I have already explained is equal to 2½d. per light per hour; and when the new arrangement is complete to Blackfriars Bridge, we intend to put the whole of the candles at 2½., and that I am bound to say is completely, but I will explain to you my reasons for putting it at that. When first the experiment commenced, the Board proposed the Metropolitan Board of Works should pay for the light per hour. From the end of March they have undertaken to pay 2½d. per light per hour; but since the 15th of March they have undertaken to produce the lights upon a different principle altogether. They are now under contract with the Board to supply the lights at 2½d. per hour net, covering everything; they take charge of the machinery, and pay all the expenses connected with it, and are to receive 2½. per light per hour.

Mr. Pullman.—Do they own the machinery?

Witness: They have the use of the machinery; they lent that to the Board from the beginning; but the whole responsibility is put upon them; it is hired by the Board. Therefore there is the interest of the machinery to be added.

What I want to get at is the total cost to the Metropolitan Board?—That would come out something very small indeed. The £12 10 for interest and wear and tear only comes to ½d. per light per hour; and, of course, if the Board purchased the engine, it would come out under ½d. With regard to the cost of the Jablochkoff candles, of course it would have been absurd, in the face of the reduction the Société have made, to reckon 5d. for the candles. I am not at liberty to say much about it; in the French reports, and what I have heard from our own engineers, I consider, 5d. is a fair sum to put down at present. I think 3½d. would be nearer the but still I have put it down at that, and it brings the whole charge up to 6½d. The items are interest on capital and wear and tear, 2½d.; current candle, 3d., making altogether 9·75d. That is upon the present 20 lights. Examined further continued: I do not know what will be the reduction upon the cost now that it is extended to 40 lights; but it is quite obvious there must be a very considerable reduction. The figures in relation to the working of the engine are these: *For 12 nights of 81 hours each, 972 hours*, 27 tons of coal, costing 2s. 2½d.; 20 lbs. of coal to get up steam, 3½d.; wood to light fires, 1d.; oil for day, 1s. 7d.; two men to defend engine, and 1 to attend to electrical machines and candles, 12s. 6d.; and two men assisting, 10s.; altogether that comes to £2 11s. 7½d. I suppose the wages would remain much the same, whether we had the engines for 20 or for 40 lights; the cost of the oil per day would be increased, and the consumption of coal by the additional electrical machines; and the quantity increased by the furnace, would, of course, be largely increased; but I do not suppose the wages would rise more than half, at all events, to the end. Then, comparing the cost of the electric lights with the cost of lighting by gas, and also the effect, I have taken the number of gas-burners between Westminster and Waterloo Bridges in the Government offices and the parapet lawn each two burners, as that there are really in the houses on the Victoria Embankment which is lighted by the electric lamps. I have calculated a certain quantity of light which would be given by those burners. They consume 5 cubic feet per hour (Gramme cannel gas); and those farther down on the Embankment, where all the gas-burners are the same, consume 3 cubic feet per hour; whereas the gross amount of light from the gas, is equal to about 1200 candles; whereas the gross amount of light from the electric lights is equal to about 2400 candles; 24 is 20 times 120 candles. That is the gross amount of light. With the opal globes the gross light comes to 3696 candles, or 2·2 times as much as is given by the gas; whilst with the frosted globes the light amounts to 2280 candles, or about 1 times the light given by gas. Then, of course, a great deal depends upon the arrangement as to the unfavourable position in which the electric lights are placed—all along on one side. I think if you want to get the best effect from the lights they ought to be in the middle of the road. The light from them is thrown partly on the river, and, as the Embankment is about 100 feet wide, I think there is considerable loss of light by the distance which it has to pass over to the opposite side. We should get a more economical result if lights be able to throw a light of 700 candles, for supposing one of the candles that would be reduced to 350 candles on the footpath on each side. As to the comparative cost of the electric light and gas, it is not easy to deal with the question of naked lights, because no naked electric light could never be used; but the light in an opal globe is very much softened and equal, and a frosted globe to 350 candles. To produce a light of 122 candles with gas with one of the large Sugg 256 candles, about 80 feet of gas would be consumed. The cost of 80 feet of gas would be about 5d. per hour; and the cost of 35 feet would be about 2d. per hour. I have already stated that the cost of the electric light is 2½d. per hour, and this is now a comparison between those lights, light for light; that is, the gas equivalent to the electric light in the opal globe is 5d.; and the cost of gas equivalent to the electric light in the frosted globe is 2½d.

The Chairman: If you placed the electric lights in more favourable positions in the middle of the road, would you require the same number of lights?—I rather difficult to say, because you have to light the whole width of the road, and if you diminish the number of lights, of course the loss of light is increased. I should say that you would require more lights, but you have a great deal of light in one place, and but little in another. Therefore, whatever may be the number of lights, I think one that is placed the light in the best way. The one great difficulty with regard to electric lighting is that whether you require a large light or a small light, you are obliged to accept the large light; and at present, so far as I am aware, there are no means by which this difficulty can be overcome.

If you raised the lamps higher, although you increase the light, you enlarge the area over which it spreads?—That is so; but it seems to me there is a great waste of light in the direction of the river, and not much in an enormous extent. It would be to the lights on the Embankment are at about the best height. Perhaps they are rather too high; they were, say, 6 feet higher, it might be better; but when you talk of putting up a light 50 or 60 feet high, it would entail very considerable loss of light.

In the present price of production, as far as your experience goes, even if you had the cost reduced to one-half of 2½d. would be more economical than electricity for the production of light?—I was unaware of light?—That is obviously so; but, at the same time, I think the electric light would be very much allowed in a little while; the putting on the additional lights will produce a great effect. If it were possible to put on 40 lights instead of 80, for instance, the 2½d. would, no doubt, be largely reduced. Then the cost of 2d. for the Jablochkoff candles is rather excessive, and I think that it will be found that there is another candle which I only heard this morning, I understand a modification of the candle has been made, so that it will last for two hours, and that candle is to be put at 3d. per candle. The candles are supposed now to burn for an hour and a half—in practice, in fact, they do not burn quite so long; but I am told they have been made to burn for about three hours, and that would be a very great economical candle.

I think giving evidence as a scientific man as to the actual results obtained up to the present time by your experiments, you are, of course, not able to give an opinion as to the probable cost of the electric light; you could not do that. I think I should be wrong if I were to say that I looked to those figures. I think that, as time goes on, the figures will be modified. My own feeling with regard to the electric light is, that it is undoubtedly established itself. I am not one of those who anticipate any sort of competition between gas and the electric light; I do not think there is any danger at all of that; but, at the same time, I think that the electric light will be found very valuable for many purposes. I have seen, in the lights on the Thames, that there are certain defects that have been talked about. The light, I believe, is very unsteady. We have never had a serious mishap. We have never had a check that could be looked upon as a practical difficulty; and, with regard to the quality of the light, I cannot see that there is anything to complain of, so far as the Jablochkoff candle is concerned. It is a soft, agreeable light to the eye, and I should say that, generally speaking, I used its eyes, I suppose, if one of the lights went out, I should be very much annoyed at the apparent as to be distressing; but for street purposes, and for the lighting of large factories, where that flickering would be removed by the use of perhaps more than one light, I do not think it amounts to anything that could be called a practical defect. When you come to attempt to measure the light, and get it upon a screen, where you observe every slight flicker, of course it is very apparent indeed; but if you look at the lamps in the street, I am of opinion that those lamps are steady enough for all purposes of practical illumination. I have seen, myself, in the lights on the Thames, slightest chance of its competing, in a general way, with gas. There are defects about the electric light which, unless some essential change takes place, must entirely prevent its application to ordinary lighting purposes. The single fact that at the present time you cannot divide the light, and that you must take the large light or nothing, is, of course, an insuperable impediment to its use.

Sir,—In reply to your letter of the 2nd ult., calling attention to the Electric Lighting Company, Limited, Bill, and asking for the Board's observations on clause 2 of the Bill, I have been directed to submit, for the information of the Secretary of State, the following remarks:—

The question whether the electric light should be introduced here has been, both in no small one of great importance, but the Board is of opinion that, if such powers as are applied for in this Bill are given, the whole sense of the undertaking should be contained in a Bill in order that the subject matter may be fully before Parliament, whereas the Bill proposed hardly seeks power to deal in a very important manner with public highways and property.

It seems doubtful whether, as the Bill stands, the Board would have any control over the breaking up of the streets, which would be necessary for the purposes of the Bill. By the Thames Conservancy Act, the Metropolitan Board has a veto in the Tideway and the Docks, and not in the Metropolitan Board. Supposing, however, that the Bill did give the Board such control over breaking up the streets, the public thoroughfares, it would be necessary that the Bill should also provide for the Board fixing the amount of capital and in the case of dividend, and providing by section clauses that no dividend should be paid exceeding 10 per cent. and that by means of a sliding scale of dividend, as recently applied to Metropolitan Gas Companies, some security may be given to the public that the land-lighting should be carried out with economy and efficiency, and that the public had not to pay, either at a remote period or otherwise, for undue profits. Further, if any benefit it would have were to the public it, when gas and water companies originally acquired compulsory powers, proper provisions were inserted for purchase by the public.

Apart altogether from these considerations, if powers are to be given to a new body to break up the streets, it might be desirable to consider that question in connection with the Bill now before Parliament for the Consolidation of the Metropolitan Police Acts, and whether some more effectual control should not be given to the Board. In the present case, however, with a Company whose capital is to be only £200,000, and which is to be limited to 10 per cent. dividend, and in some respects peculiar, it would be unfortunate if the Board were involved in an expensive inquiry before Parliamentary Committee upon the question of the introduction of the electric light. The Board therefore, unless the Bill be amended in the sense suggested in the Bill, and the Secretary of State will, no doubt, be requested to present its objection on several grounds. It is hardly necessary, but the Board appreciates that the Vestries and District Boards of the Metropolis would almost unanimously oppose the measure.

(Signed) J. S. WARDROP.

Lord LINDSAY: As to the question of appeal from the Vestries decision to the Metropolitan Board of Works, would the Board be a court of final appeal?

Mr. HAWKSLEY: Yes; we are the court of final appeal now in many cases.

Do you consider that the Metropolitan Board of Works are sufficient judges of electricity to be a court of appeal? I do not appeal as regards the breaking up of roads. I do not say that they would be sufficient judges as to whether one sort of electric lighting would be better than another.

But practically it would come to that, because the appeal might, at all events, arise on the same questions as you have with regard to gas. You are a court of appeal in the matter of gas. Supposing, for instance, any question arose as to whether the gas was strong in sulphur, or that there are too many impurities in it, and that the effect of a bad illuminating power, your officers inquire into the matter, and you have to decide whether the gas is or is not corrupt in the case of electric lighting, as you have in the case of gas?—We have many gentlemen of great eminence who have investigated gas matters, and they are doing it, in fact, every day. We have a Superintending Chemist, who understands all those matters, and I apprehend that his opinion would be taken and followed.

Then you would appoint an officer specially for the purpose, I suppose, to inquire into questions which may arise in connection with the electric light?—Exactly; we should consider it our duty to do so.

By Mr. HAYWOOD-HANDS: I think that at the present moment the question of electric lighting is in so experimental a condition that it is not desirable to give very large powers with respect to it. That view is founded on what I have read and seen of the experiments. I think it would be a wise course to allow private individuals and private companies, to a limited extent, to do so without compulsory power, to test the further development of the light before giving any larger powers to companies or corporate bodies.

The CHAIRMAN: Would you not give corporate bodies pretty extensive powers to make experiments, and to try the utility of electric lighting in their own districts?

Witness: I think it is most desirable to give public bodies the power of doing so. We are doing it now in the public interest. I may say that the Board, as a board of the electric light being perfected, so far as it has been, we think, perfected, have not committed themselves to any expenditure which went into the matter. We then decided to try it, at some small certain expense, but, being the local authority, we considered that it was an expense that was perfectly justifiable; and I think the result has shown that we were not wrong in what we have done.

You have said that very limited powers should be given to private companies in regard to any monopoly they might have of breaking up streets; but would you give facilities to them?—I think we should give large powers to suitable companies to distribute the electricity. I say, safely, if they considered it to be to the interest of the ratepayers. I do not think so. For instance, in such places as the St. George's Hall, at Liverpool, in large places and squares, or in large buildings, they might try the electric light with great advantage, and test how far it answered against gas.

If a public company, for instance, having charge of docks, might try the light that would be an instance in point; they might have power to light their own docks. In fact, you would like to be the public stage to test the experiments as far as possible?

Having a new invention, the future of which you do not see, you would not be inclined to do anything that might retard its development, whilst you would not give any monopoly in advance of our knowledge upon the subject?—Precisely.

Lord LINDSAY: Is it necessary for docks, or for large buildings belonging to companies, to have powers to break up the streets?

Witness: I should think not. For instance, Messrs. Woodhead have done it at their own cost. I was going on the assumption that powers were required. I could light their premises with it if I liked.

The CHAIRMAN: Supposing, for instance, that the Lloyds Trustees desired to light up the docks near Glasgow, they might have to pass through public roads in doing so, for the purpose of laying their wires. In such a case would you give facilities so that they should not be stopped on the ground of any temporary obstruction of the right of way?

Witness: I think the powers should be very much arranged. I think municipal authorities should be only too happy to grant any reasonable facilities, if they had the power.

Mr. *Thomas Henry Farrer*, C.B., examined by the CHAIRMAN.

I am Secretary to the Board of Trade, and in that capacity have paid considerable attention to the electric light. We have had occasion to do so, both with respect to lighthouses and to lights on ships. I Witness then read the following objections to the Electric Lighting Bill, as to the use of the electric light on ships, which, coming in the course of the evidence various reasons why the Board of Trade, and letters written, to the Board on the subject. He then proceed to consider the application of the electric light to lighthouse illumination; as to reply to the Chairman's question: "In your opinion, you having seen, in contact with all the information about the electric light and lighthouses, you consider it established its position as a means of illumination in lighthouses?" "Certainly; and if I were to venture to prophesy, I should say that we should see it sooner or later, not in all the lighthouses by any means, but on the most important stations, such as the Lizard, the Start, Portland, the Isle of Wight, Dunnby Head, the Forelands, Lowestoft, Flamborough Head, and so forth; on account of the great distance at which a powerful light, and the distance to which it travels. The real test, if necessary to be considered, but the cost of a lighthouse is as nothing compared with the cost of a ship, and therefore I should mention that there are other experiments going on. Upon my experiments, of which Professor Tyndall thinks very highly, with gas, in Ireland; as that is does not do to go too far in anything, even where there are other things that may be equally good." There are other experiments now being made at the Admiralty. I have taken into consideration the present position of the gas companies in regard to the legislative powers that they possess, and the Board of Trade have had to consider the question recently in connection with the Bill introduced into the Metropolis Gas Bills." The history of the gas companies is very interesting as bearing upon the way in which Parliament has dealt with things which become inevitably monopolies. The first attempt of Parliament to regulate the price of gas companies generally, I think, was by the Gas-Works Clauses Act of 1847. By that Act the dividends of gas companies generally were limited to 10 per cent., and the principle of sliding scale of dividend was mentioned in the Company's own Act. The Gas-Works Clauses Act was also incorporated with every Gas Act, and under that Act the capital had to be offered to the shareholders at par. At first it was supposed that competition between the gas companies might be undesirable, and in London there was a period during which that went on to some extent, a great deal of capital was wasted; shares were torn up by competition, and dividends fell very much below the sum that the Companies reasonably declared London would be benefited, making a practical monopoly; and that was confirmed by the Metropolis Gas Act of 1860. By that same Act a certain limit of price was put upon the gas. That limit was, of course, adapted to the then circumstances, and there was a liberal limit; but it proved to be more than sufficient to enable the Companies to pay 10 per cent. It was 14. 6d. per 1000 feet for 25-candle gas, and 2s. 6d. for 20-candle gas. Then there was great discussion and grumbling, and a Committee sat in the House of Commons in 1866. In 1867 there was another Committee, of which Lord Cardwell was the Chairman, who reported that the price was far too high, and that there was difficulty in altering the arrangements which had been made with the Companies, except on the threat of competition. In 1868 there was a competing Bill by the Corporation of London. Lord Cardwell was again the Chairman, and he reported against the Bill, which they feared the Bill would give power of permanent division, and made certain provisions for testing the purity and power of the gas, and for reducing the price to 3s. per 1000 feet. Then with regard to power the price of 14 candle gas was fixed at 3s. 6d., and there was a provision that either the Corporation or the Metropolitan Board of Works on the one hand, on behalf of the consumers, or the Companies on the other, might apply to the Board of Trade to appoint Commissioners to review the price in case it became too high, or too low in regard to the profit. When the price of coals went up, the Companies applied to the Board of Trade, and the Board of Trade granted an increase in the price. They did appoint Commissioners, and those Commissioners raised the price, and gave a higher price than 3s. per 1000 feet. There was great discontent expressed at that. The objection was not so much simply to the raising of the price, but to the principle of the sentence. It was thought, and the Board of Trade were of opinion, that it was really impossible for any official persons sitting as Commissioners to go into the question of the expenditure of the Companies, and to say what and such profits; and the Board of Trade again met forward the plan which they had suggested in 1868, by which it might be possible to harmonize the interests of the consumers and of the Companies, by fixing a certain dividend and a certain price, and then in allowing the dividend to rise as the price diminished. That proposal was adopted by the Committee of which Mr. Forster was Chairman, and they decided in favour of a dividend of 10 per cent. with a price of 3s. per 1000 feet for 14-candle gas, and in which the dividend dividend should be the maximum dividend 10 or 7 per cent. already fixed by Parliament. That system is now in force with regard to the greater number of the Gas Companies in London, and, I believe, has acted very well. The great Companies on the north of the Thames are now making 11 per cent.; I think, by reducing their price, while the South Metropolitan Company on the south of the Thames, who have a lower price—namely, 3s. 6d. instead of 3s.—are making the same dividend. That system has, by virtue of a Bill brought into the House of Commons last session, been applied to the case of Companies out of London. The evil of the old system was that with an easy 10 per cent. dividend, the companies had no interest whatever in economy or improvement. That system operated about the old legislation of the gas companies was the mode of raising capital. Of course gas companies, with the growth of trade and the increase of consumption, are constantly requiring new capital. They have to raise it, and they have to raise it at a dividend of 10 per cent., sometimes 7 per cent., offering it as par to the shareholders. That was, in fact, giving one-half of the capital to the existing shareholders, and charging just twice as much upon the ratepayers as was necessary. There was a great struggle about it, but the Gas Companies of London were compelled, in 1875, to introduce what had been already introduced in the case of a few provincial companies—namely, auction sales of capital. That is to say, instead of giving the capital to shareholders, the companies received those enormous premiums upon every issue of new capital, but the companies were encouraged to create as much new capital as possible. It was both an extravagant mode of raising capital, and a stimulus to unnecessary capital. It was hoped to have had a financial arrangement arrived at made. In 1877, I see that 21 Bills were passed with auction clauses; I do not know how many in 1878, but, in fact, the auction clauses are now applicable to all gas companies in London. Of course, the question as to sale of gas and water undertakings have been much considered. There has been one case in which Parliament passed a Bill for compulsory sale of water-works in the session before last; but whether that has been followed up or not I do not know. If the electric light companies get any power of breaking up streets, the result will be practically to give a monopoly to one company, because you would scarcely allow any number of companies to break up the streets. The Board of Trade would not like to see the streets in the light to be disturbed. Of course, as far as the electric light is introduced for the purpose of one establishment, such as Woodhead's, there need be no monopoly, and there persons may be free to adopt their own system; but where the public ways and streets or private houses may have to be lighted from one centre, it will necessarily lead to monopoly. If you create a vested right of that kind in the electric light, great caution must be used not to injure the existing gas companies; and if the monopoly is to be given to them, very great caution must be used that the introduction of light is not made the means of supporting the present large dividends. They have the right of supplying gas, and they have the monopoly of doing so, and upon that, by what has happened, they have the right to their 10 or 11 per cent. dividends; but I

* See JOURNAL, Vol. xxxiii., p. 501.

You are aware that it has been necessary to apply for such powers in the case of tramways?—Yes; and, on the whole, the spirit of legislation in the hands of the local authorities is

The CHAIRMAN: Tramways have been rather referred to as a case, from having the intelligence of corporate bodies. Do you think that a corporation is competent to fairly hold the functions of tramways, and the consideration of the opening, and that, under those circumstances, they would be justified in granting powers to them?

Mr. Rowe: I think they would be justified; and I would be only in a very strong case that the Board of Trade would exercise any supervision over the powers they have.

Mr. Alderman Cubitt, Chairman of the Committee.

I am Town Clerk of Liverpool, and have occupied that position since 1854. The matters connected with the gas question have been referred to the Gas Committee of the Corporation, and during the summer of last year the question of lighting the streets by moonlight was brought before the Committee, and in connection with that special matter referred to them. The view which the Corporation took of it was that the light question was one thing, the supply was another so far as relates to that; and the Corporation would be justified in going for power to light the whole of the town with gas, or with electric light, as you may say by retail; because, as soon as they acquire corporations have to satisfy Parliament that it is a good bill, and they are aware, consequently, that in that respect they labour under considerable disadvantages; besides, under the Borough Funds Act, they are liable to be opposed by the owner by the ratepayers. The Corporation felt that the question of electric lighting was sufficiently advanced to justify them in giving the matter a fair trial, and, in some respects, had peculiar facilities for doing so. As regards St. George's Hall—the large music hall—and the public buildings on the opposite side, the Picton Reading Room, and the Free Library and the Museum, they thought that they could give them a supply under very favourable circumstances in connection with those buildings; and, with the same engine power and the same boilers, they might light the front of St. George's Hall, where there is an immense amount of foot traffic, and the whole of the railway station, and also possibly light up the interior of the Lowden and North-Western Railway Station. In St. George's Hall we have a large area that is used great at night. I think the Engineer said it was for some time, but not that is a matter of small moment. Then, in connection with the floating approach to the Victoria Dock, which is now partially lighted by the Dock Board and partially by the Corporation, it was thought that this was a place where the electric light would be tried with great advantage, and that the Corporation would be the party to supply the light and charge the Dock Board the proportion of the lighting of the floating approach to the two bodies. It was needful that, as a Corporation, we should come and ask for parliamentary powers, as we had in the first instance, and should have to borrow money; and, secondly, the Corporation felt that they would be the servants of the Londoners and the public generally in the matter of the streets without your permission, so as to injure the public?—I think that if their experiment with the electric light be successful, the Corporation should be entitled to some of the profit of the streets; and I think that, as between them and the ratepayers, they are asking for

You are aware that there might be difficulties unless provided for by legislation, inasmuch as if electric wires were used to carry the current of electricity, in order to attach the mixture wires necessary to complete the circuit, to the gas pipes or to the water-pipes of competing companies?—Yes. I can imagine that there might be a difficulty in using the gas-pipes and the water-pipes, which might be a difficulty to where both of course, that objection is got rid of by using two wires where one gas or from the bituminous, we would rather have the anthracite; and, as I understand wires are used.

Practically, it is certainly that a water company would refuse the use of their pipes, even if they were willing, as a matter of business, to allow the use of return wires?—They would probably refuse it, of course, for the sake of getting a consideration for the use of their pipes; but not on the ground that the gas and the water supplies are in the hands of companies; I should think, myself, that the water supplies are in the hands of companies; but, if you look to your Bill you do not claim on the part of the Corporation that they possess the exclusive right of supplying the electric light in Liverpool?—No; we do not give you the existence of any such powers by the Corporation to sell by agreement to any company or merely to sell to the Sailors' Home, or to sell, as I have explained, by retail, but public authorities where the Corporation are for their own sakes providing better means of lighting in open places, and in the Queen's Dock entrances, and places of that sort. In such cases they think that if they are at considerable expense in providing an increased means of lighting for the benefit of traffic, there is a great deal of cross traffic and that is a subject to them before selling the electric light, if they can, to a particular ratepayer, that they should be entitled to moderate the scale in reference of the additional lighting which is rendered necessary.

But any question went further than that, and you have asked Parliament even the powers you ask for, do you think there should be a provision in your Bill that any company might come into your district as a rival company, subject only to the modifications that they do not break up the streets without your permission, so as to injure the public?—I think that if your Bill is to be carried, it must be granted; but I should imagine, I think if their experiment with the electric light be successful, the Corporation should be entitled to some of the profit of the streets; and I think that, as between them and the ratepayers, they are asking for

What as you have a preference in the case of tramways?—Yes; and powers, as regards both the Tramways Act and the Gas and Water Facilities Act, the consent of the local and public authorities is abrogated necessary, except where the Board of Trade, for some reason stated in the Committee of the House of Commons, that the local authorities are acting unreasonably and improperly. In fact, my company ought to have the consent of the local authorities before they can lay down the streets; and I think the tendency of legislation is either to increase the powers of local authorities in that respect.

Your Bill is still before Parliament; it is only being up, I believe?—It is still before Parliament. It depends, of course, upon the time when the Committee of Commons considers it; whether it will go on this session.

Mr. T. Hare: Is not the gas companies obtained the power to monopolize the use of the electric light in their pipes, to some danger that they would refuse the power to persons in connection?

Witness: I have said that the interest of the gas companies, with their very large plant and appliances, might be to prevent the development and commercial use of the electric light. They might get the power and not use it.

Mr. HARDCASTLE: What would be your view with reference to allowing a company to break up the streets across a street, or for instance, across the corner of a shop was made in order to obtain any place for the machinery for the electric light in his shop, but only to lay down the electric wire in the street road, perhaps. Do you think the Corporation would allow the opening of the street for that purpose?

Witness: I think there are many cases in which a number of shopkeepers on the side of a street might combine, when the Corporation would be willing to allow the street, underground or overhead.

Mr. STEVENSON: Could you pass your Bill, it will practically give a monopoly of electric lighting to the Corporation of Liverpool, will it not?—I do not think so. We should simply, I apprehend, be empowered to say one who liked to take it. There is no doubt it would be a monopoly to this extent—that the Corporation would be the only body who could break up the streets for the purpose of lighting by electricity.

Supposing the Corporation obtain that power, and do not yet it into operation, and Liverpool will never be lighted by electricity, will it?—As I have already explained, the Corporation have peculiar facilities for doing it, which do not affect a company; but if the Corporation did not exercise powers in force, they would have no answer if the the Company applied to do so. I think the risk would be far greater in the hands of the Gas Company than in the hands of the Corporation.

Practically, is not your Bill an attempt to repeal the Borough Funds Act of 1872?—I do not regard it as such.

Supposing the Corporation do not, for a limit of time within which, if the Corporation do not put their Act into practical operation, it should be a dead letter?—I do not think so. The Gas Company will be at liberty to come to Parliament if the Corporation do not do their duty in the matter; but my opinion is that the Corporation will advance to the practical development of science advance, so as to supply the light retail, if it be practicable.

Is it the case that the Corporation of Liverpool did not consumer lighting by gas for many years after the Corporation of Manchester?—I do not know that at all. All I know is, that the Liverpool Corporation had a Lighting Act in the reign of George II. I do not know the circumstances under which the lighting passed into the hands of the Gas Company; but the Corporation had a Lighting Act, I should think, quite as far back as the Corporation of Manchester.

(*To be continued.*)

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[33630.]—Gas.—"A Gas Consumer" says he has studied the subject of excessive gas consumption a long time. If the suggestions he throws out are the result of such studies, I am afraid, if competent and scientific men accept his invitation, the opinion they may express will not be very flattering to his suggestions. His first suggestion as to the cause of bad and expensive gas is the use of coal in place of cannel. Now, I am of the same opinion as "Sam Slick,"—I think "there is a great deal of human nature in everyone." I fancy I see "A Gas Consumer" selling an article for sixpence which costs him a shilling to make. The average Parliamentary standard of the illuminating power of gas for England is about sixteen candles. Now, it seems rather absurd to expect gas companies will go to the expense of cannel costing from 20 to 25 shillings per ton, when Newcastle gas coal costing half the money will produce gas of the required standard. Why should gas companies give him gas made from cannel equal to 26 or 28 candles when he only pays them for sixteen candles? Would he think of offering his butcher sevenpence per pound for steak worth fifteenpence? It would be just as reasonable to expect to get it. His second cause is the use of wet coal, giving rise to the production of large quantities of steam, aqueous vapour, and hydrogen mixed with coal-gas proper; and charges gas companies with saturating their coal before charging, to produce the above diluents. Now I hope he is not in earnest in his belief that gas managers are so simple as to wet their coal before charging, expecting to get a larger yield thereby. Why need the companies build expensive coal sheds to keep their coal dry, if this be true? If I saw a gas manager wetting his coal for such a purpose I should consider he knew very little about his business. What would be the use of expending fuel in raising the retorts to a high heat if he throws in a charge of coal saturated with water? Such a charge would tend to diminish the yield rather than increase it. The coal being placed in the retort in a wet state retains its moisture for a long time, and it is pretty well known that this water, on being turned into steam, abstracts a considerable quantity of heat from the retort, the effect of which is to produce a larger quantity of tar and a smaller quantity of gas. The water in the coal must all be driven off as steam long before the charge is hot enough to resolve the water into its constituents, a very small decomposition only can take place from the steam coming in contact with the hot roof and sides of the retort. Even if such decomposition does take place the company will lose more than they gain by it from the increase in the sulphur compounds to be taken from the gas. We all know that coal contains ferrous sulphide, and if the water is decomposed in the retort in the presence of this compound in a heated state the oxygen from the water will combine with the iron, forming ferric oxide, and the hydrogen combining with the sulphur to form sulphuretted hydrogen, which will be taken up and carried by the gas. Now, if the coal is placed in the retort dry no such combination can take place, and a great portion of the sulphur is retained in the coke left in the retort. On the other hand, if the coal is used wet the sulphuretted hydrogen formed in the retort and carried away by the gas will have to be taken out in the purifiers, which means an additional expense to the company. In respect to the steam and aqueous vapour, "A Gas Consumer" appears ignorant of the fact that after the mixture of gas, steam, and aqueous vapour leaves the retort they are passed through a condenser kept at about 60° F. Where will his steam be after this process? I should imagine the liquor well will have received it. And as to aqueous vapour, coal-gas standing over water and saturated at 60° F. contains 5·8 grains, or 30 cubic inches of aqueous vapour per cubic foot; this is equal to about 1·7 per cent. The greater part of this is condensed in the colder mains on its way to the consumer. From the above, I am led to think that the large bulk of steam and aqueous vapour exists only in the imagination of "A Gas Consumer." In reference to his objection to hydrogen as a constituent of coal-gas, will he kindly state what he considers the composition of "coal-gas proper" to be if hydrogen is not allowed to enter into its composition? I have always been taught to regard hydrogen in combination with carbon to be a very important constituent, and that the best coal for gas-making purposes is that which contains the most hydrogen with the least oxygen, but I may be wrong after all. I think "A Gas Consumer" must have taken the *Daily Telegraph* for his text-book when he studied his third cause. A great deal of ignorance seems to prevail in regard to the use of a steam-engine in a gas-works. It has a great many duties to perform, such as pumping water, driving scrubbing apparatus, and pumping liquor for washing the ammonia out of the gas; but the most important duty it has to perform is to drive the exhauster, which is not used to dilute the gas with air as he asserts, but is used for the purpose of withdrawing the gas from the retorts as it is made, and for forcing it through the purifying apparatus into the gasholder for distribution. If coal-gas is allowed to remain in the hot retorts under pressure it is decomposed, and the richest constituents are deposited on the rough interior of the retort in the shape of carbon, consequently the quantity and quality are materially diminished, hence the use of an exhauster. He is likewise in error in supposing the engine runs night and day without attention. A delicate self-acting governor is fixed between the inlet and outlet of the exhauster, which controls the speed of the engine according to the quantity of gas being made. It does its work with great exactitude, and has never been known to fall asleep and neglect its duties. He is again wrong in supposing air to be drawn through the open retorts in process of charging. To prevent this another simple piece of apparatus is used, viz., the hydraulic main; it is perfectly self-acting, and shuts off the gas from the retort as soon as made, and of course shuts out all ingress of air when the retorts are open. If "A Gas Consumer" had thoroughly studied his third subject, he would have studied the effect produced on the illuminating power of coal-gas when diluted with such large quantities of air as he asserts the engine draws in. According to experiments made by the late Mr. Letheby, 1 per cent. of air in coal-gas reduces the illuminating power 6 per cent., and 40 per cent. of air destroys the illuminating power altogether. For argument sake, let us assume his company are under Parliamentary restriction to supply, say, 16-candle gas at 4s. per 1,000 cubic feet. Now, if they dilute their gas with 5 per cent. of air, they will gain 2½d. per 1,000 by so doing; 5 per cent. of air will lower the illuminating power 33 per cent., the 16-candle gas will therefore be reduced to 10·72 candles. His company being under a fine if they supply gas under 16 candles, will have to make their gas equal to 21 candles before it will bear diluting with 5 per cent. of air, or their gas will fall below their standard and of course they will be fined. Now, 21-candle gas will cost the company something like 1s. per 1,000 more to manufacture than 16-candle gas will. They will, therefore, have to spend 1s. per 1,000 to gain 2½d. Gas companies are not quite such idiots as to do that. Cause the fourth is the enormous pressure used by the companies to force the gas through the pipes. He evidently does not hail from the same place as "Holdernessian"; his complaint is that the company have put a governor in the street to reduce the pressure. He speaks of the pressure used by gas companies as if they were using a pressure equal to some hundreds of pounds on the square inch. Now, he evidently does not know that this enormous pressure he speaks of is measured by a column of water a few tenths of an inch high. Suppose his company give him a pressure of 20-10ths at the inlet of his meter, he can easily find what that is equal to on the square inch. A cubic inch of water weighs 252·458 grains, and an ounce of water 437·5 grains. An ounce of water per square inch is consequently equal to a column of water 1·731in. high. The 20-10ths pressure given by his company is therefore equal to the enormous pressure of 1·15oz. per square inch. I wonder his pipes are not all burst by such an enormous pressure, but why does he not reduce his pressure? Means are given him to do so. Surely it is not too much trouble to close his main tap a little; he must know that by so doing he can reduce the pressure to his liking. As to the sudden and great expansion, I beg to refer him to my reply on p. 319; he will there learn how enormously his bills are increased thereby. Cause the fifth is the utterly unreliable and erratic measuring of the ordinary gas-meter. If this discovery is the result of "A Gas Consumer's" studies on gas-meters, I should strongly advise him to communicate his discovery to the Board of Trade; they will undoubtedly cause an inquiry to be made, and reward him with a leather medal for his valuable discovery. I suppose he is ignorant that gas-meters are made by independent makers, and are made according to a special Act of Parliament, and before they are allowed to be fixed have to be tested and stamped as correct measures by Government inspectors. Gas companies have no more control over them than gas consumers have. So if "A Gas Consumer" will inform me how they are always made to register against the consumer, and never against the company, I shall be thankful for the information. If they are liable to register in favour of the company, surely they are also liable to register against them. As to their being a clumsy and unscientific machine, did he ever see the inside of one? Also does he consider a machine as delicate in its measurement as the finest balance, and that will measure to less than the 1-1,000th of a cubic foot, clumsy and unscientific? Surely Whitworth's measuring machine must be clumsy and unscientific. My humble opinion is the measuring wheel of the wet meter is perfection, and anything simpler for the purpose could not be devised; moreover, it has stood the test of time, and inventors have had a good chance of substituting something better. When "A Gas Consumer" gets his National Association started, I am sure gas companies will become its chief supporters. If, as he suggests, it will be the means of replacing the present meter by a more scientific and better instrument, it will be a boon to them indeed to find a better substitute, and I am sure the lucky inventor will not go to his grave unrewarded by them. What need is there for his association to engage a competent man to investigate the behaviour of compound gases under the enormous pressure of two or three ounces on the square inch. Let me advise him to study any elementary work on physics, and he will soon learn for himself that a compound gas behaves the same as a simple gas, even under greater pressure than a gas company can subject it to in their apparatus. As to the possibility of hydrogen gas by its power of diffusion passing through the meter and registering when no gas is burnt, to answer this allow me to suggest a very simple experiment. Let him plug perfectly steam-tight the exhaust pipe of a steam-engine, open the supply valve, and if under these conditions the engine will work then will he convince me a gas-meter will work when the pipes and fittings are gas-tight and the burner taps closed. But why does he not shut off the gas at the main tap? Surely he cannot imagine hydrogen will pass through solid metal. I have a suggestion to make, which if carried out will make his proposed association of more value to its members, and that is to engage a competent man to teach such as "A Gas Consumer" common-sense, then I think his association will be of some use; until that is done no use at all. I am of the same opinion as "H. B.," there is plenty of room for this discussion to go on. I am sorry to see such an amount of ignorance displayed on the subject. If "A Gas Consumer" had studied the subject, as he would lead us to believe he has done, he would not have written a letter so devoid of common-sense as the one in our last issue. I should strongly advise him to study the letters which have appeared in the ENGLISH MECHANIC during the past two or three weeks, and by taking the advice given he will be money in pocket. My experience of the average gas consumer is as follows: He orders a gas-meter to be fixed on his premises, and does not give it the least attention afterwards; leaky and defective fittings are employed, the gas is lighted and allowed to hiss and roar at the burners, globes are used that intercept half the light; the consequence is half the gas is wasted by leakage and imperfect combustion. He complains of the quality of the gas, it smells very bad whilst burning, injures his furniture, and blackens his ceiling. No wonder it should do so when it passes his burners half-consumed. His quarter's bill comes in; then he declares he cannot have consumed the gas, and writes a letter to the papers denouncing his meter as a conjuring box, and the company that supplies him as a set of swindlers. He never thinks the fault is his own, and he will look anywhere else for a remedy; he never thinks of looking at home for it. I have seen hundreds of burners in use giving a light equal to only six or eight candles where the company gave sixteen or eighteen-candle gas behind the burner. To me this is something like pouring clean water into a dirty cistern and expecting clean water to run out. I am glad "Loftonian" is satisfied with the result of the discussion, and I consider he has done a manly act in withdrawing the imputation; I greatly respect him for so doing, but I hope he has let that poor gas manager come out of the corner before this.—J. R. WARREN.

[30630.]—Gas.—As a gas consumer, I am interested in the discussion now going on as to excessive charge made by the company, and should like competent and scientific men to give their opinion. I wish to throw out the following suggestions, as I have studied the subject a long time, and suffered in pocket not a little, so that I have come to the conclusion for the coming winter not to use gas, but paraffine, and had my meter disconnected, and would advise all complaining to do the same, as it is vain to expect any remedy from the companies. The first cause of the bad gas and the expensive gas I consider to be use of coal and slack in place of Cannell, the second cause in use of wet coal giving rise to production of large quantity of steam, aqueous vapour, and pure hydrogen, mixed with coal-gas proper, and which immensely increase the bulk, and consequently the profit of the company. Cases could be found where the coal has intentionally been soaked before putting in the retort to increase the yield. Another cause I believe to be the practice of having a steam-engine to pump the gas out of the main into the purifier, the effect of which is to draw an immense quantity of air in through imperfect joints, and also through the open retort in process of charging. As far as I have seen, the engine is at work "constantly pumping," and no attention ever given to the open retorts. Another cause I believe to be the enormous pressure required to drive the gas through pipe; consequently on entering the meter there is a sudden and great expansion, and the gas measured under the most disadvantageous circumstances to the consumer. Another cause, I think, is the utterly unreliable and erratic measuring of the ordinary gas-meter always and under every circumstance going against the consumer and for the company; and it is altogether a clumsy and unscientific machine, and would never have been tolerated so long except for the fact that its errors are for the maker and against the consumer. I would suggest a national association of gas consumers, with a small and nominal subscription, to offer a prize for the best instrument to replace the old meter, and to engage a competent man to study the behaviour of mixed gases under pressure, also the possibility of hydrogen gas, by its power of diffusion, passing through the meter and registering, even when no gas is burnt. This I believe to be the case in some instances, and that free hydrogen is the most common and the most injurious adulterant in ordinary coal-gas.—A GAS CONSUMER.

25–

HOW CAN GAS COMPANIES BEST PROMOTE THE APPLICATION OF GAS FOR HEATING PURPOSES?

In the following remarks on the subject of gas for heating purposes, I by no means pretend to offer a paper in the usual sense of the word; I am simply anxious that a question of such growing importance should not be omitted from the programme of the proceedings. If any other member had been prepared to "open the ball" by starting the discussion, I should not be found this year again claiming your indulgence. After briefly stating the case, like a junior counsel, I will leave the question in its more elaborate and intricate form to be dealt with by my more able colleagues.

This is comparatively a new branch of our industry and we have yet much to learn, so every day's experience is really important to us. In order to gain this experience, gas companies must be prepared to pay for it in one shape or another. The proceedings of many gas companies during the past twelve months is encouraging in this respect, inasmuch as, by the promotion of exhibitions, &c., they have shown an off-hand, liberal, and businesslike spirit, thus giving ample evidence of the convenience and excellence of gas as fuel. The public, therefore, should by this time be thoroughly educated to the fact that their prejudices were utterly groundless which in times past retarded this very important application of gas.

While speaking on this point, I will venture to occupy a few moments in giving an illustration. A gentleman in Cork, of undoubted scientific attainments, and the author of some valuable inventions, received a suggestion from his wife as to the desirability of using gas for cooking purposes. He pooh-poohed the idea, and could not be induced to believe that meat cooked by gas would be eatable. Taking advantage of her husband's absence from home, the lady arranged with me to fix a gas range without his knowledge. On the day of his return, dinner was served as usual, and almost the first remark he made was, "You have changed your cook. I never before found the meat so well flavoured." He was greatly surprised when told that there had been no change in the cook, but the actual change was in the fuel, and the improvement he noticed was due to the use of gas. The next day he ordered all his cooking arrangements to be altered for gas fuel. But this is not all. A fortnight afterwards, while we were enlarging his supply-pipe to meet the increased demand, the gas apparatus had to be disconnected, and the cook was obliged to return to the old system for that day. In the evening there was consternation in the dining-room. The master declared that the cook had poisoned the meat with gas, and that he knew such would be the case. An explanation was demanded from the cook, and certainly he "set the table in a roar" when he informed the master that no gas whatever had been used that day. This gentleman is now paying about £60 a year for gas for cooking purposes.

Although a good deal has been done in the way of exhibitions—awarding prizes to good makers, and supplying stoves on easy terms—yet gas companies must be willing to go beyond this, otherwise their previous efforts will prove to have been futile. We must assist the consumer in the economical consumption of gas, and thus indirectly reduce its price, for it must be admitted that the cheapest gas at present is an expensive fuel, unless used with care and economy.

I know there are makers who will guarantee their stoves to perform a certain amount of work with a certain quantity of gas, and thus far gas fuel will appear to be cheaper than coal. I have tested such stoves, and found them to be, on the whole, very nearly up to the representation, and in good faith I have supplied them to the consumers, with the assurance that they would find them, with regard to the consumption of gas, as cheap as coal; but at the end of the quarter the consumer is startled by finding his gas bill increased enormously, and far beyond what he had been led to expect. Moreover, his coal merchant's bill is not reduced one shilling. It is useless, then, to talk of the superiority of the cooking, and the convenience and cleanliness of the fuel. You are at once met by the *£ s. d.* argument, and with an order to remove the stove. Perhaps your own character is not improved by the transaction; thus you have lost a customer, and you are victimized by the carelessness and neglect of others.

All who have had experience in this matter will testify to the fact that this is over and over again the case. I firmly believe that by gas companies taking such steps as will assist the consumers to prevent this waste, they will more effectually develop the use of gas for heating purposes than by many other means. It is my conviction that if we make gas fuel as cheap as coal, our case is proved.

From two causes does this waste arise—

1. When the stove is fixed, it is generally connected with the ordinary fittings of the house, and supplied through the existing meter, or in some cases the meter is enlarged; therefore, in order to supply the stove, you must have gas turned on all day throughout the entire premises, subject to leakage, condensation, &c., for a much longer period than would be required for lighting purposes.
2. The careless, unchecked, and almost unlimited use of gas inevitably leads to a very unnecessary consumption. In many cases servants who have charge of this department feel that they have no responsibility with regard to cost.

One fact will illustrate this latter point. Last year we fixed a stove in a large establishment, the Company, at considerable expense, arranging for the erection of it. When the stove was put in operation, the consumption of gas was increased by 13,000 feet per week; in other words, the cost of the gas appeared to be three times the cost of the coal for the same amount of work. We made several observations, and saw clearly that no such quantity was necessary; but it was almost in vain that we pointed out this fact to the authorities. The cooking was acknowledged to be good, and labour was saved; but the cost of the gas was enormous, and unless we were prepared to reduce the price to about 1s. per 1000, the stove was doomed to extinction. At length an arrangement was arrived at to enable us to lay a separate supply, and fix a separate meter. An official of the Company attended for one week, and that week's consumption was reduced to 5400 feet. Since that time the stove has been regularly at work. The consumption of gas is deemed satisfactory, and the cook is now aware that the meter is actually a monitor to keep extravagance in check. More than that, I have a testimonial in writing from the head of the establishment, to say that there is as much coal saved as is represented by the quantity of gas used; therefore "Old King Coal" was turned out by his offspring.

With such cases before us, and remembering the fact that gas supplied during the day is a source of additional profit to gas companies, I say it is their duty to promote this object, although at additional expense and trouble.

I would look on the introduction of a stove to a house as a new consumer, and treat the case accordingly. In the first place, I would give the stove a special supply; secondly, I would use for it a separate meter; thirdly, I would have the index of the meter taken every month, and advise the consumer, having previously furnished him with an approximate estimate of the amount of work the stove was capable of performing with a certain quantity of gas.

If it were necessary to prove the advantage to be gained by such an arrangement, I should be able to do so by several well-ascertained statistics, which would show, where the opportunity was afforded for the supervision referred to, the results were satisfactory, and in many cases so much so that additional accommodation was asked for. On the other hand, where the stoves were left to take care of themselves, they were regarded as an expensive luxury, treated accordingly, seldom made use of, and, in too many instances, dispensed with after a short trial.

Notwithstanding the care and economy which would be secured by the above suggestions, there are many cases in which the price of gas would not admit of a favourable comparison with the cost of other fuel. When the price of coal is taken at the average rate, and gas at over 4s. per 1000, the margin becomes very narrow indeed, and yet it is decidedly to the advantage of all gas companies that gas for heating purposes should be developed, inasmuch as it would lead to a good day consumption, thereby rendering a large portion of capital doubly productive. With this view I think it would be the duty of companies to provide every facility for the consumer.

Under this head, Mr. Denny Lane, whose attainments are well known in the scientific world, has requested me to call your attention to the following important facts, ascertained from experiments made recently on the heat communicated to water in various boiling-stoves. If we count as a thermal unit the quantity of heat necessary to raise 1 lb. of water 1° Fahr., the number of thermal units communicated to the water in no case exceeds 450° per cubic foot of gas, whereas more than 30 years ago Mr. Defries stated that, in an apparatus for heating a bath, he had communicated 750 thermal units for each cubic foot of gas consumed. In some cases it has been alleged lately that nearly double this amount had been attained. It seems impossible, unless the chemical composition of the gas were totally different from that calculated by Mr. Vernon Harcourt from the calorific efficiency he analyzed. He fixed the maximum for ordinary gas at 750 thermal units. Mr. Lane, therefore, strongly recommends that a series of experiments should be commenced by some independent authority, to ascertain what kind of apparatus yields the most economic results. In recording these experiments, the illuminating power should always, and the chemical composition where possible, be carefully noted.

Another point is this. While it is wise to supply stoves on easy terms, yet I must say, speaking from experience, that the three years system of purchase would prove more satisfactory to gas companies and their consumers than the hiring system, in which case the stove continues to be the property of the company. Under this latter system, I have found that the consumers are careless about the stoves, subjecting them to treatment they would not permit were they their own property.

In conclusion, it is with reluctance that I appear before you a second time on the same question; but I trust the ideas I have put forward, however crude, on this important subject, will induce others to elucidate more fully its various interesting points.

Discussion.

Mr. W. Barratt (Grantham) said gas managers and companies had had serious difficulties to pass through, but if they could do as Mr. Travers had done, and get the ladies on their side, they would go on and nothing could stop them. He had paid considerable attention to gas-stoves, and thought the best way was to begin in his own house; and consequently he had a gas-stove fixed in his kitchen. Unfortunately (or fortunately) it did not answer, and the reason he found was this—and perhaps in 99 cases out of 100 it was the same—that the supply-pipe was not sufficiently large. He found that when the servants were about to prepare for dinner, they invariably lit the stove half an hour before it was required, and, as a matter of course, there was a large quantity of gas wasted. He at once altered this state of things, and since then he had fixed a large number of gas-stoves in Grantham. He always suggested an enlarged supply-pipe, and where that was done he never knew gas-heated stoves to fail. If there was not a good supply-pipe to the oven the gas came through in a sluggish way, gave but little heat, the cook got into a bad humour, and the whole thing was discredited. He was satisfied that there should be a separate supply, and a separate meter, so that the gas might be turned off for the whole of the house without affecting the heating apparatus, and when that had been done he invariably found it answer. His rule was to put in a ¾-inch service-pipe, and he thought this would be a great source of revenue to gas companies in time, if they only paid attention to it. Rather than allow individuals to be dissatisfied, he would put in an additional service at the cost of the Company, and he thought they would be gainers by it.

Mr. W. Wright (late of Brighton) said that there could be but one opinion as to the very practical character of the paper they had listened to. A separate service with a separate meter commended itself to his judgment especially, and he thought also the gas-cooking arrangements of the house should be under the supervision of the manager of the gas-works. Not that he wished him to be the cook, but that the index of the gas-stove meter should be taken separately, and at frequent intervals, with an occasional inspection of stove burners. He had pushed this matter in works of which he had had the charge, and with some success. He would mention another matter which came under his notice, as one of the causes which tended to bring gas cooking into ill odour with consumers. A gas-cooking arrangement was put into a gentleman's house and went on for some time satisfactorily, but when the gas bill was sent in he was alarmed at the amount, and he (Mr. Wright) himself could not understand it, the register being largely in excess of anything he had expected. The gentleman paid the bill under protest, and some time after it came out incidentally that the cook, having gone to turn the gas on at the stove, found it had been left on since it was last used, so that really the gas had been burning for several days without anything being done by it, which, of course, accounted for the extra consumption.

Mr. E. Goddard (Ipswich) said he had had some experience in the application of gas for cooking and various domestic and industrial purposes. Thirty years ago he urged on his Company the importance of letting out fittings and apparatus on hire, and this was done to a considerable extent, so much so as to seriously affect the capital at their disposal, for in four or five years they had something like £7000 invested in gas-fittings and apparatus let on hire. He could fully substantiate the importance of there being a separate meter to the gas-cooking apparatus. He had fitted up a stove for a large scholastic establishment, to cook for 300 people, and the plan he recommended to the principal was to watch the consumption day by day, and endeavour to bring it down. After a week or two's experience, he found that the consumption was gradually being diminished, and when he thought he had arrived at a minimum, he offered the cook a premium for all the gas he might save below that quantity. The result was most satisfactory, and the cooking of this large establishment was conducted very economically. He was quite sure that when a good supply of gas was carried to the cooking apparatus, where the consumption was separately registered, and a careful superintendence of the fittings was made, it would be found very economical. One great difficulty they had found was that the cooks left the gas burning when they had nothing to cook, and the consequence was it often appeared to be very expensive, whereas it might be rendered very cheap.

Mr. W. Bates (Worksop) asked what pressure was required at the lowest point of a district to ensure efficiency in gas-stoves. He suggested whether it would not be advisable for companies to provide separate meters without charge, and, perhaps, even to charge less for gas for cooking purposes, so as to induce consumers to use it in this way.

Mr. C. Gandon (Sydenham) said he could fully endorse the remarks that had been made as to the advantages derived by gas companies offering facilities for pushing gas cooking. At the same time, there was a great deal in what was said as to the care required in supervision. In his own house he frequently went into the kitchen and found the gas on when it was quite unnecessary, and so long as such waste as that continued, the use of gas must be disadvantageous to the consumer. A separate service and meter would do much to prevent waste, especially if observations were frequently taken, because then the consumers could be informed of what was going on. With regard to letting out stoves on the three years system, he had no doubt that would be most advantageous to the companies if they could induce consumers to adopt them; but so long as they had the opportunity of taking them at a rental, he thought there would be a difficulty in inducing them to purchase. He was informed recently that a company had offered such facilities, and that they had received no applications whatever to purchase on the three years system, but numerous applications had been received for the hire of stoves. It was said that 5-10ths of an inch of pressure was sufficient. In his opinion, however, the pressure should be rather more; but most companies gave more than 5-10ths as the ordinary day pressure. With an ample supply-pipe, 5 or 7-10ths was quite sufficient.

Mr. Magnus Ohren (Sydenham) said that the waste in cooking-stoves was not so great now as formerly. Whenever stoves were fixed by his Company they gave the consumers information how to use them, and drew their attention to the danger there might be in trusting the stoves entirely to servants. He remembered one case where a very large account was sent in—about £20 for one quarter, instead of about £5 as usual. The customer said there must be something wrong; the matter was inquired into, and it was found that the cook had never turned out the gas at all; but, after having once lighted it, she thought it was very handy to have it always going, in case it might be wanted. In another case a gentleman had an open gas fire supplied to his nursery. His (Mr. Ohren's) advice to him was, that the servants should be charged to be careful in its use, for he told him it would be rather costly if used more than the time stated—an hour in the morning and evening. He repeated that it would be [illegible] required for a short time in the morning and evening, when the ch[illegible] were getting up and going to bed, and so the stove was fitted. [illegible] end of the quarter the account was very large. The consumer [illegible] the office to complain. He was very angry, and said he had b[illegible] He still insisted that the gas fire was only used for a short [illegible]

Over

meter. One of these candles burns a little over an hour. At the end of that time the current must be switched off, from the one which has been burnt down, to the fresh candle next to it. So it is necessary that an attendant shall go to every lamp once in an hour, and turn on the current to the new candle. The lamps are lighted one after another, an hour after sundown, and are extinguished at midnight. Of course, if they are used already lighted up, must then to be put into requisition. Thus the lighting till midnight is effected.

According to the official report, from the 20th of May to the 10th of October, 1878, a little over five months, the lamps were in use less than 50 entire times, lasting from 1, 2, 3, 4, or 10 minutes, up to 15, 30, or 45 minutes. The Company, it is said, hope to do better. There have been no days yet if light up whenever the electricity is indispensed.

The number of light given by each of these lights is stated by M. Lebloun to that given by 200 gas burners, when they tried it at the Avenue de l'Opéra candle is not entered by no absolute light globe. This light is too painful to the eyes, and from its vast of volume, is not serviceable for lighting streets or houses. Besides it needed it cannot therefore be surrounded with an electrolier globe, and then the amount of light is greatly diminished. In fact the electric light does not, like an Argand burner, give the horizontal light in all directions, but the volume are is never to the screen specially front of the candles, and others it is at the back of the candles. I am not tell you that on a short distance, because the eye is not capable of testing the power of the electric light as the gas lamps been used for important difference. Such a very near room as this little distance makes a very would be exposed to give so much credence to it, yet, I do not think he they were intended to be used.

that although the light is given at the time of the trial, simultaneously stated, yet that effect is not produced when the ground is seen under a one only equal, in round numbers, to 315 candles; so that in practice, although the beautiful white from the electric lamps is the average illumination ground there was only the light of 115 candles, about 100 candles, yet on the Avenue de l'Opéra.

Mr. Lebloun has also experimented as to the comparative cost of lighting by Messrs. Jablochkoff and Yalow, they found that the light given by Wenzel-sen-Sen candal like by a Jablochkoff lamp was there equal to 107 candles. The difference between their experiment and that I have mentioned is only to be accounted for by a slight difference in the quality of their engine and that used in Paris. I think that in all estimations of the electric light the speed of the dynamo machine should be taken, as well as the number of lights in the circuit at the time of the trial, simultaneously with the photometrical experiments. This has a most important bearing on the question of cost.

Now as to the question of cost. This is, as told me by an eminent Paris electrician, a very delicate question. I shall give it you in figures founded on my own experience and observation, checked by those of the most experienced engineers who have come under my notice.

At Th. Lévy refinance but his experience shows that to obtain a light it is a Jablochkoff lamp, producing the effect of 115 candles, there must be consumed, in the form of electrical power, the force of a 2-horse power engine. Three burning together, produced by the force of a 20-horse power engine, there are 16 corroborated by Messrs. Jablochkoff and Yalow, and by Messrs. Rapieff, obtained are lights of 315 candles power. Messrs. Jablochkoff and Yalow, and Lévy, with a force of nearly 20-horse power, obtained by Messrs. Lebloun and Tremeschini, with a force of 20-horse power, or all the other of one and Bazalgette. So we may take it that we can get one light of 115 candles power, by the directions for the Avenue de l'Opéra, with a force of 120 horse power.

Now we have the question of cost. This is the Electric Light Company going to charge for their lights from 1-horse power? Of course they are concerned to inform the world. Thus the 62 lights in the Avenue de l'Opéra require 92-horse power to keep them going.

I need only say, with respect to the scope of the Electric Light Company, that, considering the very considerable number of lights they have in existence before the Select Committee on Lighting by Electricity, allows the conversion of motive force into light by electricity, and the light is effected from the motive force employed, there hopes of the Company never to be realized. Assuming the motive force employed, there hopes of the Company are at the rate of 120 candles power of light all round, from the 62 lights.

Table No. 2, appended to the Report, gives the cost of the cost of the electric lighting in the Avenue de l'Opéra, by taking the figures, as to the working expenses, of M. Lévy, and adding thereto the charges and interest on the capital expended. This, as I have already mentioned, is 2,000 francs per horse power for the 92 horse, or 54, 385, per lamp per hour = 2,170 11s. 4d.

Now, as to the question of cost of gas lighting. I have already stated, by Electricity that the commercial value of the electric light is that which the Electric Light Company charge for it. Now, without disputing his estimate, it seems to me that, as a gas engineer, as at liberty to examine into the cost ourselves, and this I have done before you for your information and criticism.

I now address myself to the comparison of gas and electricity as a means of lighting the Avenue de l'Opéra. The Electric Light Company of Paris have undertaken to light the Avenue de l'Opéra for the period of one year, beginning on the 15th day of January, 1879, at the rate of 36, per light per hour from dusk till dawn.

The number of gas-burners in the Avenue de l'Opéra electric lights was 311, each by the 311 burners have been consumed in the 200 candle burners such as shown here, they would consume the light of 1 cubic foot of gas consumed that quantity of gas, or only 200 candles less than that given by the electric lights; so that if forty 200-candle burners had been placed on the columns on the boulevards and in front of the houses, instead of the electric lights, there might be a continuous, steady, and brilliant light. The actual position of these lights might be as follows:—Six globe lanterns on the pedestal columns in front of the façade of the Grand Opéra, fitted with burners consuming 25 cubic feet per hour, and giving the light of 30 candles each. Eight lanterns of a globular form, one on each of the safety posts in the Place de l'Opéra, each of three to have a burner consuming 66 feet of gas per hour, and giving a light of 200 candles each. Six lamps fixed to the Place de l'Opéra, each fitted with burners each consuming 66 feet of gas per hour, and giving the light of 200 candles each; and last of all to the Avenue, fixed on columns, the eight lanterns on the Paris columns, but 12 feet high, fixed on columns, the eight carriage lamps now existing, a total of 62 lights. Now, as to the centre of the 92 feet of gas per hour, and give the light of 200 candles each. These would each burn quantity of gas consumed by the whole of the lights of the Avenue de l'Opéra, and the total amount of light a candles result in 12,400 candles power, that can be produced by the electricity, as I have stated, in 12,000, or 400 candles power, and which I have explained already steady, reliable, and working, I do not think that the electric light, when at midnight the electricity was reduced to 7,440 candles. If, however, the 1,720 cubic feet of gas formerly consumed by the 311 old 4-foot per hour burners, be consumed, the result would be a saving of 1,720 cubic feet per hour, or 41,280 cubic feet per day of 24 hours. Thus, the increase in light produced by the electricity is only 37 per cent. more than might have been produced by the consumption of the 1,720 cubic feet, at the exceeding low figure of 3s. 2d. per 1,000 cubic feet, as shown an increase of 123 per cent. on the 3s. 2d. per hour for the 62 lights, amount of light. The cost of the new lighting by gas to produce the same proposed, and which I have demonstrated is not only feasible by gas well-known to gas engineers, would be but half the price now being paid by the Municipality for the inferior electric lighting by electricity. All this leather of machines, engines, dynamo machines, candles is the expenditure by the Municipality of a large sum of money for doing in an inefficient manner the work which can be efficiently carried out by the Paris Gas Company for less than half the money, which they are now paying.

It is not clear that if the Paris Gas Company were to have come forward, in the small sum of money just mentioned, the Avenue de l'Opéra would have all possibility of the electric light have been lighted by electricity? and there simply because the gas lamps, as I have shown, are more than sufficient for public would never have been disturbed, and the constituting the standard, the light in place of the steady and brilliant gas-lighting and numerous electric lights were only the old flickering yellow bat's-wings of former nights. Unfortunately, there is a great evil, the electric light feed it all its own way; but in the end the best and cheapest will, and that it in the future for gas.

It is a curious fact, in the history of Vulliamy that, being present at a trial of fluidine destructive effect, which I predicted would supersede gunpowder, and gunpowder would have been an end to all wars, I got up a splendid improvement gun-cotton. Now we might say with regard to street lighting by gas and electricity.

At the Rue du Quatre Septembre, a street about half the length of the Avenue de l'Opéra, the Paris Gas Company have put up 80 lanterns, with burners composed of a fresh form of the Siemens lamp burners, each burner consuming nearly 70 cubic feet of gas per hour. The total quantity burned by the 80 burners is 112 cubic feet per hour, or 2,688 cubic feet per hour. Now, if these lamps were given, it is said, the light of 22 candles, the light given by all the 80 burners is, therefore, 10,000 candles power. Now, if the electric light in the Avenue de l'Opéra, the quantity of gas consumed in only 200-candle burners, the amount of light obtained would be 40,000 candles, or 4,000 candles more than the Rue du Quatre Septembre lighting. Now, the length of the Avenue de l'Opéra is 1,312 feet, and that of the Rue du Quatre Septembre 1,000 feet. Municipality, is 16 fr. 80 c. per hour. The Paris Gas Company are only to be paid by the Municipality for the actual gas consumed, and the Municipality would be clear that if this gas, regarding the inferior light as being of nearly double that it would be much better if they would confine themselves to the gas lighting, and give light for light and keep for keep.

In the Place du Châtelet there are 77 lamps fitted with gas-burners; 12 of these burn 11 litres of gas per hour, and the other 68 burn from 7½ to 8½ litres per hour.

In the Halles Centrales there are two pavilions lighted—one by electricity, the other by gas. They are both lighted for 1000 hours per annum. In the pavilion lighted by gas there are 24 lamps. In the pavilion of the electric light, there are six candles. Since the six lights, and the cost of 30 bat's-wing burners, each consuming 5 cubic feet per hour each, were fixed in the pavilion of the electric lights, they would produce the 720 candles for the sum of 90 centimes, or 7½ centimes per hour for the entire lighting, instead of nearly 20f., for the same work done lastly by the electric light. (Note that there were 21 extinctions and 61 relights of the electric light in the month of April last, the lamps having burned steadily from the time it was commenced, without any extinctions or starvation.)

I shall not take up your time by any consideration of the lighting of the Halles Centrales by electricity as compared with gas, or the cost of the electric lighting with respect to the lighting in Leicester. It is probable that the quantity of coal, or even electricity, does not enter into the calculations of the people who have charge of these buildings. They have seen everything to sold, seen how observed that the gas lighting is primitive. The lustres and brackets are excellent examples of the competitive effect of lighting by gas and electricity, it is about the same as a comparison between the old Roman lamp and the electric light as used on all lamp, the Carel. Besides, the electric light has not been established, as well as for others in this country, an excellent advertisement, as a matter of little importance whether the light is produced by gas, or a change the gas lighted and ready to be turned up at a moment's notice when the electric lamps go out. In most cases the

So much are the lamps felt to be a hindrance rather than a benefit, that I believe if all the lanterns were asked to vote for the cessation, they would vote almost unanimously for the entire suppression of the lanterns, if they could not have a light without shadow; but it is by no means the only thing if the shadows were more distant, and there, I think, is the first step for improvement which can be made in the future.

Mr. Woodall, as a refractor over the lamps in street lighting, at a very slight angle, is very good; Mr. Woodall, the inventor of these, I believe, was the first to introduce the internal horizontal refractor. Up to the Prussian war, in England, it was universally used, although his example for the glass top usually adopted by Mr. Stevenson was followed in South America. All the lamps in Paris at that time were glazed with the Gaudin prismatic top.

The next improvement in the direction generally is the use of the Argands in preference to the fishtail, which is mainly responsible for the blackness and dinginess which is so often seen. Next, if Argands are the troublesome shadowers they still be in favour of at least 20 per cent. more additional for the same. The railway station at most many chimneys are in the amount of light in Paris, its parts. In England chimneys to Argands only, with chimneys, instead of chimneys; but I have been told by Mr. J. N. Douglass, the Institution engineer to the Trinity Lighthouses Board, that although we have in some perhaps the greatest amount of knowledge, our chimneys of the large and small sizes are not always correct, even with the rough weather to them in their wear and tear accounts. Then comes the use of large burners in the rooms, at refreshment and, lastly, comes the use of large burners candle burners in the main corridors, and if they do not get them with gas, a public desire larger lights are erected streets.

Then they will with electricity. In case and if they do not get them with gas, electricity will vanish from the Avenues fended more than once that lamps, and other places where it is used, as in the Opéra, the Thames Embankment, and other places where it is used, as in the Opéra, the Thames Embankment, and other places where it is used, as in the Opéra, the Thames Embankment

thought it was very doubtful whether it was economical to use large burners at considerable distances, instead of small burners close together. In the Waterloo Road he put up lamps at frequent intervals, adopting the objectionable basket system. Around the shadows, whilst reflecting light, and increased the consumption of gas to 6 instead of 5 feet per hour. The general effect of the light was good, but very costly, effective, and would long remembered the ordinary large stalls for gas lighting, it was seen that there was room for economy in that direction. By reductions in expenditure, in that way for existing lighting the district lighted could be under 200*l.* per mile of lamp-bearer road, the lighting was effective, and the cost was moderate. Contrasting that with electric light, which could under favourable circumstances be done for 20*l.* per mile per annum, if it was sufficiently large margin there was for increased efficiency, if it was called for, and clearly agreed with Mr. Hartley, however, that the ratepayers would not stand the increased cost involved by existing gas systems when sufficient at the present time. In great thoroughfares, where there was much traffic, it was necessary to have a powerful light, and in the centres of traffic; but so far as the general illumination of the streets was concerned, he thought it was a question of sufficient, and any large increase in the price of a town or parish, called for in order to increase the general lighting, would be met with strong opposition.

Mr. Hartley said the paper had been so kindly received that there was very little he could add, except the remark of Mr. Wesley, that there would be more light in the streets than they now did, it was perfectly clear that they would have anything to do with electricity; and it was equally clear that they would not spend any more money in lighting streets than they now did, even with the electric light. Mr. Wesley had said they would not spend any more money in lighting streets, but what he understood him to have asserted was that, even with the number of feet of gas at present consumed, it would be possible to give much better light by the use of improved burners, and more effective illumination by shades. He was quite sure, however, that there would eventually be an increase in the consumption of gas for the public streets. Of course, the readings would be improved, and the time other places would by degrees follow suit.

[The other papers read will follow in due course.]

ROCHDALE CORPORATION GAS-WORKS.

ANNUAL REPORT OF THE GAS COMMITTEE.

At the Monthly Meeting of the Rochdale Town Council, on Thursday, the 5th inst., the following report of the Gas Committee for the year ending March 25 last, was presented:—

The Committee are again sorry to state that there has been a decrease in the consumption of gas during the year, it now being 2 millions under the previous year, a decrease of nearly 3½ in the last of the two years, although there is a corresponding profit this year amounting to £9,323 16*s.* 3*d.*, but your Committee consider this a satisfactory result, under the circumstances of the case, and as it will be seen that the amount received for public lamps is about £500 less than last year, there has been a reduction having been made in the amount charged for such lamps.

During the year the new station governors have been working. Each governor consists of a gasometer divided, and it is satisfactory to state that the pressure is now much more regular on the whole area of consumption, there being now no pressure to send gas through the long-continued [illegible] to Castleton, as was the case with one governor during the long-continued frost; in fact, with our extensive mains, no trouble was recorded.

Your Committee have also to state that the large new stalactite erected last year, and capable of replacing 80,000 cubic feet of gas per hour, is now in full operation. Taking the combined capacity of our purifying house, we have now a capacity of nearly 3 millions per day.

The following account represents a comparative view of the working for the year ending March 25, 1879, and the year ending March 25, 1878:—The make this year, 311,784,000 cubic feet; last year, 313,784,000 cubic feet, showing a decrease this year of 2 millions. The quantity sold this year, 283,372,000 cubic feet; last year, 285,372,000 cubic feet, showing a decrease this year of 2 millions. The unaccounted-for gas this year, 28,412 per cent.; last year, 27,588 per cent. Value of gas sold, this year £20,419 19*s.* 11*d.*; decrease, £921 2*s.*; last year, £21,341 2*s.* The gas sold this year amount to £9,323 16*s.* 3*d.*; the profit, £11,096 3*s.* 8*d.*; decrease, £921 2*s.* 5*d.* The number of tons of coals carbonized this year, 19,207; last year, 19,511; decrease, 304 tons. The number of consumers this year, 18,887; last year, 18,787; new tenants, 1,151; new services laid this year, 207; number of consumers lost during the year, 1,051. The number of meters fixed this year, 1,258; number of meters removed during the year, 1,051; number of meters fixed and additional meters fixed, 207. The amount received for sales this year, £20,419 19*s.* 11*d.*; amount received at rent of £1,757 10*s.* 0*d.*; the amount for gas, £20,419 19*s.* 11*d.*; amount for rents, £1,757 10*s.* 0*d.*; total chargeable to capital, £1,677 10*s.* 0*d.*; total, £22,177 19*s.* 11*d.*

Dr.—Profit and Loss Account from March 25, 1878, to March 25, 1879.

To Gas-works, ground account			
Public lamps, including lighting, extinguishing, cleaning, and repairs		£10,053 7 4	
Public lamps, contributions Local Board		1,300 0 0	
Gas tar, Waste, and Wooden do.		151 5 6	
Rates & assessments,		97 2 10	
Coals		33 19 0	
Coal and unmeasured liquor			
Wages		£7,017 7 3	£14,870 14 11
Fitting trade,		2,597 15 8	
Sundry items		21 12 0	
		23 19 0	
			2,060 8 10
			£26,419 19 11

Cr.—Profit and Loss Account.

By Declaration—			
Meters wages		£3,035 0 6	
Meters and cocks			
Meters and cocks	£16,337 3 4		
Meters, wages, unloading, and fixing	703 0 5½		
	272 1 3		
		17,309 10 9½	
			£20,344 11 4
By Sales—			
Gas, &c.,	£20,344 11 3		
Value of loss	101 12 0		
	129 0 0		
		£230 12 0	
Less spent oxide and lime sold	42 16 0		
		187 16 0	
By Rents—			
Rents	£1,651 13 6		
Do.	105 16 6		
		757 10 0	
By Fines for non-returns—			
Meters, &c.,	£103 10 6		
Gasfittings	177 17 0		
Stoves	337 0 0		
Lamps	27 12 6		
	10 15 0		
Less materials sold,	1,776 7 0½		
	10 15 0		
		1,775 7 0½	
Carried forward		£23,005 10 2½	

Brought forward			£23,005 10 2½
Wear and tear, works, and main—			
Wages			
Labour		£193 13 11½	
Coals, coke, and manure,		1,000 0 0	
Oil, paint, and colour,		1,000 0 0	
Stamp ware and lead,		1,000 0 0	
Repairs,		1,000 0 0	
Carriages,		1,000 0 0	
Sundries,		1,000 0 0	
Rates,		1,000 0 0	
Station-meter		1,000 0 0	
		1,000 0 0	
		£3,371 6 6	
Less old iron, &c., sold		45 0 0	
			3,326 6 6
Wear and tear, mains and services—			
Wages			
Pipes and castings,		£302 0 1	
Jointing materials		27 13 0	
Lead		34 17 0	
Carriages		21 0 0	
Paving		20 0 0	
		101 15 0	
		£501 1 1	
Less materials used, &c.,		109 2 3	
			391 18 10
Meter inspection, wages			
Salaries and office expenses—			130 16 0
Salaries			300 0 0
Auditing,		£1,042 12 0	
Printing, stationery, stamps, &c.,		110 0 1	
		152 2	
			1,322 0 1
Miscellaneous expenses—			
Travelling expenses,		£2 13 0	
Consultations per bank,		53 0 0	
Advertisements,		3 0 0	
Subscriptions,		3 3 0	
Miscellaneous,		3 0 0	
Sundries,		16 16 0	
		6 10 0	
		£146 4 6	
Less meter-books sold		2 15 6	
			143 9 4
Wear and tear, lamps—			
Wages,		£310 18 0	
Repairs and materials		109 0 0	
		£419 18 0	
Less materials sold,		15 3 0	
			404 15 0
Rent of land		£346 6 11	
Rent, rates, and taxes		1,260 0 0	
		£1,606 6 11	
Less rents received		1,757 10 0	
Bad debts, estimated		£151 16 11	1,606 11 0
		50 0 0	
		£201 16 11	
Interest on loan account			2,000 10 2
1-25th part of mortgage debt to sinking-fund		£1,292 12 2	
		2,292 2 3	
Balance, being profits,			9,323 2 8
			9,323 16 3
			£30,419 19 11

Dr.—Balance-Sheet.

Assets.

To Value of works, per last year's balance-sheet,		£163,871 11 9
Less 1-25th part of mortgage debt,		
this, being added to cost of sale,	£2,345 2 8	
Less per Electric Lighting Act,	1,047 0 0	
suffer for sinking fund of short,	1,047 0 0	
		4,439 3 8
Amount expended from March 25, 1878—		£159,432 11 1
Meters fixed	£703 11 0	
Stoves fixed	337 0 0	
New services, pressure-reducer, office, &c.,	2,210 11 11	
New lamp services,	1,111 11 11	
Increase of mains, &c.,	1,000 0 0	
Horses and cart	50 0 0	
	250 15 0	
		5,674 0 10
Present value of works		£165,107 11 11
Amounts due—		
Gas-rental	£12,641 1 11	
Public lamps rental	4,951 0 0	
Public lamps, Castleton Local Board	171 11 4	
Public lamps, Littleborough and Wardle Local Board	12 11 10	
Sundries bills	1,281 10 0	
Fittings meter	77 4 10	
		19,110 17 11
Stocks, as per details in stock-book—		
Coal and cannel	£384 5 4	
Sundry items	1,107 0 0	
Meter and fittings	222 0 0	
Gasfittings, value, &c.,	317 7 10	
Oxide of iron	101 0 0	
		2,131 12 2
Balance in Manchester and Liverpool District Banking Company		1,000 12 8
		£287,122 0 0

Cr.—Balance-Sheet.

Liabilities.

By Mortgage debt, as per last year's balance-sheet,	£100,133 10 7	
Amount borrowed from depreciation-fund	9,362 2 11	
		£109,495 13 6
Less 1-25th part of debt sold over to the Finance Committee for sinking-fund	2,292 2 8	
		107,203 10 10
Debts owing on trade account		£154,412 13 10
Rent owing on account		1,757 10 0
Deposits, being money paid in advance for gas		241 11 3
Balance from last year,		1,000 0 0
Balance, as per profit and loss account,		8,012 17 7
		£163,123 0 0

Dr.—Capital Account.

To Amount paid into the Corporation, and expenses incident to purchase,	£37,000 0 0
Extension of gas-works, 1852	1,000 0 0
Extension of gas-works, 1872	1,000 0 0
Balance	8,564 4 11
	£111,410 9 11

Cr.—Capital Account.

By Amount borrowed from Hand in Hand Insurance Society, 1844,	£32,000	0 0
Amount borrowed from depreciation-fund, 1852	214 11	1
Amount borrowed from depreciation-fund, 1862	1,350	0 0
Amount borrowed from depreciation-fund, 1872	9,288 3 10	
		10,638 3 10
Amount borrowed from various persons, 1852 to 1861	6,062	2 11
Amount borrowed from Finance Committee, 1862 to 1879,	100,000	0 0
		£116,410 9 11

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TO CORRESPONDENTS.

R. M.—*Too late for this week.*

We would again remind correspondents that, to ensure insertion in the next number of the Journal, letters should reach the Office by Saturday at latest.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JUNE 10, 1873.

Circular to Gas Companies.

THE big sale of Chartered Company's stock will come off on the 19th inst. What prices the new issue will fetch can only be imagined from those at which the present "A" stock stands in the market to-day. The premiums realized, we believe, will be, we will not say enormous, but it is probable that little will be thought to pay much over five per cent. This is small enough interest for investors who put their money in the concern for the first time; but the provisions of the Act under which the sale takes place are specially hard upon old Shareholders, who are fairly entitled to a *pro rata* issue at par. The sale will, no doubt, leave a very large number of investors, but the range of prices is certain to be small. The lots are arranged so as to suit all classes, from the man who can put his two thousand pounds per lot in, to the poorer investor who can only put in his hundred pounds. We expect, however, that the lots will all go off in large quantities, for it is one condition that the purchaser of any lot will have the opportunity of securing a considerable number of other lots at the price he gives for the first lot, without any further advertisement. This sale will constitute an era in the history of the enterprise. The electric "scare" has passed away, and gas will be remarkable in another sense; it will be the first occasion on which gas stock on such a considerable scale has been put up to auction, to produce premiums which will not be entitled to dividend.

An extraordinary meeting of the Shareholders of the South Metropolitan Gas Company has confirmed the resolution of the Directors to unite with the Surrey Consumers Company. It was, of course, a foregone conclusion, for although but few Shareholders were present at the meeting, the whole body have, with good reason, as much confidence in the Directors, that their sanction to the scheme was certain to be given. Happily, no discussion arose at this meeting as to the retiring allowances of the Directors and Auditors of the United Company; by the good sense of the South Metropolitan Shareholders they were passed over. The only opposition which now remains is that raised by the Phœnix Company, who object to the scheme proposed, as standing in the way of a larger combination. This Company might have had the matter entirely in their own hands, but they neglected their opportunity, which has now for ever passed away from them. What the Board of Trade may say we have no idea, but it cannot be supposed that they will endeavour to force any union between the Phœnix and the South Metropolitan Companies. There is one combination, however, which is still open to the Phœnix Company. They may, with much propriety, take all the district of the London Company south of the river, leaving to the Chartered Company all that lies to the north. This would prove a most valuable amalgamation. There might be some little difficulty in splitting up the museums of capital to be allotted to the two Companies; but it could easily be settled by a calculation made by competent engineers. The London Company may be said to be an anomaly. How their districts were allotted, when the districting arrangements were made, we could never imagine. All the area north of the Thames now properly belongs to the Chartered Company, who have the means of furnishing a supply to the districts in that area, while that on the south would naturally fall to the Phœnix Company, who would profit by obtaining the large manufacturing power of the Nine Elms works. But the London Company show a great unwillingness to enter into any combination. It is, in our opinion, a short-sighted policy, and it is to be hoped the Directors will take into serious consideration the propriety of entering into some union with the Companies south and north of the Thames.

We are sorry to see that the Birmingham Corporation are about to appeal against the judgment of the Court of Queen's Bench in their attempt to set aside the award of Sir Henry Hunt. As the case is still *sub judice*, its legal bearings must not be referred to. We object to the process because all the expenses, whichever way the ultimate decision goes, will fall upon that unfortunate overburdened animal—the ratepayer. Birmingham, as we said last week, had an excellent bargain when the Corporation purchased the Staffordshire Company's works, and could afford to be generous. The principle of arbitration adopted by Sir Henry Hunt cannot here be commented upon, as, whether the fragments of the undertaking should be sold at a proportionate price to that paid by the Birmingham Corporation, or whether they should now be disposed of at their increased value, is a question which the Court of Appeal will have to consider. All that can be said now is that it will be a blessing when this litigation is settled, and the Local Authorities get their several undertakings into fair working order. As we intimated last week, some of them may not do well; but, reviewing the whole case, we consider that it would have been better for everybody if the whole undertaking had remained in the hands of the Company.

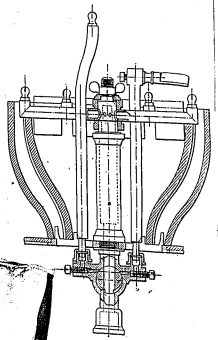
The electric light again attracts attention, and attempts are once more being made to write down the value of gas property. Much of the nonsense outlet is founded on the evidence of Sir William Thomson before the Select Committee on Lighting by Electricity, which we publish in another column. We have rarely seen a man of undoubted eminence and science fall so conspicuously to impress on his hearers the actual facts regarding the electric light. The first part of his evidence will be only intelligible to electricians, and we may pass on to such practical matters as stand out in the examination of the learned Professor. Sir William Thomson believes that the electric light has a great future before it, and no one can gainsay that; but there is still a doubt as to the source from which the electricity is to be obtained. Batteries, wet or dry, will not suffice. The employment of mechanical force, therefore, has to be resorted to, and the question is how the energy is to be obtained in the most economical manner. There is a choice between a steam-engine and a gas-engine, and Sir William Thomson appears to think that the former is the more economical. Among the immediate possible applications of the electric light, the Professor appears to think that it may be used to illuminate the drawing-rooms of noblemen's mansions. An engine of some kind may be placed in the basement, and, proper arrangements having been made, the drawing-rooms may be lighted with splendour. No scientific superintendence is considered to be necessary, but what James Plush or John Thomas would say to having the management of a steam-engine, electric apparatus, and the supply of Jablochkoff candles added

THE NEW GAS-LIGHTS IN PARIS.

As recorded in the *Journal* for May 6, p. 670, the Paris Gas Company, on the 30th of April last, introduced a new system of illumination by lighting the Place de l'Opéra by means of improved gas-lamps and burners. As the latter are altogether unlike those which have been employed in the recent street-lighting experiments in the Metropolis, the accompanying sketches and description of the apparatus, which appeared in a recent number of the *Journal des Usines à Gaz*, may possibly possess some interest for the English gas world.

It is not claimed for the new burners that they produce results superior, or even equal to, those obtained with the Siemens regenerative lamps, but they are certainly far more economical than the ordinary flat-flame burners, and consume a minimum of gas. The light is protected from the outer atmosphere solely by the glass of which the lantern is composed, and the supply of air necessary for combustion, as well as for carrying off the products of that combustion, is so arranged as to allow of the present form of street-lamp being preserved, the only difference being, of course, in the dimensions.

The upper part consists of six inbowing burners, mounted upon copper tubes, and so arranged as to form a ring about 4 inches in diameter, the bottom being cut at a tangent to the circle. Two crystal air-channels, placed below the ring of burners, serve to convey currents of air—one to the inner, the other to the outer side of the circle of flames. These air currents regulate combustion, and give steadiness to the lights. The section of the burners have been so arranged as to afford the maximum of light for the amount of gas consumed, the flow of the gas being governed by a pressure regulator.

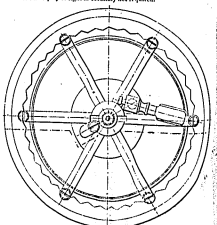


A small jet, which is kept constantly burning, enables the gas to be lighted without necessitating the opening of the lantern. There is in addition a central burner, which can be lighted from the ring of jets by the simple turning of a tap. This burner is similar to those ordinarily used in the street-lamps in Paris, and is intended to furnish the regulation supply of gas after midnight, or whenever the higher degree of illumination is not desired.

Each of the six jets of which the entire burner is composed, if taken singly, would consume about 5 litres per hour, and would yield a light equal to about 16·15 sperm candles. The amount of gas consumed by the entire apparatus is rather under 30 cubic feet per hour, and the light produced is equal to about 135 candles, or at the rate of 225 candles for each jet. This increase in illuminating power is partly attributable to the judicious manner in which the supply of air to the burner has been arranged, and partly to the absence of the blue, non-luminous portion of the flame, enabling its light-giving power to be utilized to the fullest extent. As each new gas-light has the illuminating power of 135 candles, it is estimated that the 250 lamps will be equal to 33,750 candles, or to 337 lights each of 100 candles. The Place de l'Opéra, which has been estimated by one of Montfaud Engineers at about 116 candles.

The line de Quatre Septembre is a thoroughfare about 900 yards long, by about 12 yards wide, giving a superficial area of 7800 yards. To light this area the Paris Gas Company have erected 62 lanterns, each furnished with one of the new burners, yielding an aggregate quantity of light equal to 8000 candles, at the cost of about 2s. 2d. per hour, or 17·24 per lamp, reckoned, of course, per hour, the cost of each electric light in the Avenue de l'Opéra. The lamps are placed at the height of about 10 ft. 6 in. from the pavement.

With regard to the relative merits of gas and the electric light for the illumination of public thoroughfares, the *Journal des Usines à Gaz* says that, standing at one of the refuges in the Place de l'Opéra, the spectator may form a very fair estimate of the effect produced by the two systems of lighting. Looking along the Avenue de l'Opéra, one would suppose it to be illuminated by the electric light, as the gas-lamps and their accompanying half-candles were not visible, and if the eyes they contrast still a moment vary in intensity of colour. The light, too, is unequally distributed; it is intense at the foot of the lamp-pillar, and diminishes in power in proportion to its distance from the lamp, the middle of the carriage-way being worse lighted than the rest of the thoroughfare. The line de Quatre Septembre, on the other hand, presents to the view a magnificent illumination. The lamps succeeding in perfect line seem to contain bowls of gas-light, the crystal rings encircling the burners appear to be filled with flame, which burns tranquilly, and not like the flame of a torch. The power of effect is magnificent; but, adds the *Journal*, for ordinary street illumination such a display of light is certainly not required.



...ds to obtain results similar to the analysis. No. 1, I have ... disposed of; No. 3, of course, need not be discussed; I have then only to deal with No. 2.

Mr. Paterson's meaning evidently is that all works where the absolute value of the coal is not obtained, are defective in that respect. What have commercial results to do with the question? I know of works making 50 millions a year, that produce less than 9000 feet per ton from Newcastle coal (and that, too, with a liberal percentage of Lesmahagow), and yet pay a 10 per cent. dividend. So commercial results have nothing to do with efficiency of working. I strongly deprecate the idea that, because a manager is obtaining good commercial results, he ought to remain satisfied. There are many things that produce good commercial results besides high makes per ton—*e.g.*, smallness of capital, proximity to coal-fields, &c.; and I am surprised at Mr. Young adducing this as a proof of scientific working.

Of course, if the sample analyzed is not the same as that used in practice, as suggested by Mr. Greville in your last issue, no value can be attached to the analysis. This is outside the question at issue.

C.

THE CHEAPEST GAS IN SCOTLAND.

SIR,—Among the "Trade Notes from Scotland," in your issue of the 3rd of June, is the statement that "there is certainly no instance of cheaper gas in Scotland than that supplied to the consumers in Dundee." Statements to the same effect have repeatedly appeared in the Scotch daily newspapers; but now, when your official correspondent repeats the expression, the statement must be challenged in the interest of other companies, though I, no doubt along with others, am well pleased to see that the Dundee Corporation Works, under the able superintendence of Mr. M'Crae, are supplying gas at lower rates than the enterprising community formerly had to pay.

On reference to the past, it will be found that in the year ending April, 1876, the Dundee Corporation made 285 million cubic feet of gas, which they sold at 5s. per 1000, and the net profit, according to your official correspondent's report, was £8669. The illuminating power of the gas was 27·83 candles. During the year ending July, 1876, the Galashiels Gas Company made about 31 million cubic feet of 29-candle gas, which they sold at 4s. 7d. per 1000 feet, and made a net profit to the Shareholders of £2175. The rate was, in July, 1876, reduced to 3s. 9d. per 1000, and the Dundee rate to 4s. 7d. per 1000, with 5 per cent. deduction for cash within 28 days. In February of the year 1876, the Dundee Gas Commissioners considered the advisability of reducing the quality of the gas, and, though I cannot find in the file of your JOURNAL any exact statement as to whether or when they decided to do so, I infer it must have been done, for, to a meeting of the Commission, held on Dec. 14, 1876, Mr. Kinnear, the Sanitary Inspector, reported that the illuminating power of the gas was 26·8 candles. During the year ending April, 1877, the average illuminating power of the Dundee gas was 26·49 candles (*vide* "Trade Notes from Scotland," July 16, 1877), and the same authority informs your readers that, in December of the same year, Mr. Falconer King reported the Dundee gas as equal to 26·63 candles. I am, therefore, safe in assuming that during a portion of 1877, and ever since, the standard of Dundee gas has not been much over 26 candles. The price for 1877 was 4s. 7d. per 1000, with the 5 per cent. abatement for cash in 28 days, and the Commissioners made that year 292 million cubic feet, and reduced the rate at the year's end to 4s. 2d. per 1000. During that same twelve-month the Galashiels gas, of 29-candles standard, was sold at 3s. 9d., and from a sale of about 31 millions the Company seem to have cleared £1500, for they paid a dividend of 10 per cent., and voted £2200 for new pipes, of which some £654 was a balance from the previous year's account. I cannot give the comparisons for 1878, as no account from Galashiels is recorded in your JOURNAL; but the Dundee profit was £3131, and the next year's sale began at the diminished rate of 3s. 11d. per 1000 feet, with the 5 per cent. abatement for cash. Your correspondent, in view of this further reduction, credited the Dundee Commissioners with supplying "the cheapest gas in Scotland," with "one exception—namely, Galashiels," of which the price had been, for that and the preceding year, only 3s. 9d. per 1000 feet.

We come now to the present, and find that the Commissioners of the northern burgh have resolved to sell, during the year ending 1880, their 26-candle gas at 3s. 8d. per 1000 feet, or, allowing for the abatement for cash, at 3s. 6d. per 1000, and on that your correspondent makes the affirmation which I challenge—namely, "that there is certainly no instance of cheaper gas in Scotland."

No one has any means of knowing what the rate in Galashiels will be for that year, as the annual meeting will not be held until after the close of this month; but, assuming it will remain at 3s. 9d. per 1000, at which it has stood for the past three years, my contention is that it will be cheaper than the Dundee gas at 3s. 6d., for the Galashiels standard is 29 candles, and by simple proportion I find that if Dundee 26-candle gas be worth 3s. 6d., the Galashiels gas is worth fully 3s. 10½d. per 1000 feet, and, therefore, at 3s. 9d. it is cheaper than the Dundee light. The northern burgh are supplied with 26-candle gas at 3s. 6d., and, were the Galashiels standard reduced to 27·8 candles, and sold at 3s. 9d., it would be worth as much as the Dundee light. But it is 1·2 candles higher in illuminating power, and is, therefore, cheaper by that amount.

My conclusion, therefore, is that though the consumption of gas in Dundee is about ten times that of Galashiels, the southern burgh has still the credit of beating its northern competitor in gas-making.

Innerleithen Gas-Works, June 6, 1879.

ROBERT MILLER.

POLLUTION OF THE THAMES.—The Conservators of the River Thames have addressed a notice to the Leatherhead Sanitary Authority requiring them to discontinue within thirteen months the discharge of sewage into the Thames from the River Mole, in accordance with the Rivers Pollution Prevention Act. The notice has been sent to the Epsom Rural Sanitary Authority by the Leatherhead Parochial Committee, but returned to the latter. The residents in Leatherhead are proposing to form part of their parish into a special drainage district, which, it is believed, will obviate the present state of affairs.

Colonies we sent rather more pig iron, but smaller lots of all other kinds. With Australia our business in bars, angles, bolts, rods, hoops, sheets, and plates was more comprehensive, but the figures as to railroad iron show a falling-off. All our exports to India compare unfavourably with 1877, and that is also the case as regards the United States, with the sole exceptions of tinplates and "other iron," the latter doubtless including the item of scrap for remanufacture. The summary of our exports of iron last year shows an increase in pig iron and tinplates only, all other kinds, save the minor item of old iron for remanufacture, having diminished. The concluding chapter of the report deals with the important subject of foreign tariffs and their effects on our iron trade. Tabular returns are given in support of the allegations under this head, but we do not need to quote them, as they have been forestalled by the more complete Government returns published in THE IRONMONGER of June 7. At the same time, the question is fully and fairly dealt with in the volume before us, the compilation and general arrangement of which is highly creditable to Mr. Jeans and the able Committee with which he is associated.

GAS FOR HEATING PURPOSES.

AT the annual meeting, held at Newcastle-on-Tyne last week, of the British Association of Gas Managers, a variety of subjects was discussed in an earnest, intelligent, and interesting manner. There were present gentlemen from all parts of Great Britain, a large proportion of them being the managers of the gas works of the United Kingdom, and, therefore, holding positions which entitle their remarks and proposals to considerable attention on the part of the trade. The chief points discussed, so far as we are concerned, were those raised in the paper read by Mr. Travers, of Cork, whose essay was entitled, "How can Gas Companies best Promote the Application of Gas for Heating Purposes?" Mr. Travers opened his remarks with the statement that inasmuch as this is comparatively a new branch of industry, the gas managers, like the Ironmongers, have much to learn, and must be prepared to pay for their experience in one shape or another. Already, it is true, much has been done, and many of the companies have afforded opportunities of demonstrating to the public the utility of gas for heating and cooking, and of the economy with which it is possible to attain excellent results. Mr. Travers, nevertheless, thought that to hold exhibitions, to award prizes, and to supply stoves on easy terms was not enough, but that the companies must be willing, not to say anxious, to assist the consumer in the economical consumption of gas, seeing that it is plain that the cheapest gas at present is an expensive fuel unless used with care and economy. Mr. Travers paid a just tribute to those makers of these stoves who guarantee the performance of a certain amount of work with a given quantity of gas, and said he had found these representations, on the whole, to be true. He was convinced, however, that gas companies must be at trouble to secure economy or they would never effect the general use of this mode of heating. At present there was an enormous waste, which, in Mr. Travers' opinion, arose from two causes—either from the leakage, condensation, &c., brought about by keeping the gas turned on throughout the entire premises all day, or from the carelessness of servants. To remedy these drawbacks Mr. Travers said he would propose that any gas-stove should have a special supply pipe and a separate meter, and that the index of that particular meter should be taken every month and its register communicated at once to the consumer. He was quite convinced of the wisdom of this course—indeed, of its necessity—to make the

Gas for Lighting Railway Cars.

Efficient and cheap means for Lighting Railroad Cars with gas are eagerly sought for in all countries, and it may therefore be of interest to describe Hugon's system, which, according to the *Revue Industrielle*, is the outgrowth of almost 20 years of experiment. The apparatus consists of two reservoirs of about 60 gallons each, which are placed upon the roof of the car and are able to resist a pressure of gas of six atmospheres. Tubes starting from the ends of the reservoirs unite in a larger pipe, from which the compressed gas is carried to a pressure regulator, the most important part of the apparatus. It consists essentially of two cast iron cylinders mounted at right angles to one another. The gas coming from the reservoirs enters one of these cylinders by a bronze collar, which is pierced by a conical valve. This valve tends to open by the double action of the pressure of gas and the weight of a large lever, the extremity of which is attached to the middle of a horizontal caoutchouc membrane. When gas under pressure enters the regulator this membrane is lifted, and the lever closes the admission valve as soon as a certain limit is exceeded. M. Hugon has also added a simple safety attachment in case the regulator gets out of order. The weight of the apparatus does not exceed 600 pounds and its cost is low. The gas light is much better than oil, but it has thus far proved much more expensive, as experiments on the Orleans Railroad, France, have shown.

[36630.]—Gas.—On reference to any elementary work on physics "Loftonian" will find that gas does not rise by virtue of any "ascensive force" it possesses, but for precisely the same reason that he himself would rise if placed under water, or a piece of iron would rise if placed under mercury, *i.e.*, because its weight is less than an equal bulk of the surrounding medium, and because fluids transmit pressure equally in all directions. If really disposed to "split hairs," I should say that the internal pressure in a vertical gas-pipe would be *less* at the top than at the bottom by the weight of a column of gas the height of the pipe. The burner mentioned by "A Reader" is the same as that suggested in "Common Sense for Gas Users," and I can testify as to its merits. "Sigma's" suggestion to check by the insertion of a tap near the ceiling is excellent, as with a governor at the meter and this expedient we might get very near perfection, our only irregularity being due to variation in the "call" in the pipes in the house. After all, it really seems that the tap at the burner *ought* to act as a regulator, and if your present form is bad through causing currents and eddies, it is a question whether another form might not be devised that will not do so. If Sugg's Christiana Burner Governors do half that is claimed for them they are of course a complete solution of the question; but they form an ugly excrescence immediately under the light, obstructing its passage, and I should think exposing the diaphragm to be cooked by gas in its own fat. Added to this, the expense is very great. I should think they might be advantageously concealed in some part of the bracket or chandelier. By the way, I find that in a one-light pendant, with the tap placed *above* where the pipe makes a complete turn, the evil effects, a partially opened tap, are much less, as though the passage through the curve straightened out, so to speak, the currents and eddies. If, therefore, the taps at the burners were either opened full or dispensed with altogether, and the tap at the ceiling brought by gearing within easy reach, "Sigma's" idea would be most valuable. There is plenty of room for gas discussion yet, though not of the question that first started it.—H. B.

THE USE OF GAS FOR OTHER THAN ILLUMINATING PURPOSES.

To any one who has given the matter any thoughtful consideration, it is self-evident almost, that if the distributing part of the plant of any gas company could be as fully employed throughout the entire twenty-four hours as it is from six P. M., to 12, midnight, there would be a very decided reduction in the "cost of distribution," per thousand feet of gas sold.

There are peculiarities incident to the distribution, as well as the manufacture of gas, that do not obtain in water supply, which is more nearly like gas supply than anything else. The capacity of the mains must be equal to the maximum demand, which occurs only during about two hours of the twenty-four on each day, and varies for almost every day in the year. During a large portion of the day the mains are practically unemployed; hence, the interest on the capital invested in those mains must be earned during the short time they are actively employed.

In the same way the manufacturing plant must be largely unemployed during the summer months, owing to the reduced consumption at that time, and yet interest never stops, and, whether used or not, the plant must be ready at all times to meet the requirements of the maximum consumption. All of this is perfectly evident to all managers; but the great fact remains that for years manager have been content to accept the fact without taking active measures to change the conditions at least partially. The problem is, in a few words, "how can an increased day consumption be secured"? This is purely a matter of business; and the answer to it is to be found exemplified, in hundreds of cases, in almost every other business enterprise in every city and town in the land.

It is simply in stocking, by every fair and honorable means, to extend the amount of business, and not only this but new channels of trade, and new applications to useful purposes, must be sought out and supplied.

The price of gas in Great Britain is very much lower than in this country. Gas is sold there at prices varying from seventy-five cents to two dollars per thousand feet, and yet the very clever men who manage their works are very wide awake to the necessity of still further deepening the price of gas to their consumers, in order that they may avail themselves of the increased profits to be derived from an increased business.

At Leeds, England, a very large exhibition has just been brought to a most successful termination, wherein the people were shown, in practical operation, the many economical uses to which gas might be applied. Thousands of people flocked to the great hall to see what washers—cooking in all kinds of ways; heating apparatus for various mechanical and domestic purposes; gas engines; laundry stoves; soldering iron heaters, these purposes; and, doubtless, the next annual report of the gas company will show a large percentage of increase in the annual sales of gas.

In many other cities and towns the same thing is being done. The object, in every case is to obtain increased day consumption, and we are glad to see that steps are being taken to extend the day consumption in our own country. Reduced prices are being announced in many places; but the following announcement will put the question to a practical test in one city, at least. It would seem almost certain that, at $1.50 per thousand, in a few citizens, gas would distance all competitors.

REDUCTION IN PRICE OF GAS IN NEW YORK.

At last the natural and inevitable result of opposition has made itself manifest, and the war has commenced apparently in earnest, and the prospects—rates in fact so low that they might satisfy almost any one. The first shot was fired by the Manhattan Company, followed promptly by the Mutual, after which the younger Municipal Company wheeled into line, and, finally the old New York brought up its forces, and the firing is general all along the line in the lower part of the city. Each company seems to be acting on its own account, although they all start at the same point, viz., $2 a thousand for all consumers of less than 10,000 feet per month. From this point the price is graded down; some by per centages, some at a fixed price, per thousand for different consumptions. The Manhattan announces their intention of selling to consumers of 100,000 per month at $1.25. The other companies make their prices in such a way as to practically amount to the same thing. We give the different circulars in another column. The result of this would seem to be that the company having the greatest number of large consumers, in proportion to their total number, will be most affected in its receipts by this reduction. How for this "scale descending" will be extended before the thing is over no one can tell. Probably the company having the smallest capital, per thousand feet sold, has the advantage so long as the price is not put below actual cost of production.

Those making their gas most cheaply are also better off than the others. As to the question of quality it has practically but little to do with the question so far as the mass of the consumers are concerned. What they look at is the amount of the bill.

This is very clearly shown by the fact that one company, whose gas contains from 28 to 32 per cent. of carbonic oxide, has already obtained some six or seven thousand consumers and probably sends out four or five hundred millions feet per annum. This company naturally claim that it is the superiority of the light furnished that has obtained them the popular support; but the fact nevertheless remains that they have always sold their product at lower prices than the old companies who have adhered to the hard and fast rule of the same price to every one, and that was $2.00 per thousand. The various companies will of course do every thing they can to defend the character of their own gas, and get as many consumers as possible. This is only the beginning of the matter. The people rub their hands and say "go it," and while trade is dull, in this hot weather, the proprietors of large establishments can amuse themselves by going around "shopping for gas."

How the stockholders are to be benefited by all this is a problem containing several unknown quantities, and has not yet been solved. If we were to suggest a remedy, in a general way, for this problem, it would be to amalgamate all the companies into one—with a capital stock not exceeding $5 per thousand feet sold annually, by all put together, and then sell gas at such a price that, while it would secure a fair remuneration for the money invested, it would be low enough to prevent the starting of any other competing company. In order to do this the manufacture must be conducted on the strictest scientific principles, and the sale upon purely business principles. It certainly would be possible, with such an organization to sell gas at such a price that the consumption would be very seriously increased both for domestic and other uses, and competition defied.

The harmony and co-operation which has so long existed between the old New York and the Manhattan companies has been very seriously disturbed by the action of a majority of the board of the New York company, in purchasing the right to use the Tessie du Motay process, with the understanding that the Municipal company do not enter into competition with them in the district below Grand street. It is understood that this action was taken in spite of the non-concurrence of those members of the New York company's board who are most actively interested in the board of the Manhattan company. So radical a change as this, if they actually put the process in operation, must have had the guarantee of enough satisfactory to those who brought it about. What effect the reduction in price which has since taken place may have, on calculations based on the old price, could no better determined if it were known exactly why the process was bought. Certainly $100,000, which is the sum said to have been paid by the New York company to the Municipal company, will be a very convenient little amount of pin money for the latter to have at the beginning of the war, as it so much clear gain to start with. Whether the effect of reducing prices will make it more convenient for the New York company to pay that amount, and as much more, perhaps, should they exert works for using the process, is not quite so clear.

Thus the war begins, with "every fellow for himself"; and it is to be hoped that, after the amusement has been continued long enough to satisfy all concerned, it will be terminated by an amalgamation into one of the honest city of New York, and that afterwards the manufacture and sale of the honest article of gas will be conducted on a true business basis.

If this be the result, the fight will not have been in vain. The people will have gained permanently, and the investor will have a more remunerative return for his money invested. The only question is, whether the fight is too many months delayed. If it is, then it will be a question for Mr. Gilbert to decide whether it would not be better to pocket the loss himself, and so end to a waste and disadvantage for carrying on the business and put the same interest by all stockholders. London and Paris have both gone through the same process, and the result has been amalgamation and cheap gas.

Parliament. If the Committee thought fit to reduce the capital, the Company would have to do it; but he (Mr. Littler) would remind them that they were probably charging a London as the gas consumer some seven or eight years hence, instead of postponing it for some twelve or fifteen years. Then they said, "The difference between the two systems of charging would enable them to embark in remunerative enterprises on a large scale." Now, the Company could not apply their money to anything but the supply of gas, as his learned friend had doubtless told his clients. The next allegation was, "The Company ask for a standard price of 3s. 6d. per 1000 cubic feet, which is in excess of the highest price they now charge. Your petitioners are prepared to show that they will be able to earn their full maximum profit at 3s. 6d., and that they require, with the standard price of 3s. 6d., and without that price, a smaller capital than is proposed." With regard to that, it was almost impossible that any company on a maximum 4 shilling price that they were then charging. If they did not, every occurrence of increase in the price of coal and iron would cause them to have to apply to Parliament for powers to increase their maximum.

The Chairman: What are they charging now?

Mr. Littler said 3s. 6d., as they were only asking as a maximum, for capital purposes, the price they were charging.

Mr. Otlass: It must be remembered that you have a sliding scale.

Mr. Littler said he had mentioned that before. [Reading the usual clauses.] It, therefore, they could get down to 3s., they would earn one-half more than the standard dividend, and at the same time benefit the consumers. The sliding scale was being applied in a great many boroughs, and his clients had adopted it as the latest approved method in gas matters. Then the petitioners said, "The Company have power to create preference stock, but the maximum dividend in addition to the ordinary fixed dividend is limited by clause 26." That clause was inserted to avoid a thing which had happened in other companies. A small company a year or two ago had an explosion, alleged to be due to something for which they were liable. Two or three houses were blown down, and the Company had to pay £2000 or £3000, and the Shareholders received no dividend for a long time. If the Company had had such a fund as this, they would have been able to apply it out of the loss out of it, and not have had to go to the Shareholders for it. Then they had been obliged to come to Parliament and tell them what had happened, and Parliament, feeling it was a matter which was no reflection on the management of the company, immediately raised their maximum from 5s. to 6s. The petition further alleged that "by clause 61 the Company seek power to cover merely six acres of land, in addition to their present site, with gas-works." That was a mistake. It was proposed to move the gas-works to a convenient position, and to sell the present site, which was in a densely populated district, surrounded by railings and getting dear chemical, and where they would be built on solid foundations, instead of on soil as the consumers like very well at present. Then they said, "But your petitioners will be prepared to show that the works required to supply the limits proposed cannot necessitate the use of more land than that comprised in their existing site." Upon that point he (Mr. Littler) would like to say, if the increase was going to continue in Shrewsbury, what happens it was of anybody's if the Company bought colony more land than they required, and kept it for the future? Was it unreasonable to suppose that the Company had power to buy land, and not acquire a sufficient piece of land, they would, as had happened before, become surrounded for buildings, and it would then be exceedingly costly to buy the land. The price at present was only a little over £300 an acre, whereas if they waited till the buildings were erected, it would probably cost a magnificent sum. The owner of the land did not object, nor anybody in the neighbourhood; only the Local Board. The petitioners said, "If the Local Board have any objection, and your petitioners submit they should not be allowed to take any land in addition for gas-works." What did the Local Board mean by objecting to gas-works being removed from the population? If the Local Board had carried out their proposal to purchase the works, it would be proved that they had it in contemplation to go to a site close to the one proposed by the Company. Then, as to the two hours notice, did the Local Board seriously object to the Company having to the hour's notice the ordinary time?

Mr. Otlass: You can do anything in two hours.

Mr. Littler said that was the Act. Then a suggestion was made they generally came in the evil minds of the people who made them. He supposed the imputation was that the Company would make use of these two hours to improve the quality.

Mr. Otlass: I am only stating a chemical fact.

Mr. Littler said the next objection was that "the testing-place of the gas should be at a distance from, and not within, the Company's works." It was generally within the works, but if the Local Board wished to have a testing-place of their own in the town, or at their offices, or anywhere else, they were perfectly welcome, if they paid all the expenses of it. "The quality prescribed by clause 6 is too low, and the Company, as your petitioners submit, ought to be required to supply gas of not less than 16 candles." No doubt that could be done, but it would be at enormous cost. When the Committee were told that London and Brighton, and 80 per cent. of the whole of the southern towns, had gas of 14 candles only, they would doubtless be disposed to think that 14 candles would be sufficient in the present instance, especially when it was seen that in order to avoid the penalties, at least 16 candles, or probably 18, would be supplied; which was sufficient for the whole of the southern counties might surely be deemed sufficient for the north. Taking all the circumstances into consideration, 14 candles would be found to be a sufficient and very reasonable rate for the assistance of Parliament, submitting, as they did, at the same time, to all the obligations which Parliament placed upon them.

Friday, May 16.

Mr. Littler said that his learned friend's clients, considering the only questions between the parties were those of capital and rate, had agreed to the following terms:—The original capital, instead of being £21,000, as in the Bill, should be £20,000, with borrowing powers for £6666, and with borrowing powers for £3000. They had also agreed to a thought it was a great concession on the part of the Gas Company to reduce the standard price from 3s. 6d. to 3s.; the illuminating power to stand at 14 candles, as in the Bill.

Mr. Otlass said that after the friendly way in which they had been met by the promoters, the Committee would be relieved from any further inquiry.

The Chairman: Then the Committee find the preamble proved.

Mr. Littler said that he would now proceed to the next necessary alterations. There was only one other point—that the Company were to have the power of charging 1s. more in the out-districts, say beyond a radius of two miles from the present works.

Mr. Otlass proposed it should be "beyond the district of the Local Board;" that would prevent an undue expenditure of capital.

Mr. Littler having agreed,

The Chairman then proceeded with, and the Chairman was directed to report the Bill, as amended, to the House.

Legal Intelligence.

FALMOUTH COUNTY COURT.—Tuesday, June 22.

(*Before* Mr. H. Bere, Q.C.)

THE FALMOUTH GAS COMPANY AND THE SEXTON'S RATE.

Judgment was given in the case of *The Rev. John Wright, Rector of Falmouth,* v. *The Falmouth Gas Company,* in which the plaintiff sought to recover arrears of sexton's rate in respect of tenements used and supply pipes.

His Honour said that the clause imposing the sexton's rate directed that "the Rector and Churchwardens of Falmouth from time to time might and should assess all and every the houses, shops, cellars, and counhouses, with the appurtenances, within the parish of Falmouth, which were brought in on upon the occasion, in their several precincts of Falmouth." The first objection taken in this case was that the gas-pipes which formed the subject-matter of the Company were not rateable, because they were not houses, shops, warehouses, cellars, or outhouses, and did not come within the meaning of the word "appurtenances," and he was of opinion that that objection was well taken. The statutes which imposed the poor-rate so also 43 Eliz., cap. 2, sec. 1, and 17 Geo. 3, cap. 3, sec. 1, which imposed and overseers should levy every inhabitant and every occupier of lands, houses, &c., in certain sums as they thought fit, for the necessary relief of the poor, and if the Falmouth Act had contained the word "land," then there would be no doubt at all that the gas-pipes would be rateable. Of course, in the case of Chatham, when the statute imposing the Parochial Assessment Act was passed, gas-pipes were not thought of, and although the appeal in that case was dismissed, the point was never brought in an open manner before the Court, and in subsequent cases. The case is it was a question whether pipes were not land, it was quite clear that the Act of Parliament for the Company was rateable, because the Act of Parliament provided that the gas-pipes would be rateable as occupiers of land. In a local Act of Parliament relating to the Manchester Water-Works, for example, which came under the same category, were held not to be rateable under the Parochial Assessment Act, which made other provisions, so that the question was whether other gas-pipes or waterworks could be included in the word tenement. But in the Falmouth Act the word "tenement" was omitted; for instance, they were held to be hereditaments, because hereditament meant a thing that could be inherited, and would include the ground and soil and several yards below in which the pipes were placed. There was no doubt that most appurtenances were hereditaments, but all hereditaments were not appurtenances, and he relied upon that great point—not appurtenances within the meaning of the Act. But there was another point which was equally fatal to the claim, and that was that gas-pipes were, and rightly ruled in some par, rateable in the assessment on the pipes ought to have been taken by way of symbol. In the Act of Parliament they would see it laid down that where any person was aggrieved by any equality in the operation of the rate, "or every such case the Justices of the Peace for the County of Cornwall for the time being, at the Quarter Sessions, shall have power to hear and determine all questions and difficulties arising out of the said rate." Now, the Justices of the Peace were expected appeal, or it ought to have been if objected to at all, as there were cases showing that there must be an appeal where an inhabitant was rightly rated for some property, although wrongly rated for others. A judgment by Lord Chief Justice Ingman was very much to the purpose, as it pointed out that the benefit of exemption was lost by a rate last being appealed against. He was, therefore, in this matter, bound to find a verdict for the plaintiff, although from this he should except the gas-pipes in the streets, because of the Act; but in case of appeal the question should be taken by way of appeal, and could not be raised as a defence in the action brought by the sexton. Inasmuch, however, as the very substantial question of liability was involved, he should not give costs.

Judgment for the plaintiff accordingly, but without costs.

Miscellaneous News.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from Vol.* XXXIII., *p.* 953.)

Mr. W. Cann (Halifax) read the following paper on

GAS-ENGINES.

The question of gas-engines is just now being brought prominently before the attention, not only of gas-engineers, but of the whole public, by the numerous voices of the different claimants for popular sympathy and patronage; and as these different machines promise to play such an important part in the consumption of gas in the future, I think it advisable that we should by no means neglect to give the matter our careful attention, so as to be able to answer those inquiries which will, from time to time, be put to us by those who are desirous of using gas-engines, and who trust their own judgment, and prefer to have it backed by that of a gas-person, before committing to invest their money. But as there is no good reason without some little obey, we should find that this question of amusement and useful machine will become a fertile source of complaint as it is more generally adopted; so that if it were only that we may deal intelligently with the complaints when they arise, it would be worth our while to give this matter our serious consideration.

I will not trouble you to go minutely into the historical part of the question, as I am sure you will find that fully dealt with in the day's Bill I hope you will not consider it out of place to say that if I have to what has been done by our own body in reference to this particular subject.

At the first meeting of the Association, held in Manchester in 1861, Mr. Hodkett, of Ipswich, read a paper on "The Application of Gas to Motive Power." This paper consisted of a description of the Lenoir engine, which was then being supplied by a firm of engineers in Paris, and Mr. Goddard says, "The engine is a very pretty, and, in fact, a beautiful adaptation of scientific and mechanical manipulation to believe it was difficult to conceive." He then gives a very clear and concise description of the details of the engine; but as, in spite of its beauty and adaptability, that engine has, along with others, become an instrument of the past, I shall satisfy myself with a very brief description of it, and refer any of you who desire a more intimate acquaintance, to the paper referred to.

The "Lenoir" and the "Hugon" were, I believe, the first two gas-engines ever practically applied or extensively used. They resembled in outward appearance, for the most part, small horizontal engines, and worked by drawing into the cylinder a charge of mixed gas and air during the first half of the stroke of the piston, and at the middle of the stroke this charge was exploded, either by means of a slide valve or an electric spark. The explosion which followed was intended for exerting for the moment, great pressure on the piston; but as brief was the duration of the pressure produced by this explosion, that the

THE ANNUAL REPORT OF THE METROPOLITAN BOARD OF WORKS.

The Annual Reports of the Metropolitan Board, extending now over a period of twenty-three years, afford an instructive record of the progress which has been made during those years in the improvement of the Metropolis. The machinery employed for the purpose of effecting this improvement may seem somewhat cumbrous, and the rate of advance may not be considered rapid. Still the aggregate result is imposing, and the machinery, on the whole, has worked tolerably well. Whether a point has now been reached where the existing system will be found inadequate for the task assigned to it, is a question of somewhat serious import, and suggests some misgivings. There are signs of a break-down with the Artizans and Labourers Dwellings Improvement Act, and matters also look a little ominous with regard to the Fire Brigade. In the formation of new streets the Board appears to halt, and its policy on the water question is far from happy. The Board seems of late to have misunderstood its position. It has been appointed—we might say commissioned—to perform certain duties, and to carry out certain works. Beyond the functions thus prescribed, the Board is powerless. Its nature, in fact, is that of a Commission, created for certain purposes, and capable of being employed for other purposes, as decided upon by the Legislature from time to time. Internally the Board has no power whatever. It must wait until authority is conferred upon it, before it can undertake any fresh enterprise. It is not a municipal body, like the Corporation of the City, or of Manchester, or of Hastings. In those days even Municipal Corporations, directly elected by the ratepayers, are obliged to take a vote from their respective constituencies, before they can legally enter on certain undertakings of magnitude. The Metropolitan Board is not in a position to appeal to the ratepayers. While its hands are thus tied, its responsibilities are as much the less. All it is accountable for is the due carrying out of the work confided to it by Parliament. The position may be humble, but it is safe, and may be one of eminent usefulness.

Looking at the Annual Report of the Metropolitan Board which has just been issued, we see that whereas at the close of 1865 there were simply two Acts of Parliament directly affecting the Board, there are now nearly a hundred. This shows how the Board has, so to speak, been built up. It is empirical, growing from without. Its local experience with regard to the Water Bills is startling, but instructive. In that instance we see the Board running on an errand to which it had not been sent. On this same question we have further to complain that the Board fails to do certain work which it has actually been called upon to perform. It has aimed on the water question, both by excess and defect. It has incurred an expenditure of £16,000 without result, and it has at the same time evaded its duties under the Metropolis Water Act of 1871. The error is a grave one. The Board may represent to the Government that its duties require to be re-arranged, or that some great public work requires to be carried out which it is prepared to execute. But when an obligation is cast on the Board, there is no choice except to fulfil it. The Board appears now in the aspect of a public servant which wishes to choose out of a hundred Acts of Parliament what it shall do, and what it shall leave undone. In the case of the Thames floods it goes yet further, and decides for itself how it shall do the work which Parliament requires to see accomplished. Mr. Cross seems in the case of the Thames floods to be willing to let the Board have its own way, not because he thinks that may the best, but because the Board will really work in no other. This, however, is a critical state of things for the Board, for the policy of self-will is never so dangerous as when it appears to succeed. It is necessary that the Board should be on good terms with the Government, and should show a readiness to comply with the [illegible] of Parliament.—This it has not shown of late, and it has managed on some occasions to be at variance with itself as well as with almost every other authority.

Notwithstanding its defects, the Metropolitan Board undoubtedly performs a vast amount of very useful work. Its recent conduct with regard to the Vestry of St. Luke, in respect to certain local transactions bearing on the purchase of private property for public purposes, also shows that the Board is anxious to keep itself above suspicion. That affair has ended satisfactorily, and no more need be said about it, except to commend the Board for its firmness on a matter of principle. Possibly, even in that instance, the Board went a little beyond the strict boundary of its functions; but the error—if one existed—"leaned to virtue's side," and may therefore be forgiven. In respect to the Artizans Dwellings

Act, the Board has a very responsible task to perform. The present report tells us that the Board has been called upon to consider the conditions and requirements of thirty different areas in the Metropolis, and to decide upon the course to be adopted in the case of each; "it being obviously impracticable, in view of the inconvenience of removing large "populations of the poorer classes simultaneously, to carry "into effect many extensive schemes in the same year." Of the thirty "representations" made to the Board under the Act, eighteen had been already dealt with before the end of 1878; that is to say, with regard to fifteen some kind of progress had been made, while three were considered as cases not suited for the Board to deal with, and the remaining one was that of the Holborn site, concerning which the Board and the Home Secretary were not agreed. On this subject of workmen's dwellings, it is worthy of observation that Mr. Liddle, the Medical Officer of Health for the Whitechapel district, expresses a fear that the operation of the fifth section of the Act will fail to confer the sanitary benefits expected from the statute, seeing that it contemplates retaining the working population on the old area, or close to it, thereby maintaining the population at its present density. It has been shown by Dr. Farr, that the atmosphere becomes deleterious in proportion as the population becomes more dense, that within certain limits this deleteriousness is expressed by the mortality, and that the mean duration of life varies according to the proximity of the individuals forming the population. In other words, the nearer people live to each other, the shorter are their lives. Hence Mr. Liddle contends that it is not enough to pull down and rebuild; it is absolutely necessary to "thin out" the population. "We have power," he says, "to prevent the "overcrowding of rooms, and we certainly ought to have power to prevent the crowning heights of houses on "sites of insufficient size for the healthy existence of the "inmates."

The only answer to Mr. Liddle's objection appears to be, that the structural nature of the dwellings has much to do with the health of the inmates. The working out of the sanitary problem depends not only on the extent of the area, but on the manner in which the area is occupied. But for this, the problem would in some cases scarcely admit of solution at all. It is already manifest that the practical application of the idea embodied in the Artizans Dwellings Act is much more difficult than was expected. It is much easier to pull down than to build up, and there are indications that the Act is being carried out after a fashion which for the present rather aggravates the evil it was intended to cure. The financial prospect, as depicted by Major Jones at a recent meeting of the Whitechapel District Board, is almost appalling. This gentleman states that six sites have been cleared at a cost of more than £734,000, and the sum offered for these amount to little more than £91,000, thus creating a loss of £643,000, the only set-off to which would be about £81,000, the value of the recoupment area which admirably set apart for workmen's dwellings, which the Board would retain. The statement seems almost incredible; but we fear that the case is sufficiently serious to justify grave anxiety. It cannot be deemed a sound principle that a lavish outlay should be cast upon the rates in order to provide dwellings for the working classes. Yet, unless this process is allowed to take place, there seems small prospect that the poor will be much the better for the Artizans Dwellings Act. We should be glad if this matter could be placed in a more cheerful light, for the necessity of re-constructing the "unhealthy areas" of the Metropolis cannot admit of denial, and we should like to see the Metropolitan Board dealing successfully with this important question. One hopeful feature, having a bearing on Mr. Liddle's objection, is, that in some cases the Metropolitan Board are able to provide for more occupants in the projected buildings than were accommodated in the old. Thus, in one instance 559 persons will take the place of 805, and in another 3600 persons will take the place of 1800.

The primary object contemplated in the creation of the Metropolitan Board, was the carrying out of a scheme of main drainage. This has apparently been accomplished, and yet there are complaints that all is not right. It is alleged that the sewers are not big enough, that the sewage is not altogether carried down to Barking and Crossness, and that at most an gross blither is a serious nuisance, by polluting the stream and silting up the channel. The perpetual growth of London gives rise to a state of things which accounts for some of these complaints. As for the alleged silting up of the Thames by the discharge at the outfalls, it is very difficult to prove that such is the case, so long as the volume of water going up and down the river seems to be larger than ever. Another of the great works executed by the Board consists of the cement embankments by the river-side. The Board regard this as a great work, and it is generally admitted to be worthy of the necessity in some districts—notably, in Lewisham and Brixton—and if these are not forthcoming within a reasonable period, there will doubtless be a very active agitation to obtain what is wanted.

In that part of the report which treats of the water supply, we find the Board stating that their scheme for the new supply, "on being first broached, seemed to meet with a good "deal of support on the part of the organs of public opinion," but the project "subsequently encountered considerable opposition outside the walls of Parliament," so that "the Board "came to the conclusion, in view of the disfavour with which "the scheme appeared to be regarded by most of the Local "Authorities of the Metropolis and others, not to bring it "before Parliament again in the following session." Concerning the Bill for purchasing the undertakings of the Water Companies, the Board perceived "the impracticability of successfully promoting in Parliament a measure affecting "interests of such magnitude, unless it received the support "of Her Majesty's Government." By the 10th of December last the Board learned that the Government did not see its "way to further the scheme" for buying up the Companies, and so the Board "resolved to proceed with it." The little difficulty which followed with regard to the coats of these Bills will doubtless occupy a few lines in the next Annual Report. In the present Report we find an acknowledgment of the fact that certain of the Water Companies are supplying the constant service system in parts of their districts. Four Companies are thus specified. Colonel Bolton, in his report for the month of May, speaks of six. More than three-fourths of the East London district now have the constant supply, and the system is being continually extended. There are seven Companies, the Companies who are not moving in the matter being the Southwark and Vauxhall and the Grand Junction. The Metropolitan Board, in Spa-ground Street, besides twelve in a district between Commercial Street and Hackney Road, and twenty-two in the district of the West Company. This is certainly an improvement on the practice of former years. It is also satisfactory to find the Board taking steps to utilize the hydrants which the Corporation are providing in the City.

Of the six Gas Companies in the Metropolis, we are told that three are subject to conditions imposed upon them by Parliament in 1875 and 1876, "which are more favourable "to the interests of consumers than those which previously "existed." One point is a source of trouble with the Metropolitan Board, and that is the difficulty of determining where the gas comes from in the different parts of the Chartered district, the mains being so connected as to mingle the supply from the different stations. This uncertainty might render it difficult to levy the statutory fine in the event of default in lighting power. Hence it was proposed to levy the fine at £25 per candle. To this the Chartered and the two other Companies concerned in the matter were willing to agree, providing the magistrate had a discretionary power to reduce the amount of the fine. The Board refused to confide in the discretion of the magistrate, and so are now told "the question remains unsettled for the present." The accusation pronounced by the *Daily Telegraph*, that consumers are often charged for an immaterial and impossible amount of gas, owing, of course, too late for the present report; neither do we expect that it will receive notice at the hands of the Board. The annual report is a carefully prepared document, distinguished by letting things alone as much as possible. Thus, a reference to the Water Companies is the sole allusion to be complained as to the levying of water-rates according to enlarged assessments. Credibly it is felt at Spring Gardens that if the water supply were transferred to the Metropolitan Board, the charge must necessarily be levied in accordance with the assessment. The Board would not even have the option which the Companies frequently exercise, of letting the old charge remain unaltered where there is no change in the tenancy.

The construction of new streets is an important chapter in the history of the Metropolitan Board. It is, no doubt, a troublesome business, environed with many tedious details in respect to the acquisition of property. There are critics who think that the Board might proceed more rapidly than it does, both in this and other matters. But greater speed would involve an enlarged Board, and, still more, an augmentation in the staff of officers. The fact that the business of the Board is increasing is indicated by the enlargement of the official premises at Spring Gardens. Another storey is being built, and some addition is being made laterally. The task assigned to forty-five gentlemen, of looking after the principal local affairs of more than three millions of people, must necessarily create a strain at certain junctures. The burden is not groaning lighter, although much has been done. A department is sure to make work for itself; but the Board has plenty of labour assigned to it. The most untoward part of the affair is that the Board should attempt to go out of its way to do the work of the Gas and Water Companies. For the present it may be content to leave both the gas and the water in the hands which have hitherto taken charge of these matters. The gas question has been pretty well settled by Parliament, and the water question has brought the Board into sufficient trouble already. So far as the gas supply is concerned, the Board may now carry on its warfare in a pleasant manner, by trying to develop the electric light. In this enterprise it has acquitted itself very creditably, thanks to the skilled assistance which it is able to retain.

Looking down the list of subjects with which the Board has to deal, we may marvel that they are all managed so well. In the case of parks, commons, and open spaces, the Board is promoting the public health in a manner that is eminently popular and pleasing. In the demolition of ledge cells it is accomplishing a great practical enterprise, which will work wonders both for street traffic and house property. Still more marvellous, should it ever come to pass, is the projected high-level bridge at the Tower, designed by Sir J. Bazalgette, and now under the consideration of Parliament. The obelisk of the Pharaohs—Cleopatra's Needle—is another trophy in the hands of the Board. But for the Embankment, whither would the monolith have gone? From bridges and the obelisk we proceed to the consideration of slaughter-houses, manure factories, and other unsavoury places, in the regulation of which the Metropolitan Board is preventing much public annoyance, especially in the more crowded districts. The diseases of cattle also receive the cognizance of the Board. The trade in explosives is a matter which concerns the safety of the public in a greater degree than is always apparent on the surface, and here again we find the Board exercising its protective power, as the local authority for regulating the manufacture, conveyance, storage, and sale of explosive substances throughout the Metropolis. Nearly two thousand premises for keeping explosives for sale were registered by the Board in the course of the year, and these have been periodically inspected and reported upon. The storage and sale of petroleum is a kindred subject, dealt with under an Act which the Board has long endeavoured to get amended. The Board is also the local authority for enforcing the Infant Life Protection Act of 1872, so far as concerns the Metropolis outside the City. There is much propriety in the suggestion that "institutions" where infants are kept should come under inspection, as well as the present registered houses. Some recent events show the necessity of such a provision.

A Board of Works cannot be kept going without money. The Metropolitan Board expended more than three millions sterling during the year 1878. Of this sum rather less than two millions was defrayed out of money raised by loans. The estimated expenditure for current purposes in the present year is over a million, of which more than half is for interest on loans and stock. The redemption of debt takes £213,000. The estimated income consists of a quarter of a million from the coal and wine duties, contributions to the amount of £31,000 from the Government and the Fire Offices towards the expenses of the Fire Brigade, and £101,000 in the shape of interest, rents, fees, and other miscellaneous receipts, leaving £681,000 to be raised by rate—an amount nearly equivalent to the interest to be paid on loans and stock. During the year the Board advanced, or agreed to advance, the sum of £200,000 in loans to Vestries and District Boards. "The "increased scope of the Board's operations" is mentioned at the close of the Report, with the encouraging intimation that although the work has thus grown bigger, "the consolidated "rate levied by the Board is still below sixpence in the "pound." What this amounts to, we have seen; and the growth of London, in magnitude and wealth, enables the Board to get more for its sixpence every year.

THE RETROSPECTIVE EFFECT OF THE GAS-WORKS CLAUSES ACT OF 1871.

SIR,—The question involved in the consumination of your correspondent "Glascow" on this subject, in your issue of June 2, say, I think, so far as its present position is concerned, be fairly taken as answered by your editorial note; but as it seems to me to be a subject of a very important character, and has been translated, up to now, unnoticed by your numerous readers, allow me, in such absence, to draw further attention to it, and for the reason that it appears to have a much wider range than simply affecting the procedure of gas companies and their equitable and legal rights, for the principle also applies to water-works, railways, reconveries, piers, and all undertakings which have been compelled to seek, and have obtained parliamentary powers. If I am correct in my views, the dictum of Justices Lush and Quain is on variance with our ordinary conception of equity. If, on the other hand, their decision be correctly over the Lord Chancellor, in making the Gas-Works Clauses Act of 1871 retrospective, has exceeded its functions and overstepped its bounds. In support of this view, allow me to make the following remarks:

A private undertaking requiring parliamentary powers, and consenting to submit to certain clauses embodied in a previously passed Act or Acts, applies for a special Act. Assume the Bill to have passed, and received the Royal Assent. It declares that the company "shall be a body corporate with *perpetual* succession and a common seal, and with power to purchase, hold, and dispose of lands and other property." Is not this, therefore, a right in the character of, if not absolutely a freehold; and, if so, can the Legislature, without due notice and consideration, take it, or any part of it away? In fact, is it unless with our common rights for a public Act, sitteous without notice, to annul or even to amend a private Act, without cause being shown that the undertakers had neglected to comply with the sections of their Act? In other way, where is the sanctity of a "Special Act" and its "perpetual succession"?

This there has been no error committed in the Act of 1871 by the introduction of clauses differing in significance from can be no doubt; but when it contains one clause in unison with the existing powers and usage of Parliament—namely, "That the provisions of this Act shall apply in every gas undertaking authorized by any special Act *hereafter* passed," this should surely be enough to prevent its being construed otherwise than as having a retrospective meaning.

Mr. Hatsell, Q.C., in the second edition of his very able work on "The Law Relating to Gas and Water," remarks: "There whose duty it is to administering the law very properly grant against giving to an Act of Parliament a retrospective operation, unless the intention of the Legislature that it should have so construed is expressed in clear, plain, and unambiguous language; because it manifestly shocks one's sense of justice that an act, legal at the time of doing it, should be unlawful by some new enactment." The Legislature has always strictly observed that liberals from the law, and whenever it is possible to put upon an Act of Parliament a construction not retrospective, the Courts will always adopt that construction." Further, your correspondent's illustration of giving an already incorporated person an exemption merely because the silvers of a new act have been place since his first constituted, is not only much to the purpose, but is clearly shows that the decision of Justices Lush and Quain is to be taken as a settlement of "this nice sharp quillet of the law," the "letter that killeth" (probably unknowingly) a most unjustifiable and unconstitutional act.

And, further, in support of this view of the matter, I would refer to the following twelve Acts of Parliament—namely, the Lands Clauses Consolidation Act, 1845; the Companies Clauses Consolidation Act, 1845; the Railway Clauses Act, 1845; the Gas-Works Clauses Act, 1847; the Water-Works Clauses Act, 1847; the Markets and Fairs Clauses Act, 1847; the Commissioners Clauses Act, 1847; the Towns Improvements Clauses Act, 1847; the Town Police Clauses Act, 1847; the Cemeteries Clauses Act, 1847; the Telegraph Act, 1863; and the Railways (Ireland) Act, 1851—we find that they all carefully, clearly, and decidedly state that they shall extend only to such works, &c., as shall be authorized by any Act of Parliament *hereafter* to be passed. Again, as in the case of the Water-Works Clauses Act, 1863, and the Railway Clauses Act, 1863, it is distinctly exercised it was to be incorporated "to any special Act which shall hereafter be passed."

Although it has been written that "a little learning is a dangerous thing," I hope you and many readers will excuse it by citing a quoting of the law; but the question raised was, in my opinion, so fraught with importance, not only to gas undertakings, but to the general public, that opinion appeared in unison with the exposition of giving it, especially as my quoted work says: "The opinion of the writer is that the Act of 1871 is only to apply to such companies of Parliament have been established since the date mentioned subsequently to 1871, selected its proceedings will be brought clear gas undertaking had been authorized by their subsequent special Act."

If your readers feel disposed to have a little historical episode of this parliamentary morsels—this controversies—I refer to the Journal of Gas Lighting, &c., they will find it in the 1871 volume of your Journal, pp. 216, 291, 371, 387, 388, 428, 461, 501, and 549; but we of no moment, I shall only venture to extract three from, trifling as they are, to show that the spirit of your late respected Editor (Sir. J. Clegg, Barbar), and the deference of the petition presented against the original Bill, was that the Act never was intended to have any other than a prospective effect:—

(Vide "Circular to Gas Companies," March 28, 1871.)

"We print this Bill in extenso in another column, and may produce its remarks we have to make on its provisions with more propriety. It although ostensibly intended to enable gas companies to sell their gas by meter, or otherwise, it will, nevertheless, be found to have much wider bearings than any Special Act or by any Act hitherto introduced into any Parliamentary Session, for in many instances where they apply for further powers, it is probable that they will insist on them being inserted in the Bill, therefore it is desirable that every gas company should carefully peruse the provisions of the Bill, as we have said, it is sure to affect them."

(Vide the petition on page 501, Vol. XXI.)

"Your petitioners fully admit that the Bill does not propose that clause in the Act of 1871 should be made applicable immediately to all existing companies; but, nevertheless they are of opinion that as it is the practice of Parliament to impose upon new or existing companies any new conditions which they may apply for further powers, it is probable that the clauses in question will, if the Bill be allowed to pass into a law, become a fair and reasonable subject to be introduced into a local power against its receiving the sanction of your Honorable House."

2, Great George Street, Westminster, June 23, 1879. EDWARD SAUNDERS.

THE AMERICAN GAS LIGHT JOURNAL AND CHEMICAL REPERTORY.

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WEDNESDAY, JULY 16, 1879.

The Contest of the Gas Companies.

Those of us whom the present appears clearly as the more bridge between the past and the future find greater cause for congratulation in the recent speech declared war whilst less broken out so suddenly and so vigorously between the gas companies, than in the welcome fact that gas bills are certain to be reduced. In the first place, the final cost of gas is going to be made cheaper, for that the dollar will be able to understand a while the contest is evidently going to be of such a vigorous character that the noise it will make must excite the attention of even the most apathetic.

The spectacle, too, of these great corporations contending for the endowment of their power to tax the community will be a most instructive sight. Already society is beginning to feel that the destiny is something more than simply serving as an exploitation ground for corporations. We are no longer in the days when the hallow-day was an inquisition upon the gaze of the stick brook and the force of innovation was supposed to have reached its limit. A community like New York has become a thing of importance in the world, and recognizes that it is entitled to a share of progress but on account of its client usage to first cost. It is the best promoter of order, security, and peace there is. Put a gas light in a city's blind alleys and they cease to be the lurking-places of vice and crime. They are no longer blind alleys.

Our very language recognizes the moral power of light, and an enlightened community, to be really such, must maintain it in the public places in as much as in social and industrial institutions. We do not usually fit it as an objection to be too unobstructed for the service it requires us to be favored with. It is like an ocean to be favored for ballast, and certainly will not injure itself for its betters.

The perfect organism is made up of a combination of organs, each performing its functions, not to each other's injury but to their natural benefit. That the social body has not yet arrived at its perfection in this regard is the very context of the gas corporations shown, with some of us who can remember a few years back how harshly some of those companies disregarded the reasonable request of their workmen, as surprised at seeing them to-day overtaken by the Nemesis that regulates such matters.—*N. Daily Graphic.*

Correspondence

[We are not responsible for the opinions expressed by Correspondents. Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—Ed.]

Sugg's Large Burners.

The American Meter Company has received the following from Sugg, which answers many anxious inquiries:

VINCENT WORKS, VINCENT STREET,
WESTMINSTER, June 27, 1879.

AMERICAN METER CO.—Gentlemen: I am in receipt of your two letters of the 16th inst., and much regret having been compelled to delay sending off your orders. As you will perceive from the inclosed invoice, a large parcel of burners, etc., have been sent off. I have had such a treadmillous run on 60-candle burners that I found it impossible to get more than four ready by the time the cases were ready for shipment, and did not wish to keep some here any longer, knowing how pressed you would be for the goods. I can well understand how unpleasant it must be for you to have been kept so long without the burners, and should have been only too pleased to have supplied you with five times the amount if it were possible. I have been very much engaged lately in professional work, which necessitated my absence from town and from England for nearly three weeks, but I forward also lithographs of large burners and bat forms, of which the globe lamp is my latest design. I hope to advise you shortly of having despatched another parcel, completing your orders. I think it would be well if you would impress on your patrons that the new lighting system being, so to speak, in its infancy, it is perfectly impossible for me to quit off more work than I do at present without running the risk of turning out inaccurate and shoreuly work, which would only result to damage my interests more than the delay in the delivery of orders. You may rely on me using diligence for the future. I am working my hands nearly day and night now, and hope to send on all the rest of your orders very shortly. I am, dear sirs, yours very truly,

WILLIAM SUGG.

Clinging Retorts.

Mr. Editor:—Now that the electric light agitation has somewhat subsided, it may not be amiss to discuss one of the means whereby the gas consumer of to-day is enabled to cheapen the manufacture of gas, as well as to increase the production of the same from a given amount of material.

By what system of charging retorts can the best results be obtained? is a question of importance to many of your readers, and one which, perhaps, every manager has satisfied to his own satisfaction, but which, as a matter of interest to all, may bear a little ventilation. The systems of charging in actual operation are, as is well known, chiefly the shovel and the charging with the scoop. Both systems have their advocates, but, which is unquestionably the best? That is the question which might be very profitably discussed. In charging with the shovel, from the fact that the shovelful of coal is thrown into the retort until it is closed, gas is wasted; and no matter how experienced the workmen may be who handles the shovel, the coal can not be charged so slowly as when the scoop is used by men who know how to use it. Nearly two years ago your correspondent introduced the use of the scoop in a works where for over twenty years the retorts had been charged with the shovel. The men were very expert in the use of the shovel—some could be more so; yet the result is justified—that the same men, using the same kind of coal and the same benches of retorts, now carbonize 26 per cent. more coal per retort in 24 hours, and get over 16 per cent. more gas out of the coal. Of course there was violent opposition to the introduction of the scoop. "It was tried before, and could not be done." "Our retorts are not large enough," etc. In fact, all conceivable objections that could be made were made; and as it will be in the case of every superintendent who may try to introduce anything new to save labor in his works. But let all who have at least three men employed about the works try the scoop, and try it under their own supervision, with proper scoops, and in a way that they should be handled; and although their gain may not be as large as ours actually was, they will nevertheless gain enough to repay them for the trial.

Some years ago your correspondent was given charge of a large retort house, in which all the work soon had gone on stolen. Having been given authority, he engaged new men, nearly all of them having never seen the inside of a retort house. Within two days therefore that company's district was well supplied with gas, although just before that time there was not enough gas on hand to light up the works. There were some 90 benches under fire. One week after this time his regular number of benches only were needed. Had the system of shovel charging been used then, the men could not have learned quickly enough to do the same.

There is another system of charging retorts which deserves far more attention, especially for large gas companies, than it seems to receive. This is charging retorts by machinery. Your correspondent had the good fortune to come in daily contact for nearly a year with a machine now for drawing and charging retorts. The machine was constructed by Mr. T. Z. Rowland, of Green Point, N. Y., and was run at the works of the New York Gas Light Co. Although, in the opinion of your correspondent, this machine was too complicated as then constructed, it seemed to him that Mr. R. was on the right track to success in this matter. By removing a few of the unnecessary parts of the machine—the ones that always gave the most trouble—and by substituting a simpler device, which was known at the time, and also by letting practical gas men, not merely good mechanics, run the same, it might now be all it was hoped it would be, and might spell some of the calculations of the electric light people. The machine charged the coal into the retort evenly and quickly, and, supposing the present requirements of the retort were used in connection with this machine (which, by the way, is saving in labor to large gas companies would probably not fall short of 60 per cent. It may be to the interest of all the larger gas companies to try and induce Mr. Rowland to finish and bring out his machine. Meanwhile let those who are not now using prejudiced give the reasons why, in their opinion, shovel charging is to be preferred, and thereby enlighten, undoubtedly, many of your readers. Yours truly,

Norfolk, Va. FREDERIC SOZER.

Shoftpville (Ind.) Gas Light Company.—

On the 7th inst. the following gentlemen were elected officers of the above company: John Hensley, President; George H. Dunn, Vice-President; A. J. Gorges, Treasurer; and G. W. EDE, Secretary.

Prices of Gas Coal.

Penn and Westmoreland,	$4.50 at New York	
"	2.50 at Baltimore.	
"	3.75 at Philadelphia.	
Dungurl,	1.25 at New York.	
Newburgh Orrel,	2.50 at Baltimore.	
Murphy Sun,	3.50	
Fairmount,		
Cherryvale & Oil,	4.00 at New York.	
Shovel,	2.25 to 2.50	
Pittsburgh Peerless,	2.50 to 2.75 York.	
Cannelton Cannel (by cargo),	2.25 at New York.	
Splint,	2.00	

The above prices are about $1 per ton below those of 1878.

GAS ENGINES.—The introduction of gas engines, says the *Engineer and Mining Journal*, has attained to remarkable dimensions in Germany and England (especially), where engines of this class, as high as 20 to 30 horse power have been built. Mr. Robert Grimshaw, reporting upon a recent visit to the Manchester Jubilee, Bazaar, notices that 5 to 6 horse power gas engines, for a land-agar factory, are in course of construction there. The gas companies, in view of large consumption, furnish gas at very reduced rates for such engines.

Fuel-Gas from Water.

Much attention has recently been directed to the Lowe & Strong processes for producing a cheap gas by the decomposition of water, which in the form of steam is brought in contact with incandescent carbon. The experiments that have lately been made in London and Boston have been attended with favorable results, and several scientific men, sense of this government officials, declare "that the gas can be readily employed for welding wrought iron, for smelting in crucibles as well as pig iron as the only fuel necessary in all those experiments have been very satisfactory as to the heating power of the gas. Only a few days after land, we can confirm the above, and it is in the employment of the gas for cooking purposes a most extraordinary saving in the household department, and that the cleanliness and convenience of its use must make it a favorite with all housekeepers."

The gas was used in a small baking and roasting stove, which required a gas consumption of only fourteen feet per hour, to maintain a heat heat of 250° and upwards.

For illumination the gas was conducted through a vessel filled with cotton saturated with benzine, and the result was eminently satisfactory.

Great Reduction in Rates.

NOTICES ISSUED BY THE NEW YORK GAS LIGHT COMPANIES.

OFFICE OF THE MANHATTAN GASLIGHT COMPANY,
No. 4 Irving Place, New York, June 27, 1879.

The Manhattan Gaslight Company respectfully informs its consumers and the public generally that on and after this date the price of gas furnished by this company will be at the reduced rate of 20 cents for 100 cubic feet to all who consume less than 10,000 cubic feet of gas per month. To those who consume 10,000 feet per month the price will be 19 cents per 100 cubic feet, or $1,90 cents per 1,000. To larger consumers a still greater reduction will be made, the price depending upon the quantity supplied. Having availed itself of all known improvements, this company will continue to furnish in the future, as it has done in the past, as pure, as good, and as desirable a light as can be obtained by any process yet invented or discovered.

JAMES W. SIMPSON,
Secretary. GENERAL ROOME,
President.

OFFICE OF THE NEW YORK MUTUAL GASLIGHT CO.,
26 Union Square, New York, July 1st, 1879.

The New York Mutual Gas Light Company has this day reduced the price of gas, and from and after this date the price of gas will be as follows: To consumers of less than 10,000 cubic feet, per month, 20 cents per 100 cubic feet, or $2 for 1,000 cubic feet. To consumers of 10,000 cubic feet, per month, 19 cents for 100 cubic feet, or $1.90 for 1,000 cubic feet. To larger consumers a still further reduction will be made.

THE NEW YORK GAS LIGHT COMPANY,
By WILLIAM H. WEBB, *President.*

Gas Companies and Electric Lights.

The following letter from Mr. Edison to the Secretary of the Manhattan Company, and the reply of the latter, will be read with interest:

MENLO PARK, June 30, 1879.

DEAR SIR,—I have the pleasure to inform you that I have succeeded in producing a perfect electric light, which is not only steady, but can be subdivided to any desired degree of feebleness, and which is entirely free from odor, smoke, or any injurious effect. It is also cheaper than the light from gas burners of equal illuminating power. I shall be ready to introduce it as a practical illuminator in the course of next winter. Before doing so, however, I desire to make such arrangements with the gas companies as will prevent any injury to their interests. I am aware that the introduction of my system will involve the abandonment of a large amount of gas fixtures, and that the companies will be subjected to a heavy loss in consequence. I propose, therefore, to pay the companies a royalty sufficient to cover this loss, and I shall be glad to know whether your company will be willing to enter into such an agreement with me. Yours truly,

THOMAS A. EDISON.

NEW YORK, July 2, 1879.

DEAR SIR,—Your favor of the 30th ult. is received, and I am directed by the Manhattan Company to say in reply that they will be glad to see you at the office of the company at your earliest convenience, when they will be pleased to hear from you in regard to the introduction of your system of electric lighting, and to make such arrangements with you as may be mutually satisfactory. Yours truly,

WILLIAM H. WEBB, *President.*

THOMAS A. EDISON, Esq., Menlo Park, N. J.

Fuel-Gas from Water.

Much attention has recently been directed to the Lowe & Strong processes for producing a cheap gas by the decomposition of water, which in the form of steam is brought in contact with incandescent carbon. The experiments that have lately been made in London and Boston have been attended with favorable results, and several scientific men, sense of this government officials, declare "that the gas can be readily employed for welding wrought iron, for smelting in crucibles as well as pig iron as the only fuel necessary in all those experiments have been very satisfactory as to the heating power of the gas. Only a few days after land, we can confirm the above, and it is in the employment of the gas for cooking purposes a most extraordinary saving in the household department, and that the cleanliness and convenience of its use must make it a favorite with all housekeepers."

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JAMES W. SIMPSON,
Secretary. GENERAL ROOME,
President.

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THE NEW YORK GAS LIGHT COMPANY,
By WILLIAM H. WEBB, *President.*

consumers a reasonable reduction from above prices will be made. Service pipe, meters, and burners will be supplied on application, without charge. This company has availed itself of all improvements in the manufacture of pure, safe and economical gas, and claim for it great superiority over any gas sold in the city. We solicit a continuance of your patronage, and that of all your friends, assuring you and them of prompt attention and courtesy.

CHARLES PLAGE, *Secretary.*

The following burlesque "ad." appeared in the daily papers on the day after the Manhattan's announcement. Who paid for it?

TO CONSUMERS OF GAS.—GREAT REDUCTION IN PRICES!!

OFFICE OF THE MANHATTAN RIBS LIGHT CO., }
RIP VAN WINKLE PLACE, NEW YORK, June 17, 1870. }

This company respectfully informs its customers and the public generally that for the past 40 years it has endeavored to supply them with light, and by the arrogance and incivility of its officers to maintain a monopoly of the lighting business. As many company having recently started to supply a gas, said to be made from water (?), this company finds it necessary, in order to try to maintain its monopoly, to reduce the price of gas, and therefore to simplify its business and to make it really understood by its customers, it has from this date adopted a scale of prices, 42 in number, so arranged that a consumer of 9,000 cubic feet of gas per month will be compelled to pay more than a consumer of 10,000 cubic feet, and so on, with a still greater reduction to larger consumers, on the principle that the poor man should always pay more than the rich man for the necessaries of life. The officers of this company having made themselves masters of the gas business some 25 years ago, feel confident that they have all the improvements that existed then, and also feel sure that no improvements of any kind have since been made in the science of making gas or in any other science, and they will always in the future, as in the past, furnish the best light that can be made by any of the processes which were in vogue 25 years ago.

PIPP-FAPP-POOH, *Secretary.* GENERAL ROOME, *President.*

OFFICE OF THE MUNICIPAL GASLIGHT COMPANY, }
Nos. 358 & 360 FOURTH AVE., July 1st, 1879. }

Bills rendered by this company after the 1st of July, 1879, will be made at the rate of 22 per 1,000 cubic feet per month. When 10,000 cubic feet has been consumed during the month, a discount of 5 per cent. will be made from that price, and a greater discount to consumers of larger quantities. The municipal company's gas is from 20 to 30 per cent. cheaper to the consumer, at the present price, than the gas of the Manhattan company. To say nothing of the 40 per cent. more light given by the Municipal gas, which is 22 candle power against the Manhattan's 16 candle. The Municipal company trusts that the public will will not lend its support to the Manhattan company in the futile effort now being made by them to crush out the opposition companies (which companies have brought about a reduction in the price of gas to this city and its inhabitants) for the purpose of regaining the monopoly so long held by them; and, therefore, appeals to all its customers and the public generally to support it and not to be tempted by the offers of the Manhattan company to sell gas at far less than it costs to furnish it, a proceeding which must lead all thinking men to the conclusion that its object is to obtain some selfish end.

PHILIP ALLEN, *Secretary.* CHAS. G. FRANKLYN, *President.*

OFFICE OF THE NEW YORK GASLIGHT CO., }
157 & 159 HESTER STREET, NEW YORK, July 1st, 1879. }

The price of gas supplied by this company, on and after this date, will be as follows: *For less than* 10,000 cubic feet per month, the price will be $2 per thousand. For 10,000 feet per month a discount of five per cent., and for a larger quantity per month a further rebate will be made.

GEORGE W. DOANE, *Secretary.* THOMAS N. LEES, *President.*

INTERVIEWS BY HERALD REPORTERS.

In an interview had with a *Herald* reporter General Roome, the president of the Manhattan Gas Light Company, who began the present war of retrenchment, gives another view of the cause for the present movement. The public will probably care but little about the real or imaginary causes of the quarrel among the gas purveyors, so long as they get good light and cheap rates, or have the prospect of performing their household cooking cool, cinders, ashes, and the better and no inconsiderable item of servants' wages. Yesterday a *Herald* reporter paid a visit to all the gas light companies in the city, and the result of his tour, printed below, will be found of interest to every gas consumer.

GENERAL ROOME'S EXPLANATION.

General Charles Roome, president of the Manhattan Gas Light Company, was called upon at his residence in West Fifty-second street, where

the gentleman was confined by a slight illness. "In the absence of data, which are at the office, I will tell you all I can," said he, "about the reduction in the price of gas made by the Manhattan Company, and the causes which led to it."

"What is the extent of the reduction?"

"The extent of the reduction which went into effect on the 1st of July varies. To the largest consumers we sell gas at $1.25 per 1,000 cubic feet, and the prices vary laterzaddicatly according to the quantity of gas consumed. To the more exact, the price of gas to those who consume less than 10,000 cubic feet per month is $2 per 1,000 cubic feet; to those who use the latter amount and over per month it will be $1.90 per 1,000 feet, and still further concessions are made in the case of large consumers, until the minimum rate I have spoken of is reached."

"How many consumers has the Manhattan Company?"

"About 27,000."

"Has the introduction of the electric light had any influence upon your company in making these reductions?"

Mr. Roome replied contemptuously and quickly, "The electric light has had nothing whatever to do with the matter. I do not think the electric light worth a moment's consideration."

"What are the causes, may I ask, which have led to the reduction?"

"I will tell you what the policy of the Manhattan Gas Light Company has been, and then the subject will be better understood. I have always been in favor of selling gas at as small a profit as possible consistent with a fair degree of profit to our stockholders. Since my connection with the company, which began in 1836, we have reduced the price of gas from $3 per 1,000 cubic feet to $2.00. Having no opposition when the war broke out, the increased cost of all materials and the enhanced value of labor compelled us to advance the price. There was also at that time the government tax of 25 cents on each 1,000 cubic feet of gas made. The increased rate at that time was from $2 to $3 per 1,000 feet. And now I will inform you of a fact which has never hitherto been made public. Mr. James Brooks, then a member of Congress from the Eighth district of this city, at my request urged upon Congress the propriety of the abolition of this tax. It was done upon giving him my personal pledge that the consumers of gas should have the benefit of the change. We at once reduced the price to $2.75. Afterward we reduced it twenty-five cents per 1,000 feet, making the cost $2.50, at which rate it remained up to the 1st of July."

"There have been complaints against your company in the past," the reporter remarked, suggestively."

WAR TO THE KNIFE.

"I will recite some of the facts of the past. Years ago the Manhattan Gaslight Company made a contract with the city by which we agreed to lay pipes wherever the authorities might direct. At that time the resolutions authorizing the use of gas by the Corporation were passed by the Common Council, the work under their provisions being carried out under the direction of the Superintendent of Lamps and Gas. Under that contract we were to light the street lamps for a price then agreed upon for a period of twenty years. The city required the company to lay pipes in streets where we could have no inducement to go, because the amount of private consumption would be very small. A large part of the money thus expended has never been remunerative to the company. We have laid pipes and lighted every street in our district, extending from Grand to Thirty-fourth street, and, before the Metropolitan Company went into operation, as high up as Central Park. Three more opposition companies have been chartered and obtained the consent of the city to lay pipes wherever they pleased on the Island. Two of these companies are under no restriction whatever as to

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tured by either of the others, and that its illuminating power is reduced to effect."

"Do you think the electric light will ultimately supplant the illuminating gas?"

"I do not. The electric light is costly and unsteady. The [illegible] however, when it may be made available for purposes of display for large open spaces. Up to this time we have no reason to expect that [illegible] ever come into general use. In Paris, during the Exposition, it was [illegible] times as much as gas, and was unsatisfactory. Paris paid [illegible] use during the exhibition, because it made an attractive display. [illegible] don it has been lately tried to light the banks of the Thames, [illegible] count of its great expense they have abandoned its use."

THE NEW YORK COMPANY'S OBJECTION.

At the office of the New York Gaslight Company, in Hester street, the reporter found Mr. George W. Doane, the secretary. "Our company," he "supplies the district below Grand street from river to river. [illegible] now charges is $2 per 1,000 cubic feet. The subject of a reduction in the price of gas furnished to our consumers was agitated before the [illegible] July, and would have been acted upon before the present time, except that many of our Board of Directors are in the country and it has been impossible to convene a board meeting."

"Will you reduce the price?"

"I have no doubt whatever of it. A meeting will be held to-morrow for the purpose of taking steps toward putting into effect a reduced scale of prices. The Edison light induced the company to make a reduction."

"Edison has had nothing whatever to do with it. Competition at times have influenced the change. The reduction to be made by our company will date from 1st of July."

"What will be the extent of the reduction?"

"I cannot at present state. When it is made gas will be cheaper than ever before been in this city."

THE MUTUAL FALLS IN LINE.

"The Mutual Company," said Mr. Charles Place, its secretary, leaned back in an easy chair at its office in Union Square, "contemplates a reduction in the price of gas furnished its customers some time after the Manhattan Company put the start of us. We have made a reduction, however, since the Manhattan Company announced its intention. The directors will meet to-morrow to make still further reductions. In other words, we shall adopt a sliding scale to apply to large consumers, the purpose to sell gas as cheaply as any other company in the city."

"How many consumers does your company supply?"

"We have about 18,000 customers on our books."

"What are the influencing causes of the reduction?"

"The action of the companies in reducing the cost price of gas is caused in consequence of the spirit of competition and the lessened cost of material and labor."

"Has the electric light had anything to do with it?"

"Not a particle."

"Is it possible for the Edison light to compete with the gas companies in furnishing illumination to small consumers, as it were?"

"It has been demonstrated that it cannot. That fact has been ascertained. We have in use now a sliding scale. We sell to those who use 10,000 cubic feet a month at the rate of $2 per 1,000 feet; [illegible] who use 10,000 cubic feet during the same period we sell at the $1.90, and to larger consumers a liberal discount in prices will be made. The revised schedule to be prepared will apply more particularly to consumers, such as institutions, hotels, theatres, and similar places. The proposed reduction will make it an object of economy for people [illegible] use of gas for cooking purposes. It will work [illegible]

[illegible] Company will not be so low but I can satisfy my self that the [illegible] now paid by a part of the town is paid by the whole town. [illegible] during those hours when the [illegible] At present the [illegible] of the street lamps are extinguished. [illegible] [illegible] [illegible]

raised, renders it of great value as a fire engine in country mansions and other isolated building, where it can also be used daily for pumping, lifting, it can also be used daily for pumping, lifting, laundry work and ventilating. The gas engine appears to offer to architects a way out of the difficulty they have hitherto found in efficiently ventilating buildings for want of a suitable motor. In crowded rooms fresh air can be drawn in from the most suitable side of the building according to the season, those of day and locality, by means of a fan, and diffused and distributed where required without producing draughts, which are only a discomfort primitive, not to say barbarous, method of ventilation still in use.

[illegible] given to proper ventilation, [illegible] the want of success in the [illegible] mechanical difficulties [illegible] creditable to such a [illegible]

The destruction by fire of [illegible] buildings recently has been ascribed to the presence of a steam boiler on the premises. The danger from fire by starting or keeping the hot ashes is greatly increased when the boiler is placed on any story above the ground floor. So great is this danger that the insurance rates are often as high as to preclude the use of steam boilers by the tenants in the higher floors of a building, and often leads to the exclusion of steam power altogether on the part of the owner. This prohibition of the use of steam power has proved to be a great tax on many small industries, and in the working of crimes and holes in warehouses in London and other places where the cost of working hydraulic engines direct from the mains is too great to admit of their use. The want of a suitable motor to work in the upper floors no longer exists, as gas engines, working up to 10 horse-power, can be applied without any more risk or trouble than accompanies the use of a steam engine without a boiler.

With respect to the comparative economy of working small steam engines and gas engines, this depends chiefly upon the relative prices of steam and of coal gas. Taking the price of coals per ton, and that of gas per one thousand cubic feet in some towns in the north where coined gas is used, the relative prices are two to one, while in London they are as five to one, so that the cost of working were the same for gas and steam in Manchester, the cost of working in London would be over 50 per cent. in favor of the gas engine, a slightly smaller quantity by volume of gas being required for a given amount of work when rich coined gas is used.

The Otto gas engine is said to require not more than 23 ft. of gas per indicated horse-power per hour. At London prices this is equivalent to about one penny per hour, and therefore, working at the same cost for coal and time, would take the place of one horse power per hour. This appears at first sight a very extravagant rate of consumption even for a small steam engine, say under eight horse-power. But as the superior economy of the gas engine has been repeatedly proved where it has worked side by side with a steam engine, it may be as well to inquire into the cause of the extravagant cost of working in many small steam engines. These are used for many purposes where the resistance is very irregular, the power required varying, perhaps, from one to eight horse power. In a very great number of small steam engine and boilers over, say, four or five years old, the amount of steam lost by leakage at joints, taps, glands, slide valves, and piston rings, forms a large proportion of the quantity of steam generated, and the further great quantity of heat lost through the chimney, and by radiation from the furnace, boiler, and pipes, leans a not inconsiderable proportion of that utilised. As this waste is a pretty constant quantity, whether the engine is giving off one or eight horse power, it follows that the amount of fuel used is not at all proportionate to the power developed. When the engine is indicating two horse power, almost as much fuel may be used as when it is indicating six horse. With a leaky safety valve and steam stop valve it sometimes requires a considerable quantity of coal to raise steam and keep it up a few hours at the working pressure even with the engine at rest.

We grant this state of things is disgraceful, but we are speaking of things as we have too often found them, and not as they ought to be. There is little hope for improvement in this matter with many small steam users. As long as they have a boiler which furnishes them with a means of making up for the waste of steam and heat by wasting more coal, they prefer doing so to being at the expense of having their boiler fittings and engines put in good working order. There are thousands of small boilers and engines at work, upon each of which the judicious outlay of a few shillings annually in necessary repairs would yield a return of as many pounds.

In the case of a steam engine and boiler in fair order, and doing intermittent work, there is always a considerable loss in getting up or maintaining steam. With the best forms of gas engines the case is very different. When the engine is in fair order, the quantity of gas used is always in proportion to the power exerted. A certain volume of gas is drawn from the meter just when it is required. Should the engine not be in good order, and there be an escape of the expanding gases past the piston rings, there will be a waste and loss of power, and more gas will be required, but this has seen trenches to built. An engine only of the Otto type cannot use more gas than the quantity corresponding to its maximum power. Such an engine, working up to within 25 per cent of its greatest power, cannot waste more than 25 per cent. of the greatest amount of gas it is designed to use. When the piston rings require renewal, the defect is made manifest by the escape of the burnt gases, and in order to regain the power which the engine loses in consequence, the rings must be renewed, and as economy is mercifully forced upon the user. In a steam engine, on the other hand, the waste of steam in escaping past the piston is easily made up by burning more coal, and this waste is only limited by the quantity of air that can be made to pass through the fire-bars. The above consideration will serve to show why it is always economical to spend a certain sum in order to keep steam engines they have replaced.

Besides the economy in fuel that there is also a great saving in attendance where a gas engine is used, as there is no stoking and continuous expenditure of time and attention. When all is ready, the engine can be started up and left and started from the meter can be locked up and left to itself for hours like a steam engine. The benefit in use of the gas engine was strikingly illustrated in the Royal Albert Hall, at the recent exhibition of electrical light apparatus, by the course of the current, the engine in the body of the hall upon a seven signal was started from a state of rest, the bell slipped on to the pulley and the light produced, all in a few seconds. The engine might be left for a week or more and the same thing repeated without any preparation.

Gas engines may be often used with great advantage as auxiliaries to large steam engines. In many works a steam engine of over 30 horse power is run all night to drive a long line of shafting in order to work a small machine requiring not more than a couple of horse power. The loss in coal, attendance, and wear at tear is often very great when this work is often repeated. By using a small steam engine the evil is only partially remedied, as the friction has to be in attendance. For most such cases, gas engines have been applied with great advantage, as the man who attends little attention can start the engine and give the little attention it requires, and the cost of working is reduced to a minimum.

It is, however, in connection with small industries that gas engines will most likely engines be found in the future. Where steam is required for heating, boiling, and other purposes, the steam boiler will always look its ground, but for many minor industries we may say that the days of small steam boilers are numbered.—*Engineering.*

GAS ENGINES.

At a congress in Brussels, in 1857, of the chief engineers of the French and Belgian navies, plans for inspecting steam boilers, it was the opinion of the meeting that steam engines are not the motors for small industries. The reasons given for this opinion were that small boilers are difficult to examine, their repairs are very costly, and their life is comparatively short. It was agreed that the small motor of the future is to be found in electric, hot air, compressed air, hydraulic or gas engines. The last mentioned was justly regarded as that which has not yet fulfilled its promise.

It is only natural that the stringent laws which regulate the application and working of steam boilers on the Continent, should tend to the effect of increasing the cost of power, and to encourage the use of motors which come under lands governing more inspection with its severe tests and penalties, but we were scarcely prepared to find boiler engineers going, we might almost say, out of their way to advocate the use of gas engines, as it is evidently against their interest, in some measure at least, to do so.

Notwithstanding the favorable opinion of gas engines entertained by steam-boiler engineers on the Continent, there still exists a very strong prejudice against gas engines among engineers in general on this side of the Channel. This prejudice arose from the failure of the first gas engines introduced from France some time ago. Those engines were wrong in principle. It was overlooked by their inventors that the sudden but momentaneous pressure consequent upon the explosion of a strong mixture of coal gas and air exerted against a piston, was not so suitable as the sustained pressure of steam for obtaining a steady motion of a crank and fly-wheel. To this oversight as well as to a considerable amount of complication, necessity for skilled attendance, trouble from heating and accumulations of working, the failure of these first gas engines was mainly due. There is still about it amongst the engineers of this country, but most of those who work have been abandoning the converted steam engine, a change which their construction readily admitted.

The defect in principle has been entirely removed in the gas engines of the present day, of which we have given a description from time to time as they made their appearance.*

Nearly all the drawbacks attendant upon the use of steam, especially for small powers, are due to the risk, attention, and anxiety inseparably connected with the use of the boiler, and it must have occurred to many steam-users what a blessing it would be if the steam engines could be used without a boiler. Now, it is just this desideratum that a gas engine is designed to meet, and the success which has attended the introduction of at least one type of gas engine, renders it easy to predict with certainty that a large new field will be opened out for the employment of motive power; that many small industries will be greatly developed and extended and new industries created, now that a cheap motive power can be employed without the risk and trouble of having a steam boiler on the premises. For instance, the advantage of being able to start a gas engine at full power by lighting a jet and turning the flywheel, instead of having to wait till steam is

* *See Engineering*, vol. xx., pp. 314, 515; vol. xxiii., p. 127; vol. xxvi., pp. 158 and 321.

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How Much will a Locomotive Pull? Methods of calculating the working power of locomotives.
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II. METALLURGY.—Relations between the Chemical Composition and the Mechanical Properties of Steel. By V. DESHAYES.
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July 11 1878

GAS BURNERS.

Among our Meterites will be found a notice of a new English burner, consisting of two flat flame tips placed so as to maintain the flames in a parallel position close to each other. This expedient will remind our readers of the Paris burner illustrated in our last issue. To our mind there seems quite a field for ingenuity in the construction of new burners, or in using combinations of batswing tips. Mr. Wigham has adopted this method with great success in his lighthouse burner. The general rule is, that the more gas is burnt in one flame the better candle power per foot is obtained, and in no way can this end be obtained at the cost of so little trouble and expense as by joining together a number of those burners that we already possess. Mr. William Farmer, of this city, supports the theory enunciated in the well known "Farmer's Theorem," that the illuminating power varies in proportion to the square of the amount of gas consumed. This is yet open to discussion, but the general principle holds. The patentees of the duplex burner claim that 25 or 50 per cent. of gas is to be saved by its use; this, of course, must be taken with a grain of salt. Their idea, however, is an ingenious one, and deserves investigation. It would be interesting to try the effect of a third or fourth flame upon the result, placing them parallel or at right angles, thus IIII, or thus III. Burners have been constructed so as to give a flat flame on the Argand principle. It was about the shape of a domino, but thinner, placed on edge. It was hollow, to adm of the passage of gas, and perforated on top with a nu ber of holes. A chimney was, of course, required. A combination of such burners as these might be arranged so as to produce good effects. The principle in all these cases is to make the flames by their closeness to each other add to the degree of heat, one flame helping along the other, so that the separated carbon is heated to a higher temperature. Mr. Sugg in his new multi-ring Argands does the same. To insure a good draught the Paris gas engineers placed two glass cups below the burners. If the result was well attained this was a very valuable feature. The chimneys used on Sugg's immense burners are very apt to crack. At the present time, in this country, the effort—and a very laudable one, too—is to bring down the cost of manufacture of gas. The next thing for us to attempt, and it comes very gracefully from a gas company, is to enable the consumer to obtain more light for his money. One of the great ways of attaining this result is by giving them better burners and globes. Why should not some of our gas engineers study out these questions themselves, instead of leaving them to those uninterested in their success, except as a purely private matter? Our feeling is, that it is time for an American burner to appear, equal to Sugg's latest.

There is yet another point which arises in this connection. Cannot a burner be constructed which shall have no chimney, yet shall not flicker any more than an Argand? One of the fatal objections to the electric light was its flickering. Many people complain that they cannot read or write by gas because of this trouble. If they had an Argand burner the trouble would vanish, but these will never be universal, on account of their chimney and their cost. The hint of the direction in which to work is contained in the Paris burner. If a combination of shade and draught regulator could be made which would steady the flame a good step in advance would be made. This advance has been attempted with considerable success quite recently. We refer to the wide mouthed globes. They have effected a vast improvement, but more remains. They are constructed on the principle of letting the gas alone. The old globes with narrow openings interfered with the draught and made the light unsteady. The new globes with five inch openings remove this cause of unsteadiness, and leave the flame in its natural state. The question arises, whether this natural state again cannot be improved, and some arrangement of little or no cost be made, which will remove from the flame every trace of flickering, and make it as steady as an Argand.

What is now wanted is a burner without chimney, and of as little cost as a batswing, which will produce as economical and pleasant a light as the expensive lava Argand. Or this end may be obtained by some arrangement of draught regulators attachable to any flat flame burner.

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July 12, 1878

The Excitement concerning the Speedy Development of the Electric Light, which six months ago seriously infected not only the holders of gas stocks, but a large proportion of the reading public, has almost completely subsided. The inventions that were to demonstrate the practicability of the indefinite subdivision of the electric current, and place at the disposal of the private household any number of electric lamps, of any desired power, that could be turned on and off with the same ease and convenience as gas-light is served and controlled, still remain unrealized. What the future may have in store for us we know not, and in view of the remarkable surprises that the invention of the telephone, phonograph, and microphone gave to the world, it would indeed be hazardous to predict that the onward course of invention in this special field had received a permanent check. When we consider, however, how little has been actually achieved during this last periodical flurry, in the direction of adapting electric lighting to domestic uses as a substitute for gas-light, the prospect that the problem will be solved in the near future is most unpromising. We have, indeed, made most substantial progress in improving and cheapening the sources of our supply of electricity, and in obtaining it in unlimited quantity by the direct conversion of mechanical force, in the dynamo-electric machines of recent invention, incomparably superior for all practical uses to the galvanic battery with its many inconveniences and want of constancy; lamps and regulators of ingenious construction have enabled us to utilize the electric current more perfectly, to improve the quality and steadiness of the light; and the superiority of the electric system of lighting for large open areas, public buildings and halls, etc., where central lights of great intensity can be advantageously employed, and the question of economy is not a prime consideration, has been abundantly demonstrated; but so far as the practical subdivision of the current, to meet the wants of the household, is concerned, inventors are apparently as far from the solution of the problem as ever.

Reduction in Price of Gas in New York City.—On and after June 27 the gas supplied by the Manhattan Gas Light Co. will be charged for at the rate of $2 per 1,000 to those consuming less than 10,000 cubic feet per month; to consumers of 10,000 cubic feet and over, the price will be $1.50 per 1,000.

Prices of Gas Coal.

Penn and Westmoreland..... $4.50 at New York.
" " ..... 3.50 at Baltimore.
" " ..... 3.75 at Philadelphia.
Despard..... 4.25 at New York.
Murphy Run..... 3.25 " Baltimore.
Fabiestock.....
Clearspeake & Ohio..... 4.00 at New York.
" ..... 3.25 to 3.60
Newcastle .....
Provincial ..... 3.50 to 3.75
Canneloa Cannel (by cargo).. 5.75 at New York.
Juno Hall..... 7.25

The above prices are about $1 per ton below those of 1878.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks, (with W. H Scott & Co.,)
24 Pine street, New York City.
July 2, 1879.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

Gas Co.'s of N.Y. City.	Capital.	Par.	Bid.	Asked.
Central.....	600,000	50	60	75
Harlem.....	1,800,000	50	40	45
" Bonds	170,000			102
Manhattan.....	4,000,000	50	170	175
Metropolitan.....	2,000,000	100	125	128
" Scrip ...	$1,000,000		100	103
Mutual.....	6,000,000	100	65	70
" Bonds, gold...	900,000	1000	98	103

(From the London "Journal of Gas Lighting.")

Midland Association of Gas Managers.

At the Sixth Quarterly meeting of this Association, held at Birmingham, on Thursday, May 1, Mr. Charles Hunt, of Birmingham, the President, in the Chair, a paper was read by Mr. C. E. Jones (Chesterfield), on

PUBLIC LIGHTING, WITH SPECIAL REFERENCE TO STREETS, ETC.

The paper commenced with a few remarks on the use of artificial lights in the past ages. It then proceeds: But we pass on to treat more particularly that branch of our industry selected for to-day's consideration—viz., public lighting—the discussion of which I hope may interest and benefit each one of us. It is a subject that certainly has not received too much attention, and perhaps its unremunerative character is responsible for the lack of interest manifested in its development; but even this consideration should not deter us from endeavoring to bring to perfection every branch of our profession.

The chief requirements of public lights are—(a) steadiness of flame, not susceptible to atmospheric commotion; (b) uniformity of intensity; (c) great penetrating power; (d) great diffusive power; (e) over available without preparation, and easily lighted; (f) non-liability to any sudden or self-extinguishment; (g) *wholesome*; (h) commercially cheap.

The first of these is effected by the kind of burner used, and the form of lantern employed to shield the light. Upon the selection of the material to produce the light depend *b*, *c*, *f* and *g*; *f* is chiefly a matter of interruption in supply or mechanical defect; *g* refers to the form of support and the structure of the lantern; *h* we will consider collaterally.

In the wide range of materials from which artificial light can be produced, that which fulfills most of the above requirements is coal gas. No other source of light at present known possesses the inherent qualities of coal gas in anything like a corresponding degree, and the light-giving which the more nearly approach it have a similar composition, being hydrocarbons. Candles and oil have been tried over and over again, both remotely and recently, with the result of leaving coal gas the master of the situation. To coal gas, then, the public returns, being won back to the old love by its many excellent and unique qualifications; and if we this day advance its just claims of coal gas, and bring out more prominently than hitherto its meritorious and special features, we shall not have spent our time in vain, however imperfectly the subject may have been put before you.

To secure a successful combination of the above conditions may be considered by some to be practically impossible, the nature of the service demanded being of such a varying character, depending upon the various circumstances exceedingly difficult to effect; but if we cannot insure theoretical perfection, we must strive to secure a position as near to it as is possible in our particular and individual cases.

By a little study of the foregoing principles which I have submitted to your consideration, and careful attention to the details of their application, very great utility. Some excuse may be found for our forefathers upon the ground of ignorance; but that cannot apply to ourselves in the present day, when knowledge is universal. The ancient cry was, "Where shall wisdom be found?" Now the answer is, "It reteth on the housetops," and knowledge, says Solomon, "increaseth strength;" so that if we are already of all undertakings is safe when directed by the "excellency of knowledge." Let us, then, widen the foundations of our professional fabric by showing the public that ours is the right path to tread, the right way to use the light they pay for for street illumination, and if they refuse to follow done our duty.

Before the introduction of gas lighting, very little sound knowledge existed generally of the laws that govern the combustion of inflammable bodies; and much of the extraordinary progress made by science is attributable to the earlier efforts to light thoroughfares.

The earliest forms of oil or candle lamps that I have met with were apparently designed by unskilled people, totally ignorant of the commonest principles of combustion, and no effort was made to obtain the maximum of scarcely any air-ways, or perforated in such a manner that the carbon became deposited in graceful festoons of soot, which you will agree with me is "matter in the wrong place" in a lamp, rendering the instrument practically useless for the purpose for which it was intended. When coal gas superseded oil as a public illuminant, the old form of lantern was retained and largely used. At one of the earliest imitation of it, and to the circumstance may be traced some of the evils attending the present system of street lighting. Had we to begin de novo without such examples to follow, or vested interests to consider, far better and more suitable lamps would be produced, and the public lighting rendered much more effective.

To make matters worse, when gas works became multiplied, no portion-lap pattern of bracket or lamp column was adopted. No uniformity in height, strength, size, or distance apart was observed by engineers. Each put into practice his own ideas of taste, or what he thought the best for the locality he had to illuminate, regardless of the physical principles of light or the chemical laws of combustion. Hence we find an astonishing variety and diversity of the shapes in both lamp columns and brackets, some being designed with filagree work, called "ornamental," and so placed as to obstruct the distribution of light, and darken most effectually the same element in the immediate neighborhood of the lamp. This desire of ornamentation extended to the lanterns, and scroll-work added its shadow to that of the support, while the metallic ribs and angles were made so wide as to amount in some cases to 10 per cent. of the whole surface of the glass, and consequently augmented the evil. Uniformity in the rate of combustion was disregarded, or a quantity per hour adopted without due regard to the quality of the gas to be supplied, and when a town was well lighted, it was more an accidental circumstance than otherwise.

I have observed in many towns new lamps being put up which embodied all the defects of the old ones, and, of course, with a like result. The public lighting of the Metropolis, except in certain places, is perfectly disgraceful, and reflects no credit on the companies or the local authorities; while in Birmingham, with every deference to our valued President, a state of things exists which is little better.

In many large towns, notably in Scotland, where the street lighting does not appear to be of the slightest consequence, or else is regarded with very little interest, the effect is most disappointing, particularly when we remember the high illuminating power of the gas there as compared with places in the South. There is scarcely a town with which Scott cannot be found, though it must be confessed that there are a few in the South that are fairly lighted, and I hope before long to witness a general improvement in this much-needed direction. Of course, the change will not be a sudden one. The capital invested in lighting plant cannot be sacrificed; but when renewing broken lamps, or rearranging their situation, much can be quietly effected, whilst in new streets or districts no obstacle can interfere to prevent the adoption of suitable light-giving apparatus.

It is evident that designers and manufacturers have not paid attention to this branch of the subject, inasmuch as the designing and manufacturing of grotesque columns and brackets is still going on. In bracket lamps, instances might be advanced *ad infinitum* of intricate designing of ornamentation, and flagrant disregard of the physical properties of light, and as long as encouragement is given to manufacturers to elaborate these articles in opposition to good taste, in defiance of common sense and the true principles of utilitarianism, so long shall we be doomed to have badly lighted streets and thoroughfares, and so waste the light-giving power of the gas.

Not only is the designing and constructing of lamp columns, brackets, and lantern frames defective, but attention to the commonest glass is used for glazing, and a great interception of light takes place from this cause alone. After putting a good light into a lamp, it is not at all an uncommon thing for a lamp contractor to receive it back dim and glassy for glass.

Glass, as you all know, is manufactured by fusing silicic acid with carbonate of soda or potash. The transparent material so obtained is incapable, however, of resisting atmospheric influences, and water alone will dissolve it in time. The glass maker, therefore, has to add small portions of lime or baryte, or the oxides of iron, lead, or zinc, to enable the compound to resist the action of the atmosphere. The commonest glass consists chiefly of silicate of lime, some proportion of the silicate of alkali, and of alumina, and oxide of iron. Some kinds of window glass are very little better than the commonest bottle glass; and we shall therefore find it of service to us if we possess to consider the composition of glass, since more depends upon the quality of this material than many people suppose.

The composition of window glass is usually as follows:

Soda.....	23.3 per cent.	
Lime.....	12.9	"
Silicic acid.....	61.1	"

with a trace of alumina. Now, soda imparts a green hue to glass, so much so that in the manufacture of crown glass, the variety largely used for optical purposes, it cannot be used, and potash has to be substituted, the proportions usually being—

Potash.....	22.0 per cent.	
Lime.....	12.5	"
Silicic acid.....	65.0	"

According to an analysis of Faraday, English flint glass has the following composition—

Silica.....	51.03 per cent.	
Oxide of potassium.....	13.77	"
Oxide of lead.....	33.28	"

A small proportion of the oxide of iron gives a dark color to glass, and it is as well to remember, when selecting glass for lamps, that, next to its brilliancy, its power of resisting atmospheric influences should be considered. In manufacturing towns the atmosphere soon destroys the polish of the surface, and cheap glass is soon "etched" in this way. It is therefore more economical to use a clear, brilliant, hard glass, though its first cost may be more than many of the dull waxy varieties manufactured from gas lime, soda waste, clay, and rock salt, and largely used by spreading builders for windows, and unwise gas managers and avaricious lamp contractors for street lamps. The rougher the surface of the glass, the sooner does it become dirty, and the more readily are the rays of light intercepted; whereas a good clear, smooth glass will keep cleaner for a longer period, and allow the light to pass readily through.

Whatever media are used to inclose the light, it is inevitable that some loss will be sustained. This loss is not invariably the same for the same medium, but varies with the penetrative power of the flame, and likewise the distance from the flame. The larger the flame the smaller the loss up to a certain point; thus a strong argument is supplied in favor of larger burners in street lamps. Some experimentalists have arrived at the conclusion that window glass occasions a loss of light equal to 9 per cent.; but unless we are told what kind of window glass was used, the statement is certainly vague, if not misleading, glass of nearly all qualities, with varying powers of light-interception, being used for windows.

The following are the results of my own experiments, conducted with great care, every precaution being taken to eliminate all sources of error:

The first series of experiments were made with a pane of clear, lead 16oz. English glass, quite new, free from flaws, and possessing a good polish, but identical with the kind I use for street lamps; the only difference being that ours was used in its selection—in fact, it was the best of its kind. The illuminating power of gas used was 16.25 candles, and the loss of light by the interposition of this glass was only 1.78 per cent. Having procured from a glazier a similar sized sheet with very lines and air globules or bubbles in it—a veritable specimen, though perfectly new and clean—I found the loss of light to be 14.38 per cent.; therefore, by using this common foreign glass for glazing lamps, we sacrifice some 12½ per cent. of the light rays, which would otherwise be utilized by employing a glass equal to that used in the first series of experiments.

I next tested a pane of glass that had been in use for some time, and purposely allowed to become dirty, and to some extent also smoky. The result was remarkable, no less than 51.81 per cent of light being obstructed. The same glass, even when clean, intercepted 16.22 per cent. of light. This demonstrates the desirability of more frequent cleaning, and also exhibits the etching power of the atmosphere when charged with impurities, and the feeble resistance offered by the glass to its chemical action. By subtracting the percentages of the first-named experiment from the 16.22 lbs.: 16.02—1.78, we have 15.14 as the percentage of obstruction due to the corrosive wear of the glass when subjected to atmospheric influence in a manufacturing district containing chemical works and potteries. It would be interesting to know in what proportion of time this deterioration of glazing was effected; but that information, I regret to say, I am unable to give with strict accuracy, notwithstanding that I believe I am quite safe in this instance in putting it at from three to four years.

Red and ruby glass is frequently used for private lamps over shop doors, hotels, etc. I find their power of intercepting light varies with the intensity of color, and not so much with the thickness of the glass, as one would almost expect. A very thin specimen intercepted 61.36 per cent. of the light, while a sheet very much thicker only obstructed the light rays to the extent of 51.76 per cent.; the average of all my experiments being 48.68 per cent. Red glass is produced by the addition of suboxide of copper, and the finest ruby glass contains a little gold, 1-100th part of a grain of gold being sufficient to impart a deep rose color to a cubic inch of flint; while stain of cobalt is used to produce the magnificent blue which usually adorns the portals of police stations. Such glass, when quite pale and without clear spaces upon it, such as the word "station," etc., obstructs artificial light to the extent of 36.19 per cent. Various experiments with ground glass and other ground glass induced me to place the loss of light at 22.32 per cent., while glass covered yellow by the oxide of antimony only intercepted 11.64 per cent. of light.

In the laying of gas lamp services workmen are often either too idle or too ignorant to select good soil with which to surround the pipe. In consequence soils, such as contain the compounds of iron, lime, and some, pipes are also destroyed or "eaten away," and the least subsidence or disturbance of the surface—oftentimes the vibration of the railway caused by the passing

are not private consumers of gas in any way, I cannot subscribe to the unjust principle of selling gas to the *quasi* consumer at a lower rate than to the private and public consumer. That the buyer of the smallest quantity should be placed on better terms than the buyer of the largest quantity is an anomaly difficult to reconcile with commercial principles; but this is so whenever gas is supplied to public lamps at a reduced rate per 1,000 cubic feet.

It is obvious that the rate payer who only pays through his rates for gas supplied to the public lamps, obtains such gas on easier terms than the one who happens to be also a private consumer. Thus, assuming gas for public purposes to be sold at 2s. 6d. per 1,000 *cubic feet*, and for general purposes at 5s., it follows that A., who is only a ratepayer consuming his share of gas via the public lamps, obtains his gas for 2s. 6d., while B., being a large private consumer as well, has to pay an increased rate for his private consumption. So much money being required to pay the dividends of a company say, the larger proportion is contributed by the private consumer, and I am driven to the conclusion—and I am glad to be in a position to state that I am supported in that conclusion by many friends—that, to be equitable in price, no reduction should be made in favor of the public lighting. Another point worth remembering is that in many districts public lights are used for only four, six, or eight months of the year; whereas a private consumer is a constant customer, using gas all the year round, not even extinguishing on moonlight nights.

Of the average meter system I shall say but little. The framers of the 25th section of the Gas Works Clauses Act, 1871, were evidently neither engineers nor gas managers, or they would have put all the public lamps on meters direct, or at least have settled how many lamps were to be metered or unmetered. Whether they wished 1 per cent. or 50 per cent. of the lamps to have meters attached, they hesitate to inform us, and very graciously leave the parties interested to fight it out among themselves. As far as I have been able to learn, this "average meter indication" system is a delusion; it has been tried and abandoned. Important economical results have been reported from time to time as due to its adoption, but I venture to think that such economy is due, not to the supposed check by a meter, to so many lamps, but to the shortening of the hours of burning by the local authorities. With fair and open dealings between the officials of local authorities and the officers of gas companies, with confidence in man's honor and doing to others as you wish them to do unto you, the "average meter" system is utterly unnecessary, and the absence of its general adoption must be taken as a proof of its failure. If any member of this Association has the system in operation, I trust he will give us the benefit of his experience therewith, and show us the advantage conferred on the public by this system of supplying and charging for gas to public lamps.

Having now, sir, discharged my duty and fulfilled my promise, I must ask for forgiveness for the many imperfections to be found in this paper, considered with regard either to importance, its interest, or to its possible operation on the future of gas companies, no excuse is needed for its introduction to your notice to-day; and I venture to hope, sir, when you invite discussion, as you will do directly, upon the substance of this paper, that any member of this Association who hesitates to accept its tenor as correct, himself of the opportunity, and express his views with earnestness, with those we may be assisted to establish scientific truth, increase more and bond of fellowship.

demands. A few years ago the intended to consolidate the Thames; but they allowed the what may be called a second ment, if effected, prove of great ings worked together would yield reduction of price, and consequ gratifying to both consumers and of is only *its power*, but we could effected, sooner or later. Every We have had no hesitation in ex if the gas supply of the Metr have constantly urged that if the panies might all be consolidated manner constituted into one unit Works will probably have no amalgamation, and therefore we their approbation. As to the Pa mon. We only hope that it w A meeting of the shareholders o for to-day, to sanction the a suppose that any one would company urgently requires it They have not, at the present m storage, although they have fou apparatus and the reception of assist them in both particulars, will be led into the folly of *Journal of Gas Lighting.*

circumstances indica now, but one t toward the goal.

It would ill be secrets locked u of or lament over loud to a result h the march of intel fully welcome any finding, or all t these feelings ma the electric light; sell, I went on to respecting what sumption of gas. tumiture of the

I have formed t light, in its prese like with coal gas, were notes or rig for safety respe possessed by coal- superseded by ele we are populated a some distinct fun cess all improve heavenly bodies di interest, they reac in tins, and I very ever, as the consid

GAS AND WATER COMPANIES.

By G. W. Stevenson, C.E., F.G.S., London.

Through the courtesy of the author we are in receipt of this very valuable work.

In the Kingdom of Great Britain all gas and water undertakings are regulated by law. While the legislation is general in its character, still, in almost every case, where a company comes before Parliament for additional powers, some special modifications of the general laws are sought, which in some cases are granted, and, in some cases, the company does not get all the powers it asks, but has conditions imposed upon it which it did not seek or desire. The result of this is quite a complicated amount of legislation on the subject, involving a great variety of special provisions.

The object of the work referred to above is to give, under appropriate heads, in a classified form, the result of this legislation; and, also, the data by which any member of the act in each case, so that those desiring full particulars as to what has been done, in any or all cases, may, by reference to this book, find exactly where to look for the details not contained therein.

It has involved much labor, and while of not so much interest to gas companies in this country just now, yet, should any company desire to obtain or oppose legislation, we know of no work that would be of so much value, from the fact that it embodies practically all the English legislation in every department of the business up to the close of 1876—giving many details, such as the capital authorized, the illuminating power and purity required, the amount of dividends allowed, the price of gas, etc., etc.

As a compendium of condensed and useful information it should merit a large sale, even at the price of one guinea, and should be in every gas library that makes any pretensions to completeness.

Gas-Works in Germany.—A German statistical paper recently published the following details relating to the gas-works at present in existence in that country:—Number of private works, 352; annual production of gas, 2,911,077,000 cubic feet; maximum production per 24 hours, 10,049,500 cubic feet; number of public lights, 51,034; number of private lights, 1,050,525; amount of capital employed, 23,715,117. Number of municipal works, 230; annual production of gas, 7,855,950,000 cubic feet; maximum production per 24 hours, 30,000,000 cubic feet; number of public lights, 86,681; number of private lights, 1,711,000; amount of capital employed, 54,748,000. Total number of works, 582; total annual production of gas, 10,767,027,000 cubic feet; total maximum production per 24 hours, 41,049,500 cubic feet; total number of public lights, 137,737; total number of private lights, 2,762,525; total amount of capital employed, 78,463,243, or at the rate of 134 6.5d. per 1000 feet of make.

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 8, 1879.

Circular to Gas Companies.

TELEGRAPHIC news from America tells us that Mr. Edison has devised a dynamometer, by means of which he is able to calculate the exact amount of force required to give a certain quantity of light by the use of electric machines. By the aid of this instrument, we are told, he has determined that one-sixth of a horse power is sufficient to produce an electric light, of what intensity we are not informed. The telegram further expresses Mr. Edison's confident opinion that the successful use of electricity for the production of domestic light is now decided; but he admits that a great mass of details have to be worked out before his system can be brought into operation. This is a wide admission, and we may calmly await the working out of these details, which, in our opinion, will probably occupy Mr. Edison for the remainder of his life. Presumably Mr. Edison still adheres to platinum poles for the production of the light, and it seems that he has satisfied himself that the metal may be obtained in large quantities at a comparatively cheap rate. Our present supplies come mainly from Russia; but, if we remember rightly, a few years ago it was reported that large deposits had been found in California. It is from this latter source, probably, that Mr. Edison proposes to obtain his supplies.

Mr. Edison has now filed the specification of a third patent for the United Kingdom. It includes details of what we may call his burner, which, up to a certain point, is not novel. He continues his system of winding round a cylinder of lime a fine strip of platinum foil, which is to be covered by a pyro-insulating material, the description of which is somewhat curious. For example, he professes to take the metals "zirconium, zirconium, calcium, magnesium, or other metal or material which will not be injured by a high degree of heat," and, dissolving them in acids, dip his strips of foil in the solution, and then expose them to an intense heat, by which they become coated with a layer of the oxide of the metal. This looks all very well upon paper, but probably no one knows better than Mr. Edison himself that his "pyro-insulation" is mere nonsense. Lime, for example, deposited in the way described, would speedily peel off, leaving the platinum bare. A better plan proposed by Mr. Edison is, to put layers of his "pyro-insulator" between the coils of his spiral burner, in which position the material might be expected to last. The patents propose that from a central position iron tubes should be taken, carrying within them an electric cable consisting of several strands of copper wire. From these a single wire will be taken into the basement of each house, and from this, small wires will run into the apartments, wherever the light is required. Each light is to be furnished with a switch, which will act in much the same way as a gas-tap. When every switch is turned off, it is expected that the steam motor will nearly cease to operate, and hence a great loss of power will be obviated. All this looks extremely pretty; but, as Mr. Edison himself admits, a great mass of detail will have to be worked out before the electric light can ever be adapted for domestic use.

Our readers will see in another column a letter from Mr. W. Livesey, in reply to the remarks of Mr. Warner at the recent meeting of the British Association of Gas Managers, relative to the action taken by the Gas and Water Companies Association respecting the applications of Gas Companies for powers to supply the electric light. It was always a moot question with us whether or not the thirty-four Gas Companies should proceed with the clauses intended to empower them to "supply" the electric light. It is quite true that no one of them knew exactly what they wanted; that is to say, they were unacquainted with any details which would have enabled them to carry into effect the powers they asked for. The electric light is so recent a novelty, and so little is known about the best modes of using it for public illumination, while absolutely nothing is known of the possibility of applying it for domestic use, that, under the circumstances, it certainly seemed premature for Gas Companies to apply for powers which they would not have known how to exercise. And yet there was some reason in the applications. It was like taking the bull by the horns, and announcing an intention to supply the new light wherever it might be found convenient and profitable to employ it. The report of Dr. Playfair's Committee shows clearly that the action taken by the Gas and Water Companies Association was correct. It is admitted that our present knowledge of the electric light does not justify any legislation on the matter, and that we must wait for a much more extended development of the system before Parliament can confer any exclusive powers to supply the new illuminant.

There was a large sale of shares in the Brighton and Hove Gas Company on Wednesday last at the London Auction Mart. They were 220 shares, fully paid, entitled to, and, of course, receiving seven per cent. dividend, and were sold with the dividend accrued up to June last. The prices ranged from 254 to 244. It is clear that the public lose no confidence in gas investments. That there is no fear of the competition of the electric light, even in the Metropolis, is shown by a recent rise in the "A" stock of the Chartered Company, which now touches 179—181. This stock will no doubt also go up to par rates, and fetch a considerably advanced price. We thought the price would never have been affected by the large quantity of stock thrown on the market; but our fears, we are happy to find, have not been justified by the result.

All our readers know the principles on which we have always advocated that Corporation gas undertakings should be managed. It is, that they should be so conducted that the net income over expenditure should be applied in reduction of the price of gas. This is obviously what the Lord Chief Justice had in his mind when, in delivering judgment, on the application of the Birmingham Corporation to set aside the award of the Umpire in the arbitration case between them and the West Bromwich Improvement Commissioners, he remarked that the business of a Corporation is not to make a profit. They have to supply consumers on the cheapest terms possible, and "if a profit is made, it is pointed out how it is to be applied." We rely on the words, "the cheapest terms possible," used, applying them to the Corporation of Salford, we may repeat the remark made last week, that the consumers in that borough might be supplied at a much lower rate than will obtain when the twopence reduction is made. The gas undertaking of the Corporation at the present time is, and has been for the past few years, increasingly profitable, and, in our opinion, the profits belong to those who take and pay for the gas. We do not forget that repeated reductions have been made during this period. We are aware that our opinions

are not fully accepted in this country, but they are well understood in Germany, where the gas undertaking of almost every Local Authority is conducted upon the principles we advocate. We have nothing to retract from the observations made in our last item respecting the reduction in the price of gas in Salford. A small calculation will show that if the Corporation would forego a good part of the profits they now set aside in aid of rates, the reduction might have been twice as much, and still some profit have been realized.

The Corporation of Swansea seem determined not to be on good terms with the Gas Company. A bill amounting to about £50 has been owing from the former to the latter since 1876, and repeated applications for payment of the money have brought neither reply nor cash. Under these circumstances, the Gas Company took the unusual, and we will not say legal step of withholding the payment of rates due, and till their own debt was satisfied. The consequence was the immediate issue of a summons, by whose authority seems doubtful. The Mayor distinctly repudiated that no summons should be issued, and the Town Clerk denies that the proceedings were taken with his sanction; but at this point the evidence is somewhat foggy. The moral appears to be that Gas Companies, when dealing with Corporations, especially those like that of Swansea, should act with them the same as with an ordinary consumer, and demand immediate payment at the risk of the cutting off of the gas supply. That Corporations can be as high-handed as Gas Companies is shown by the proceedings in this case, in which a summons was issued for a rate that was only due on the day the summons was taken out. We are happy to say there are not in the Kingdom many Corporations like that of Swansea, and therefore we do not know that these proceedings offer much interest.

The Dublin Gas Bill has gone up to the Lords with the expressions which will doubtless delight the Gas Company to convey the electric light, if it should ever be deemed desirable in such a city as Dublin. It is one of the last places in the world in which we think the electric light is likely to be desired. There are public spaces and squares which might be illuminated, but at the present time nobody frequents them after dark, and probably few would do so if the electric light were installed in their midst. However, the Gas Company, so far, have failed to furnish the electric light, but it is not an exclusive power. The Corporation may at any time step in by the aid of its own Commissioners, without let or hindrance; but we know that they will do nothing of the kind. They will not simply on the dog-in-the-manger principle. They will do nothing themselves, and, if they can help it, will not allow the Gas Company to do anything. This is written with a knowledge that before these lines meet the reader's eye, the Bill will be before the House of Lords. Sir Arthur Guinness appears to have done his best to prompt Earl Beaconsfield, so as to induce him to reject the clause which indirectly gives the Company power to supply the electric light; but the terms of the Act of 1868 still remain, and, unless we are greatly mistaken, they will, as they stand, justify the Company in supplying any new mode of lighting which may seem fit to them. The Bill, as has been said, went before the Lords yesterday, and in all probability will pass in its present shape.

The *Liverpool Lighting Bill* has passed a Common Committee, with an amended preamble and certain amended clauses. This Bill is one of the most important that has been introduced this session. It was originally intended to give *the Corporation of Liverpool* power to supply the electric light without limit all over their area; but the Committee have so far restricted them that they can only use the light "for the purposes of experiment for a limited period, but not "for the purposes of profit." So far so good. The Corporation could, without asking for any parliamentary powers, have supplied the electric light to all their private and public places, such as St. George's Hall, St. George's Square, the Market, &c.; but their action extended beyond this. They wished to be placed in a position to furnish the light to places of public resort, such as the Prince's Theatre, and also to illuminate the Lime Street Railway Station. To this extension of Corporation Powers the Gas Company naturally objected, and, as the Bill now stands, opposition will very properly be made in the House, the result of which, of course, we cannot anticipate. The intentions of the Corporation obviously is to launch with the dominion of the Gas Company. They will, if the Bill be passed as it at present stands, obtain power to make an experiment which is to bring them the light to theatres, railway stations, and other places of public resort. The Gas Company cannot sit still and see their ground thus wrested from them. Therefore the Bill will be opposed in the Lords, and although we are precluded from expressing my opinion as to the result, we confidently expect that it will be rejected in its entirety. The Liverpool United Gas Company have not, like many other Gas Companies, sought power to use the electric light, but they naturally look askance at any powers which may be granted to the Corporation, and which may interfere with their business. Thus they are entirely opposed to the provisions of this amended Bill, which, if it should be carried, may militate against their interests. The Company suspect that the Corporation contemplate a serious attack. It is true that the purchase clauses have been struck out, but the Gas Company are perfectly right in opposing any measure which they conceive will tend to interfere with their profits. We shall watch with much interest the progress of this and the Dublin Bill, feeling well assured that the Gas Companies concerned need have no apprehensions that their profits will be injuriously affected. Perhaps it ought to be mentioned that the Liverpool Corporation only seek power to borrow £50,000, which they can easily expend in a very short time in making experiments with the electric light.

The Corporation of Norwich seem determined to make an effort to acquire the undertaking of the British Gaslight Company. They are hardly conscious of the difficulties which lie in their way unless they make terms with the Company previous to applying to Parliament. There is, we believe, no instance on record of a Gas Company being the victim of a purely compulsory purchase. Now, the British Gaslight Company have distinctly announced their intention to hold fast by their property, and we know they will persistently adhere to that resolution. The Corporation of Norwich, therefore, if they should have the temerity to go to Parliament, will have to face a most determined opposition, the result of which will, we think, be their utter discomfiture. They should be content for the present with the reduction of price which the Company have granted, and wait patiently for further reductions, which we trust to follow.

We continue our notice of the papers read at the meeting of the British Association of Gas Managers at Newcastle. The paper of Mr. Sanderson, of Newcastle-on-Tyne, on "Economy in the Manufacture of Concrete," with reference to the construction of gasholder-tanks, we must leave to the consideration of those engaged in the works specially referred to. On this matter we cannot pretend to give an opinion. Much useful information was contributed in the course of the discussion which followed the reading of the paper, a full report of which will be found in another column. It is generally supposed that cement contracts on solidifying. Probably closer observation will show, as pointed out by the President, that expansion takes place, in either case leading to cracks; but when it is once settled whether cracks are caused by expansion or by contraction, due allowance may be made for either of these, and thereby all accidents avoided. It will be seen that a good deal of experience has now been gained in the erection of concrete structures, and we think they will come more and more into favour. Engineers, we fancy, will soon get over the backing difficulty, and that all that is necessary will have been accomplished. Of course, every one will agree with Mr. Hunter that there are cases under which a brick tank may be cheaper than one of concrete, but, as a rule, this is not the case. Mr. Sanderson deserved the hearty thanks of the meeting for bringing so important a question under their notice, and dealing with it in such an effective manner.

Mr. Wright's new form of cooler is a promising arrangement of apparatus which is credited with many good qualities not the least of which is the fact stated, that, by its means naphthalin can be kept out of the mains. It is to be regretted that unfortunately opinion does not exist among the profession as to the best form of condenser to be used, nor as to the temperature to which gas should be reduced in the process of condensation. On these points much valuable information remains to be elicited, if speakers in the course of the discussion. The remarks of the President were very pertinent. Close and continuous observation with different forms of apparatus are highly desirable.

The lecture by Professor G. A. Lebour, F.G.S., &c., entitled "Practical Notes on Coal and Coal Getting," though possessing nothing of special interest to managers, as gas makers, formed no doubt a valuable contribution to the proceedings of the meeting. A gas manager is now expected to be an educational man, and is he especially learned about the staple which he uses. The lecturer gives some useful information of a rather elementary sort, to which his audience appeared to listen with pleasure.

Some re-arrangement of the gas-testing stations of the Metropolis is, with the sanction of the Referees, about to be made, mainly, we believe, at the instigation of the Commission of the City of London. The stations at Beckton and Priendly Place will be discontinued, and in their stead will be substituted three testing-stations within the limits of the City. It has long been the contention of the Corporation of London that gas should be tested where it is consumed, and to this, we suppose, the Chartered Company have agreed.

In another column will be found an abstract of the Quarterly Report of the Chief Gas Examiner appointed by the Board of Trade, which shows, as usual, that the Metropolitan Gas Companies under his purview continue faithfully to fulfil the obligations imposed upon them by the several Acts of Parliament. The average illuminating power was considerably in excess of the requirements of the Acts, and in no case was the presence of sulphuretted hydrogen reported. As regards the impurities of "sulphur" and ammonia, the report shows that the instructions of the Referees had been fully carried out, the amounts being, in every case, far below the quantities permitted.

It is generally believed that a gasholder will not explode, nor will it, if filled with gas only. But a recent accident at Dartford seems to show that under some circumstances a real fatal season to allow that under some circumstances a real fatal season to allow that under some circumstances a real fatal explosion may take place in a holder. We must wait for further details and some explanation before an opinion can be arrived at; but it seems clear that the contents of a new holder, said to have been in use for only a week, became ignited, with most disastrous results. The holder and tank were crumpled up like a sheet of paper, and the tank was drawn to the centre of the basin. A very large quantity of air had gained access to the holder, it must have been discovered by a want of illuminating power in the gas. A strongly explosive mixture of gas and air gives very little light. The explosion occurred in the night, when only street-lamps are burning, and probably a want of power in them was not observed. [Since the above was written, we learn that the accident was caused by the bursting of the gasholder-tank, and the gas in the holder becoming ignited, both tank and holder were destroyed.]

A steam roller has been at work again crushing gas-mains, at this time at Croydon. The escaping gas, of course, mixes in with the steam, and the mixture of gas and air coming way into some houses, and the mixture of gas and air coming in contact with a kitchen fire, an explosion resulted, which was nearly destroyed two houses. Local Authorities must see that their rollers are not unnecessarily heavy. They may do that their rollers are not unnecessarily heavy. They may do that their work of crushing-in granite or gravel without being so ponderous as to make their weight felt a foot or two below the surface.

Correspondence.

[We do not hold ourselves responsible for the opinions expressed by Correspondents.]

THE GAS AND WATER COMPANIES ASSOCIATION AND THE APPLICATIONS FOR ELECTRIC LIGHTING POWERS.

Sir,—In your report of the meeting of the British Association of Gas Managers on the 10th of June, there are some remarks in the President's Address which it is necessary for me to notice. I would have done so before, but the pressure of other business prevented me.

The President states, in effect, that he thinks it his duty to say that those Companies who had Bills in Parliament with powers to supply the electric light ought to have been consulted before the petitions were presented by the other companies against the granting of such powers. On this point, I am sorry to say, I do not agree with him. When a person says he feels it to be his duty to state this or that, it implies a grave neglect of duty on the part of some one else, and as I happen to be the "some one else" in this case, you will perhaps allow me to say a word or two as to my view of the matter.

At the very commencement of the session all the Gas Bills containing powers to supply the electric light were suspended before their second readings, to give the authorities time to consider what should be done with them. It was then determined to appoint a Committee to inquire into the matter, and make a report to the House, and upon that the promoters of these Bills were informed that if they desired to obtain these powers out of their Bills they might proceed with them at once, but otherwise they must wait until the Committee had made their report.

Subsequently to this the Gas and Water Companies Association made several applications to them Companies, both through their agents and directly to themselves, to withdraw these clauses, so as to enable the Association to take some decided course before the Committee. The Association could not also, its eyes to the fact that if such powers were granted to gas companies, they could not be refused to local authorities where they were gas suppliers, and the effect of that I need not stop here to comment upon. The policy of the Companies was, therefore, clear and unmistakable—to show that electric lighting was inapplicable to private houses, and no parliamentary powers for such purposes ought to be granted in any one.

On the 12th of March I sent to all these Companies a circular containing the following paragraph:—"As it is very desirable that the Companies promoting Bills shall have some general understanding among themselves as to the course they intend to take before going into committee, the Committee of the Association proposes holding a meeting at the Westminster Palace Hotel, on Monday next, the 17th inst., at two o'clock, to consider this question, and I am instructed to say that, as your Company are promoting a Bill in the present session, they hope it will be convenient for you to appoint some gentleman to attend the meeting on their behalf." And on the 24th I sent another as follows:—"The Committee on Electric Lighting will be prepared to hear counsel from any persons who may after themselves as witnesses, but will not hear counsel. It is probable that the Committee will only sit one or two a week, and not day by day, as with an ordinary private Bill, and that the inquiry may be extended over the whole session. The issue, therefore, that there is for other causes for the Companies to take them to proceed with their Bills without the electric light clauses, and upon some general measure being passed, if it should be found expedient to do so."

The object of the meeting on the 17th of March, at the Westminster Palace Hotel, was to ascertain, if possible, before taking any interior proceedings, whether the Company really had any clear idea of their own what they meant or intended by "powers to supply the electric light"—whether the supply was to be compulsory or permissive, whether they had devised any mode of ascertaining the price, whether it was to be carried out as a separate undertaking to bear its own losses, or be worked up with the gas undertakings and the losses charged upon the gas consumers, or whether they had any plan whatever of carrying out such powers if granted.

One or two of the Companies sent representatives to the meeting, but the majority only sent their agents who, having no practical knowledge of the working of a gas undertaking, and still less of electric lighting, could give neither information nor advice upon these matters, and for all practical purposes they might as well have stayed away. But the truth is—and it is a folly to try and shirk it—that none of the parties promoting these Bills had any clear idea of what they ought to ask for, or what they would be willing to undertake if the powers were offered to them.

After the House of Commons Committee had been appointed, the Committee of the Association had several meetings to determine the best course to adopt, and decided not to oppose the electric lighting itself, but only the granting of parliamentary powers for that purpose, on the ground that the local authorities had already sufficient powers for lighting the public lamps by means of the electric light, and that it was not necessary, with our present knowledge, to light private houses; and although there were but little difference of opinion between the members of the Committee as to this being the proper course, they deferred putting it in force from time to time, in consequence of the many Gas Bills containing these electric lighting powers, and hoping they would be withdrawn. At last it was intimated to them that if they intended to give evidence at all, they must be prepared by a certain day, and thereupon, as I would have been, to say the least, a very great inconsistency for the Gas and Water Companies Association to be giving evidence that electric lighting was utterly impracticable for private houses, while a number of gas companies were at the same time actually taking for powers to supply it, and thus, in effect, contradicting the evidence, the petitions were determined upon—in fact, they became a necessity.

During these proceedings the Companies had one by one—but some of them very reluctantly, and only when they found that they could not proceed with their Bills to a second reading without doing so—withdrawn these clauses, and the very last of all was the Company which

the President of the British Association of Gas Managers himself represents.

The earliest second readings of the session were on the 24th of February; the second reading of the Bill last referred to was on the 6th of May. The Electric Lighting Committee commenced their inquiry on the 17th of April. Your readers will probably see in this the reason why the presentation of these petitions was so improper a proceeding.

It would have been a calamity to all gas companies if any individual company had obtained powers to supply the electric light, as such powers would unavoidably have been very imperfect, and in their imperfect state been copied from one Act into another, and in the end made the standard for all others. If it should ever come to pass that electric lighting can be applied to private houses, the power for gas companies to supply it must be given by some well-considered public measure applicable to all companies alike, and not by means of the special Acts of each individual company, and this is the object, so far as I know, that the Gas and Water Companies Association have in view.

As the Companies promoting these Bills did not admit any obligation on their part to withdraw the electric light clauses in deference to the views of the other companies, it is somewhat unreasonable on their part to complain of the other companies not withholding their petitions in deference to them.

The comments on the Gas and Water Companies Association generally are legitimate, and the suggestions would, I think, produce beneficial results if acted upon; but no Association can have much weight if its individual members persist in taking their own course, regardless of the views of the majority. An Association would but make itself ridiculous if, every time one or two of its members adopted a course they disapproved of, they were to abstain from taking the course which they thought the proper one. They would be neglecting the interests the other members if they failed to do so.

I do not think the President's good faith in thinking it was his duty to remonstrate against the presentation of these petitions, although I do not agree with him; but if I had been in his position, I should most certainly have felt it to be my duty to put the boot on the other leg. I am quite sure it would have pinched that better.

So much has been said about electric lighting, that I fear your readers must be heartily tired of it. There is, however, still one point upon which information is very much wanted, and which I, with many others, have been unable to obtain, and that is, What is meant by supplying the electric light? Will any gentleman connected with either of these 24 Companies condescend to inform us how he intended to carry out such powers, if granted?

I am, Sir, your obedient servant,
W. LETCHER.

Gas and Water Companies Association, 6, Victoria Street, Westminster Abbey, S.W., June 28, 1879.

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Eng. Mechanic July 1879

GAS CONSUMERS AND GAS PRODUCERS.

[15920.]—It will simplify and enlighten a great deal of your correspondence on this subject if your readers will divide the numerous letters into the above division, *Consumers* and *Producers*. To the latter division, I have no doubt "Sigma" and many others belong. *Supposing* that I held gas shares by the hundred, and *supposing* I held a retaining fee as tester and chemical adviser to a few gas companies, very probably I might write as many of your correspondents do, and wish to keep things *as they are;* but seeing that I am only a consumer, and am at present paying *four times* the value of what I receive as gas, I am a long way from being convinced by anything yet advanced by any of your correspondents, and think it the duty of every consumer to try and bring about a better state of things.

In my last letter I named some of the causes which in my opinion helped to make bad gas. This seems to have acted like a "red flag" to "Sigma," and brought forth a storm of abuse and bad words.

The fact of *wet coal* being used is one which I can vouch for, having seen it put in the retort, and noticed that a six months' stock of coal was stored in an open yard, exposed to all the vicissitudes of the weather, and a convenient corner arranged to act as a urinal—for the use of thirty or forty men—during a long winter. Perhaps in "Sigma's" opinion, the resulting gas would be all the richer for that addition.

As to the other cause I named, "the admission of air," anyone taking the trouble to refer to any modern chemical work will find that this very thing is named as a danger, and very possible accident.

There are numerous causes at work in a large gas works that might lessen the height of the water in the hydraulic main, and supposing that to be reduced ¼ or ½in., a larger quantity of atmospheric air might gain admission without detection.

I am not such a fool as many of your correspondents seem to think, as to suppose that "atmospheric air and aqueous vapour," mixed with the coal in the retorts, remain as such. The evil shows itself in the resulting compounds. The oxygen of the air combines with the carbon of the coal forming carbonic acid and carbonic oxide. The nitrogen with the hydrogen appear in the "by-product" as ammonia.

Certainly one fact is very significant, and may point to a solution of the present question, and that is the complaint as to bad gas and "high charges" have all arisen since the wonderfully increased value of the "waste products." The problem seems to be with them, to use that material that will yield the most by-products, and not that which gives the best gas.

As a gas consumer I appeal to other gas consumers, and ask them and the public at large to ponder and consider over one or two facts, and then draw their own conclusions.

The process of gas manufacture in this country is exactly the same *to-day* that it was fifty years ago; the schoolboy's experiment of filling a tobacco pipe with coal and putting it in the fire represents exactly the process on the larger scale, and although Science has benefited every other trade in the country, all that gas engineers and gas companies have done for the public is to supply them with a far inferior gas at the present time than was made 60 or 70 years ago, when gas was first invented. The gas made by the first company that started was a *better gas* than what is supplied by most of the companies of the present day. There is another fact to bear in mind, that throughout the length and breadth of the land there is the same cry—that though less gas is burned, the price and cost is increased, and the deliberate answer of the gas companies, with all their science and engineering skill to aid them, is simply this: "We *can't tell* and we *don't know* the cause." All complaint and inquiry is met by—"The quantity is registered by your meter, and we intend to make you pay."

When every journal and paper is drawing attention to the facts above-named it is mere child's play for your correspondents to try and throw dust in the eyes of the public and talk about the respectability and honesty of gas directors. There *must* be a cause for the wide-spread dissatisfaction, and every gas consumer's fittings and meter cannot be defective.

A Gas Consumer.

[All readers of the English Mechanic, and "A Gas Consumer" among them, ought to know that the opening statement in this letter is untrue. If "A Gas Consumer" has so little confidence in the disinterestedness of those from whom he seeks information, he should not ask for it at their hands.—Ed.]

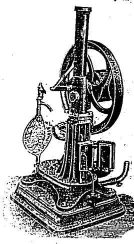
Engineer July 1879

GAS ENGINES AT THE ROYAL AGRICULTURAL SOCIETY'S SHOW.

Several examples of gas engines were exhibited at Kilburn during the recent show. This form of machinery is daily growing in importance, and the improvements which have been effected in its construction since Lenoir first produced a practicable gas engine some fifteen or sixteen years ago, are so numerous, and have been attended with such excellent results, that it is difficult if not impossible, to say when anything like finality will be reached by engineers who devote their energies to the improvement of this type of motor.

The largest exhibitors were Messrs. Crossley Bros., of Manchester, who showed six Otto silent gas engines, varying in power from half a horse power to 16-horse power. This last is the largest gas engine ever made. The cylinder is 13in. in diameter, the stroke being 18in., and the engine has indicated 32-horse power we were informed. In none of the engines exhibited, save this, were there to be found any novelties of construction; a very ingenious arrangement is fitted to this engine in order to overcome a serious difficulty. It is known that on starting the Otto engine it must be turned round two or three times by hand, as quickly as may be. Now with small sizes this is easy, but it is otherwise when we have to deal with a 16-horse engine. To facilitate the turning of the engine a handle is provided, by which the action of the exhaust cam is so modified that the compression period is practically eliminated, and to obtain an instantaneous ignition of the gas, and consequently a propelling force from the first, the following device is employed:—At the back of the cylinder is fitted a little rod, which can be taken out; this rod has a small cavity in its end, into which can be stuck the head of a lucifer match. The rod with the match head is pushed into the gas chamber, and rests with the match near the side of the chamber. To the cylinder lid is fixed a hammer, held up by a trigger. The gas being on as soon as the engine is turned round, so as to withdraw the piston a short way from the end of the cylinder, the trigger is released, and the hammer falls on the end of the little rod before mentioned. The match is driven against the side of the chamber, and, detonating, ignites the mixture of gas and air, and supplies power to start the engine. The consumption of gas by the Otto engine varies between 21 and 24 cubic feet per horse-power per hour, according to the condition of the engine.

Messrs. Thwaites and Carbutt, of Bradford, proposed to exhibit one of Clayton's patent Excelsior noiseless gas engines, which resembles the Otto engine in many respects; circular valves, however, being used instead of sliding valves, but it was not ready in time for exhibition. It has been shown at work at the Gas Exhibition, North Parade, Bradford, and is spoken well of; but we have had no experience of its capabilities, nor can we say what its consumption of gas may be. Bischoff's well-known and excellent little gas engine was shown at several stands. We illustrate it in the annexed cut. There is a piston valve only in this engine



which, when raised, opens the exhaust, and when closed admits air and gas to the cylinder. When the piston is raised it draws in the explosive mixture, and when the valve rises this mixture is exploded by a jet R outside, and drives the piston to the top of the cylinder. The gases quickly contract, and a partial vacuum is made which aids the descent of the piston, but it is essentially single-acting.

Mr. Turner, of St. Albans, showed a neatly-made vertical gas engine. This is of a very simple type, the mixture of air and gas admitted below a long trunk piston being exploded by a flame outside the slide valve. The working cylinder is placed in a small square tank or jacket containing water to keep it cool, the jacket being fitted with flow and return pipes communicating with a suitable cistern. The most defective point about this engine is the arrangement for lighting the explosive charges. We do not know how the case may be when the engine is carefully sheltered, but when working in the Kilburn showyard about twice as much gas at a moderate computation was being used for ignition alone as for producing power.

The most scientific labourer at the production of an efficient gas engine is beyond question Mr. Clerk, who had two gas engines at the stand of Messrs. Thomson, Sterne, and Co., Glasgow. One being an improvement on the engine exhibited last July at Bristol, and then illustrated in The Engineer; the other being an entirely new engine. As the foreign patents for this engine are only now being completed, it would not be fair to Mr. Clerk to say too much concerning this new motor with which he informs us he has succeeded in getting a horse-power out of but 15 cubic feet of gas per hour; the lowest consumption yet reached. In the other gas engine, a mixture of air and gas is compressed to about 30 lb. on the square inch and then exploded, the cylinder answering the purpose of a compressing pump as well as a place in which power is developed. In the Clark engine, a mixture of air and gas is also compressed and subsequently exploded, but a compressing pump is used, and all the arrangements are quite different. Indeed, neither the degree of compression nor the proportion of the mixture is the same as in any other. This

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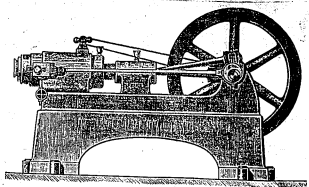
engine has two cylinders of equal diameter; one cylinder is an air pump and the other is the motor cylinder. The air pump takes through an inlet valve a mixture of gas and air, and compresses it into a small reservoir, from which the motor cylinder is supplied when required through an inlet valve worked by an excentric on the crank shaft. On this inlet valve closing, an ignition port in a small slide opens to the motor cylinder, the gases in which are immediately ignited, the pressure rising no quicker than in a steam engine, and falling slowly by expanding, doing work on the piston as it moves forward. The igniting arrangement is entirely new; it is very simple and is absolutely certain in its action. The ignition port already mentioned contains a small platinum box or cage, and all that is required to start the engine is to send through the platinum a current of gas and air from the reservoir, and in about half a minute the platinum is at a bright white heat. To start the engine it is only necessary to open a small valve. This novel and very ingenious arrangement of ignition will enable the gas to be ignited at every stroke, and as many as 400 ignitions have been made per minute; but as the engine runs at about 200 revolutions per minute, there is only the same number of ignitions. The piston speed of this engine is so regulated in relation to the high pressure utilised, that less heat is lost through the sides of the cylinder, and more is converted into mechanical work, than is the case in slow-running engines, whereby a great economy in the consumption of gas is effected. Messrs. Thomson Sterne, and Co. are now engaged in building gas engines of 30 nominal horse-power, and on a future occasion we shall have more to say on the subject.

The improvement effected in the vertical engine has been made by Mr. Handyside, and is very simple; it will be remembered that this motor is really a hot air engine, worked with petroleum vapour, although gas may be used for the purpose, a flame being constantly kept burning in the cylinder, and no explosion taking place. It has been found that in this and all other engines of the kind a deposit of carbonaceous matter—mingled soot and grease, in fact—takes place, and operates very prejudicially on the piston. Again, the piston rings work up into the hottest part of the cylinder, and are thus speedily destroyed. Mr. Handyside's improvement consists in substituting a plunger for a piston, which plunger works in a very ingenious metallic packing, adjustable from the outside at the cool end of the cylinder. As the trunk or plunger which passes through this is exposed once at every revolution to the air outside the cylinder, through which it moves rapidly, it is efficiently prevented from becoming too hot. The arrangement is ingenious and works very well.

Messrs. Lewis Simon and Son, of Nottingham, exhibited the gas engine illustrated and described in our impression for January 17th, 1879.

We believe that we have now freely noticed all the gas engines exhibited at Kilburn. If there were any others there they were buried in mud or otherwise inaccessible. The manufacture of gas engines promises to become a very important branch of engineering, and if, as is not improbable, the consumption of gas can be brought down to 10 cubic feet per horse per hour, the steam engine for moderate powers will no longer be the most economical motor. One-third of a penny is not much to pay for an indicated horse power per hour.

Over



CLERK'S PATENT GAS ENGINE.

Progress, July 1879

ATTENTION is steadily directed to the price of gas in the great cities and on further examination I find that the neighborhood to the coal, which is a necessary ingredient in the production of this illuminating element, is a controlling factor. There are three companies in Brooklyn, where the price ranges from $2.00 to $2.50 per thousand; three in Baltimore, where it is $1.50 and $2.00; three in Pittsburg, where it is as low as 75 cents and $1.50. In New York city the movement for cheaper gas is pressed with a determination that is sure to produce good results.

Soon July 1879.

GAS LIGHTING EXPERIMENTS.—Colonel Haywood, C.E., the engineer in the City Commissioners of Sewers, has reported in favor the results of an experiment now being made in a portion of Queen Victoria Street, between Mansion House Station and the Poultry, with new gas burners, by the Gas Light and Coke Company, at the Company's own expense. The experiments commenced on the 6th March. The new lamps are fitted with the "Sugg London Argand" burners, with glass chimneys. They are of two sizes—one consuming 10 cubic feet of gas per hour, the other 30 cubic feet. The gas is consumed in the smaller burners in two concentric columns or rings of flame, and in the larger burners in three rings. The burners are so arranged as to be self-lighting when the gas is fully turned on. They are in lanterns of the ordinary description, the smaller in the form of a hexagonal in plan, and the larger in twelve-sided lanterns. The lanterns are larger than those generally used, and have the upper parts glazed with a new kind of white glass, which partly reflects and partly transmits the light. The lower portions are glazed with ordinary clear glass. Proper means are provided for ventilation, and preventing down-draughts. There are 30 of the smaller and 5 of the larger lamps, and they supersede 35 ordinary lamps. The length of the street lighted is 1,100 feet. The burners consuming 10 feet of gas per hour have an estimated illuminating power of 80 candles, and thus 30 lamps are equal to 2400 candles. The 30-feet burners have a power of 200 candles, and five lamps are thus equal to 1000 candles. The 5 large lamps temporarily superseded 35 lamps of 720 candles, or 25,200 candles. The 30 small lamps. The cost of the 35 ordinary lamps superseded is £1 17s. 6d. each per annum, or the large £21 0s. 0d., or £777 0s. 0d. in all. The cost of the smaller experimental lamps is £10 0s. each per year, and of more costly then she did. The general result, therefore, is nearly three times larger as much light as that in general use, and lasts about three times as much. It should be added that the experiment is being conducted at the sole cost of the company.

Engineering 4th January 1879 Gas Lighting in Public Streets

Gas Stocks.

New York, Friday Evening, July 18, 1879.

We note a steadier market for gas stocks, a slight improvement being reported in the stocks of the Manhattan and Metropolitan companies. The stock of the Municipal is down 82 per share. The Metropolitan Gas Company publishes the following advertisement, which, it will be observed, contains many valuable suggestions, and we are free to predict that this war of the gas companies of the metropolis, if continued, will ultimately result in great good, both for consumers and the companies themselves.

OFFICE OF THE METROPOLITAN GAS LIGHT CO.,
BROADWAY, corner 29th st.
New York, July 16, 1879.

From the 1st inst. the rates for gas will be as follows: Those using less than 5000 cubic feet per month, $1.75 per 1000; 5000 to 10,000 cubic feet per month, $1.50 per 1000; and to those using larger quantities, a further reduction is made.

We constantly take advantage of and adopt every improvement in the manufacture of gas and endeavor to furnish a superior light, which shall, at the same time, be pure and safe to the consumer.

We also call your attention to the utility of gas as the above rates for power, cooking, etc. No ashes, no coal, no ashes, and less labor.

Indianapolis Gas Works.—The contract for building the gas works at Indianapolis, Ind., will be awarded on the 25th inst. to Messrs. Coppell & Co.—The company will sell of 2,240,000 feet during the year just ended—a falling off in quantity corresponding to the previous year—which gas is chiefly responsible.

Gas Consumers Gas Question.—At the meeting of the Gas Consumers' Association, held on Tuesday, June 24th, a report by Mr. Bennett was read, which referred to a Committee of the Whole. It fixed the price of gas at 3s per 1000 feet, net, at which rate the city would be saved £25,000 per year.

The Tillsbury Gas Co. has declared a dividend of $2 per share.

ADVERTISED RATES:

Leavenworth (Kan.) Gas, Co.—20 shares, at 40.
Owensboro (Ken.) Gas Co.—40 shares, at 71.
Lawrence (Mass.) Gas Co.—5 shares, at 135.
Lowell (Mass.) Gas Co.—5 shares, at 141½.
Lowell (Mass.) Gas Co.—5 shares, at 141½.
Portland (Maine) Gas Co.—10 shares, at 110.
Saco (Maine) Gas Co.—6 shares, at 90.

The following list of companies in New York and vicinity is reported weekly by Messrs. Hunter, Dimmick and Dodge in this STAR, No. 52 Broad street:

COMPANIES IN NEW YORK AND VICINITY.	CAPITAL STOCK.	PAR.	DIVIDENDS. LAST PAID.	DIVIDENDS. PAID IN 1878.	QUOTATIONS. PRICE OF 1878.	QUOTATIONS. PRICE OF 1879.	QUOTATIONS. LAST.
Bklyn, N. Y.	2,000,000	50	P. ct.	P. ct.			
N. York	2,000,000	100	3	Apr., '78	90	90	90
Harlem	2,000,000	50	3	Apr., '78	70	70	70
Metropolitan	5,000,000	100	3	Apr., '78	100	100	100
Municipal	2,000,000	100	3	Apr., '78	100	100	100
Bklyn, Nassau	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Citizens	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Central	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Mutual	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Equitable	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Consumers	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Fulton	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Peoples	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Bushwick	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Williamsburg	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Standard	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Manufacturers	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Nassau	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Citizens	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Central	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Mutual	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Equitable	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Consumers	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Fulton	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Peoples	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Bushwick	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Williamsburg	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Standard	1,000,000	50	3	Feb., '78	50	50	50
Bklyn, Manufacturers	1,000,000	50	3	Feb., '78	50	50	50

Engineering July 1879

Gas at Boston.—The sales of gas effected in 1878 by the Mutual Company for Lighting and Heating by Gas were united to 7,310,319 cubic metres, or more than 260,000 cubic metres in excess of the sales of 1877. The net profits realized by the company in 1878 were 90,283l., or 15,037l. more than the corresponding net profits in 1877.

Miscellaneous Items.

METROPOLIS GAS SUPPLY.

The following is an extract from the report of Dr. Williamson, F.R.S., the Chief Gas Examiner to the Metropolitan Board of Works, for the quarter ending the 24th of June:—

I. *Illuminating Power.*—The maximum, minimum, and average illuminating power in standard sperm candles at each of the testing-places were—

	Max.	Min.	Aver.
The Gaslight and Coke Company—			
Beckton	17·5	16·3	17·0
Friendly Place	17·5	16·3	17·0
Hilly Fields (barrel gas)	19·4	18·2	18·7
Ladbroke Grove	17·8	16·6	17·3
Lewis's Mews	17·8	17·0	17·4
Curtain Square	17·8	16·6	17·3
Tyssen Street	17·8	16·6	17·3
Graham Road	17·8	16·6	17·3
Commercial Gas Company—			
Barrel Road	18·2	16·2	17·3
Old Ford	18·2	17·4	17·8
South Metropolitan Gas Company—			
Hill Street, S.E.	17·3	16·7	17·0
	19·4	16·2	17·6

At all the stations of the three Companies the average for the quarter has been above the parliamentary standard, especially at the Beckton, Ladbroke Grove, Lewis's Road, Camden Street, and Graham Road stations of the Gaslight and Coke Company, and the two stations of the Commercial Gas Company.

II. *Impurities.—Sulphur.*—Sulphuretted hydrogen has not been present in the gas at any of the stations. The proportions of sulphur in other forms than this were—

Grains of Sulphur per 100 Cubic Feet of Gas.

	Max.	Min.	Aver.
The Gaslight and Coke Company—			
Beckton	11·5	9·1	10·2
Friendly Place	11·5	9·1	10·2
Hilly Fields	11·5	9·1	10·2
Ladbroke Grove	11·5	9·1	10·2
Lewis's Mews	11·5	9·1	10·2
Curtain Square	11·5	9·1	10·2
Tyssen Street	11·5	9·1	10·2
Graham Road	11·5	9·1	10·2
Commercial Gas Company—			
Barrel Road	12·1	9·7	10·8
Old Ford	12·1	9·7	10·8
South Metropolitan Gas Company—			
Hill Street, S.E.	12·4	9·1	11·8

From these results it will be seen that at all the stations of the three Companies the maximum has been within the requirements of the Act of Parliament, and that the average in all cases considerably better than required by the Acts.

III. *Ammonia* has been present in the gas during the quarter, in slight quantities, at all the stations of the three Companies, with the exception of the Hilly Fields station of the Gaslight and Coke Company, situated in the Kingsland Road. The Chief Gas Examiner to the Board on the 23rd of May last, that, in consequence of the ammoniacal liquor from the Hilly Fields station not being mixed with the Gas Referees on the 16th of May, and a letter has since been received, in which the Referees state that they propose to prescribe, as a testing-place for the gas manufactured at the works in question, the testing-station already fitted up and used by the Company, and which is situated in the Kingsland Road, from the works. The Chief Examiner states that he will shortly examine the place on being satisfied that the gas supplied to the proposed testing-station is identical with that supplied from the purifiers works. The Referees, at the same time, intimate their concurrence in the views of the Board as to the selection of the testing-place at Beckton; and that they also propose to establish the testing-place now prescribed, by them at Friendly Place, Bow, and to establish three testing-places within the area of the district recently added to the limits of the Metropolis.

The Chief Examiner has no early intimation thereof should be given to the officer engaged in the testing of the gas supplied from the Beckton works, recommended—That notice be given to Mr. Young of the intention of the Gas Referees to discontinue the testing-place at Beckton, near Barking, to which he was appointed Gas Examiner by the Corporation of London and the Board conjointly; and that he be informed that, on the discontinuance of the testing-place, his appointment as Gas Examiner on behalf of the Board will cease."

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 25, 1876.

Circular to Gas Companies.

THE Alliance and Dublin Gas Bill has passed a Committee of the House of Lords, but the influence of Sir Arthur Guinness has so far prevailed with Earl Redesdale that all clauses in the Bill which would directly or indirectly give the Company power to supply the electric light have been struck out, or amended so as to prevent the Company from having any authority in respect to it. Of course, it was never intended that the Company should have any exclusive power to furnish the electric light. It was settled long ago that no such exclusive privilege could be granted; but the Company were fairly entitled to make experiments with the light, as it promised to lend itself to their service. There are questions behind, which would, of course, require consideration. For example, whether the Company supply capital, granted to them for the purpose of supplying gas, to making experiments with the electric light? The answer of their opponents would, of course, be a very ready one: No such power can be conferred. As for a monopoly to supply the new light, no one dreams of such a thing. The Company might demonstrate the feasibility of illuminating public spaces and large interiors, but the making the slope of a monopoly could be granted. We may take the Bill as it is now amended, and as it will pass, with the remark, that it will be long before Dublin rejoices in the exhibition of an electric light. The impecunious Corporation could do nothing, if they had the will to do anything. Adventuring inventors may come from all quarters to exhibit their lights; but if they are successful, who is now to take them up and make them render public service? The Corporation never will, and now the Gas Company are prohibited. Who, then, will introduce the electric light to Dublin? We look on the fate of this Bill as in every way unfortunate. It was promoted with the best possible intentions, and if it had been carried in its form in which the Company proposed, it would have given them the opportunity of employing the light or not as it seemed convenient in them. As it is, it is left to the Corporation or a new Company to promote a Bill when the electric light has been so developed that its exploitation promises to be interesting to the public and advantageous to investors. We know very well that the Corporation will never do anything, and as for a new Company, the chances of raising capital for any public purpose in Dublin are very remote indeed.

In other columns we publish a report of the proceedings on the Liverpool Lighting Bill before a Select Committee of the House of Commons. The evidence was of a very interesting character, and fully bore out our opinion that the object of the Liverpool Corporation was to gain a foothold for the supply of light for public and private purposes. In this attempt, however, they have been disappointed; but sufficient power has so far been given us will enable them to make a series of experiments to ascertain whether or not the electric light may be made permanently available. The Bill, as we said last week, will be opposed in the House of Lords, with what result we know not. It is curious to note that the Corporation do not show their hands, or give us any idea of what they intend to do if they should gain the power which is now withheld. What system of lighting do they propose to adopt? Is it the Jablochkoff, the Lontin, the Rapieff, or the Werdermann? or do they intend to rely upon Mr. Edison's inventions, of which as much is now being written? It seems probable that as long a time will be taken in considering the light to be adopted, as has been consumed in arriving at a decision as to the sites and a new water supply. In this case, the five years which the Committee have granted to the Corporation will be occupied in perfectly useless discussions, without a single electric light being displayed. Corporations never very slowly, and, considering the vagueness of the propositions for electric lighting now before the public, we shall not be surprised a see the five years pass without any decision from the Council as to the best light to be adopted. But our speculations are at present premature; we must wait the result of the deliberations of the Lords Committee before we express any further opinions.

The cause of the explosion at the Dartford Gas-Works, to which we referred in our last issue, is now made tolerably clear. The cast-iron tank, standing about 16 feet out of the ground, gave way under the pressure of the water, which ran in torrents all over the works, and, as a matter of course, the seal being removed from the holder, the gas escaped. There can be little doubt the first explosion occurred in the open, but as the gas escaped from the holder, air, of course, got in, and thus there resulted an explosion within the holder. It is quite clear that nothing but a violent explosion, caused by the ignition of mixed air and gas, could have wrought so much destruction, and how the air got into the holder is now perfectly explained. The moral of the accident, so far as we can see, is that managers should look after the strength of their cast-iron tanks.

A majority of the Town Council of Hanley are waking up to the fact that a gas-lamp is generally under a policeman for the preservation of social order. The respite in the town of "sans-and-dog fight" celebrity are solicited to committing assaults on the police and innocent passers-by during the dark hours. Hitherto the Town Council have not lighted the lamps in the borough during the months of June and July, and it would appear that it is just in the dark hours of these months that most burglaries and assaults take place. It is an old remark with us that gas has contributed more than any other agency to the safety of our streets, and we feel certain that the Town Council of Hanley will never regret the small expense they will incur by lighting the streets during the dark hours of the summer nights this year exceptionally dark.

The Directors of the Commercial Gas Company have given notice that from and after Midsummer-day but the price of gas will be reduced from 4s. 6d. to 4s. per thousand feet. The standard price of the Company, subject to the sliding scale, is 3s. 9d. per thousand; thus they might, during the past half year, with a charge of 3s. 6d. per thousand feet, have paid a dividend of eleven per cent. As a matter of fact, however, they have only paid ten and a half per cent. Now that the price is reduced by another twopence, they will be enabled to pay eleven and a half per cent. Supposing all things to go well, we may expect that the first dividend declared by the Company next year will be eleven per cent., which will make them the best paying Company in the Metropolis.

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65 Coal trade Journal

PRICES FOR GAS COALS, AT NEW YORK.

Penn and Westmoreland, $4 60; (At Amboy $4 20, at Philadelphia, $3 75.)
Staten Coal Company, $4 50; (At Philadelphia, $3 75; Staten Is. $4 50.
Wurster Youghiogheny, $4 60; (At Baltimore, $3 75.)
Murphy Run, Newport, Pittsburgh, Monongahela, Newburgh Crest, Tyrrconnel, Palestine, Pittsbridge, etc., etc., $4 25 at New York; $3 25 at Baltimore.
Cannelton gas coal, $4 60; (At Richmond, $4 75.)
Cheapeake and Ohio Agency, 5-6 coal $4 00.

Pictou and Cumberland Canmel, quoted at $9 per ton at New York—shipped at Richmond Va. 2nd Bank Cannel, $5 50 per ton,—$4 00 f. o. b. at Philadelphia.
Newcastle $5 00. Liverpool Steam Orrel, $11. Iron Hall Cannel, $11—for gas $5 00
Scotch, $7 00. Nova Scotia, $3 75 to 4 00 as to quality, nominal.

A company called the Municipal Gas Light company of St. Louis, has applied for permission to lay gas mains in that city. It apparently intends to manufacture gas by the same process as that used by the Municipal Company of this city. It offers to furnish gas at a lower pressure and candle power for $1 per 1,000 feet, and to light the city lamps for not over 200 a year each. The price of gas in St. Louis is now $2.50 per 1,000 feet, and the city pays $27.50 a year for its street lamps.

Journal of Gas Lighting, water supply, &c. July 15 1876

THE GAS AND WATER COMPANIES ASSOCIATION AND THE APPLICATIONS FOR ELECTRIC LIGHTING POWERS.

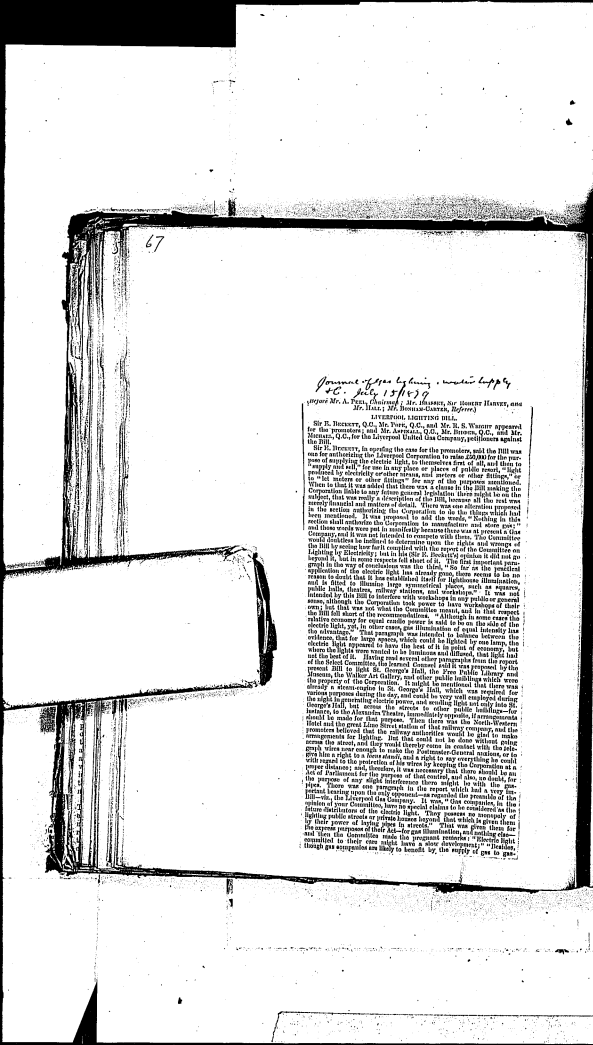
SIR,—In replying to Mr. Livesey's letter, which appeared in the last number of the JOURNAL, relative to my remarks at Newcastle upon the Gas and Water Companies Association, I will not discuss the question as to whether the action of the Committee was right or wrong in the matter of the electric light clauses. That was not the principal object of my remarks, though Mr. Livesey has thought it right only to dwell upon this. My remarks were intended to be of wider scope, and of a more general character. They referred rather to the constitution of the Association, the general conduct of its business, and the support given to it by the Companies.

That which I aimed at was even by yourself, as in your "Circular" of the 17th ult. it is said: "The Gas and Water Companies Association may not in all that could be desired; but wherever they fail, it is no reason, entirely the fault of the Companies, whose interests are identified over with the most zealous care by the energetic Secretary of the Companies Association, who is, we believe, left almost entirely to bear their deficiencies. A stronger combination, as Mr. Warner proposes, is undoubtedly desirable; but it can only be effected by the more hearty co-operation of the Companies themselves." Mr. Livesey himself says the same in some thing, but in other words, thus: "The remedy rests in the Gas and Water Companies Association generally are legitimate, and the suggestions would, I think, produce beneficial results if acted upon."

Though I know nothing of the actual position of the Association, I have an impression that what is most needed is a greater interest to be taken in its working, and a higher appreciation of the value of its work. More like attendance on occasion of members, which doubtless is greatly needed, would quickly follow. The members of the British Association of Gas Managers render good services by pressing the matter upon their chairmen, and discussing it before their friends. The Gas and Water Companies Association has a special claim upon us, too, just now, from the good work it has done through the present session. It effectually in my other way. An Association feebleness must have, if properly established and fairly managed, greater influence than any private combination for guarding our common interests when attacked, and, further, the Association can grow in experience and influence, and it has its machinery always ready for work.

Now the subject has been opened up, I do hope that the estimable Secretary will be encouraged to renew his efforts to place the Association in the position it should fill.

South Shields, July 10, 1876. W. J. WARNER.



Journal of Gas Lighting, Water Supply & &c. July 13 1869

REPORT MR. A. PAGE, *Chairman*; *Mr. Hargreave*, MR. GEORGE HARVEY, AND *Mr. Hall*; MR. HOUSE-CLERK, *Reporter*.

LIVERPOOL LIGHTING BILL.

Sir R. Bickersty, Q.C., Mr. Pope, Q.C., and Mr. R. S. Wansey appeared for the promoters; and Mr. Archibald, Q.C., Mr. Bidder, Q.C., and Mr. Morgan, Q.C., for the Liverpool United Gas Company, petitioners against the Bill.

Sir R. Bickersty, in stating the case for the promoters, said the Bill was for the purpose of enabling the Corporation to raise £250,000 for the purposes of supplying the electricity, to themselves first of all, and then to "supply and sell," for one in any quantities, to any persons, any light produced by electricity or other means, and motive or other force," light to "let meters or other fittings" for any of the purposes mentioned. When the Bill was first introduced there was a clause in the Bill making the Corporation liable to any future general legislation there might be on the subject of electric lighting, but a deputation of the Bill, because it did not merely benefit and matters of detail. There was one alteration proposed in the section which limited the powers of the Bill to the places which had been specified. It was proposed to add to the words, "So-thing in this section shall authorise the Corporation to supply light to any place or district and those words be put in specifically where was at present a clear Company, and it was not intended to compete with them. The Committee of the Bill's coming here fairly complied with the report of the Committee on Lighting by Electricity Bills (Sir F. Peckston's opinion it did not go far beyond it, but he was content to let him stop at it. The first important paragraph in the way of competition was that which refers to the practical application of the electric light that already exist, there seems to be no reason to doubt that it has established itself for lighting large manufactories and be fitted to illumine large symmetrical places, such as squares, public halls, theatres, railway stations, and workshops." It was not intended that it should interfere with warehouses in any public or general areas, although the Corporation took power to have warehouses of their own; but that was only to meet a particular case. The Bill did not in that respect relative economy for equal candle power in the case of the electric light, gas, in other cases, the illumination of equal intensity has the advantage. That paragraph was intended to indicate generally how competition was to be carried on, and it was proposed by the Bill that large spaces, which could be lighted by one lamp, the electric light appeared to have the best of it in point of economy, but where the area was limited to a hundred and fifteen feet radius of the not the best of it. Reading over several other paragraphs from the report of the Select Committee, it would be seen that it was proposed by the Bill to illumine the Walker Art Gallery, and other Public Library and the property of the Corporation. It might be mentioned that there were already a steam-engine in St. George's Hall, which was required to work pumps during the day, and could be very well employed during the night in generating electric power, and sending light not only into St. George's Hall, but also to the streets or other public buildings—for instance, to the Sessions House, immediately opposite, if arrangements could be made for that purpose. The Bill was for the North-western Hotel and the great Lime Street station of that name, and the North-western directors believed that the railway authorities would co-operate, and the arrangement would be for the benefit of the public, as they could not do those with the electric light. The cost of supplying light by the means proposed by the Bill would be much greater than the present cost of supplying gas by existing electricity to illuminate. Look at those which they could not light by gas. Gas Company's Hall and the area of the Exchange, and other places connected with them. They could creating a subterranean communication between the Exchange buildings, and they hoped they could erect steam-engines at each of those Railway Company could not be expected to go to the expense of laying down pipes for the purpose of supplying gas to the Corporation, and permission to do so by merely laying a pipe, according to the Corporation, and the Bill was one principally to enable the Corporation to do what they could not do without it. The Bill was opposed by the Liverpool Gas Company. It was, "Gas companies, to the opinion of your Committee, have special claims to be considered in the lighting public streets or private houses, which is given them by their power of laying pipes in streets." That was given them for the express purposes of their Act—for gas illumination, and nothing else; and then the Committee made the proposal somewhat ridiculous—"although compelled to their care might have a slow development," "electric light though gas companies are likely to benefit by the supply of gas to gas-

opinion, when you were called as chairman for producing electric light, as general principle, if gas manufacture and supply are under public control for the production of electricity as a source of illumination." That having any right of control over gas or future, to have anything to do with electric lighting, using it in the most remunerative sense. Then they went on to say that they "do not consider that they can arrive at any general powers to control gas companies in the interest of the local authorities," but they would be willing to grant to the Corporation "power to purchase the undertaking of any gas company, on such terms as may be agreed upon between the progress of invention brings a demand for facilities to transmit electricity for the purposes of gas, and makes it necessary to consider the question of the public interest." That was an important remark—"then, no doubt, the Corporation" that was an advantageous for a monopoly of the supply of electricity for illumination. The Liverpool Corporation were willing to take to the Bill if it was to say, if the Corporation already possessed the power to supply and make the company—the monopoly of the supply of electricity for illumination, compensating advantages. It was to take that the public should receive notice upon the public illuminations, and there could be no conflict between them and any company as to the supply of electricity. It was very difficult, whenever the time arrived, to enable, so as to obtain, through its corporation, the compensating advantages. It was directed against anybody who had a right any gas streets, and that was the case called a monopoly for the whole the electric light. It was not a monopoly for the whole, but somebody must take the lead in the matter, and there was no corporation in England more fitted to do so, and there was no corporation in Liverpool or Manchester, and possibly others in Corporation as that of the Liverpool Corporation were willing to take the leading them out, if experience had already conveyed for the benefit of the town and the company—the company—for the benefit of the town in some instances Liverpool had taken the lead, for it was the first to lay down in 1866, in Dublin, power was given for the express purposes of using the electric light, founded upon the Liverpool Act, and the Liverpool Act was also similar. That was the case of the Liverpool Corporation, and if there were any gas companies there was no reason why the Corporation should not have power to deal with the electric light in connection with the additional light which had grown up of the Liverpool Corporation had before them two agreements which had been entered into between the Corporation and the Gas Company. The first was with reference to the electric light, and that, generally, parity with reference to purchasing the undertaking was entered into between the Corporation and the Gas Company. The second agreement inserted other matters had been arranged and also the purchase price of the undertaking. The first agreement was to the Corporation the exclusive and other powers were granted (Sir R. Bickersty thought that was not necessary, and, for it was the first time in the Bill as it originally stood, that paragraph was written with a view to include the present Bill; but it could hardly be applicable so far as mean that, especially as his learned friend had already fully understood in the Bill was an important one, as it was the first time that the Corporation had taken powers to supply electricity. When they said, "We undertake to exercise electricity authority," they had to do with the undertaking of the Corporation character." In some cases it was true, but in another it was not; it had been a long course in particular cases, and it was not to be supposed that the Corporation would not have such powers. It was not to be supposed that the Corporation would not have such powers. It was not to be supposed that the Corporation would not have such powers. It

of each. I am advised that we require this Bill to empower us to take up the pavement. We have not tried to do so, and been stopped from proceeding. I am aware that competent authorities have advised that we have the power, and that evidence was given before the Select Committee to that effect.

Mr. Bidder: I see that the marginal note to clause 2 of your Bill is, "Power to supply electric or other light to public streets and places;" so that you not only contemplate illuminating St. George's Hall from the approaches to the landing-stage, and possibly some other avenues, but also supplying electric light for private purposes?

Witness: I do not think that at all likely.

Mr. Bidder: The words in the Bill are, "In any place or places of public resort."

Witness: That means railway-stations, theatres, and music-halls, but I do not know whether they are contemplated, although there is no reason why some of the rooms in the large hotels should not be lighted by electricity.

Mr. Bidder: When you come to light the theatres, music-halls, and hotels to any quantity, what is going to be the effect upon the business of your present clients?

Witness: I do not think that such lights as are likely to take place, having regard to the state of the invention up to the present time, will permanently depreciate the value of gas shares.

I did not ask you anything about the effect on gas shares; but it is not obvious, if you carry out your intentions, you will deprive the Gas Company of a considerable part of their public places of resort?—The use of gas in the particular places we might have provided the electric light would, of course, be gone; but, to counterbalance that, there would, I believe, be a very large use of gas in gas-engines for driving machinery, the machines, I am inclined to think, also, that the time is coming when there will be a demand increased illumination generally in all places of great traffic. I am satisfied that when gas companies find that their 10 per cent. is not forthcoming from them, they will discover other uses for gas, in the way of heating, which it is not now applied.

The Chairman: I think that will have anything to do with the effect of this upon the Gas Company or the gas shares.

Mr. Bidder said, with great respect, that the whole question before the Committee was whether the Corporation were entitled to ask for parliamentary power to do a thing which would injure the Gas Company, which had a parliamentary position; or, if granted, upon what terms, so as to protect the interests of the Company. Before many Committees there had arisen questions as to the supply of water and gas under tidings into the hands of corporations, and in some cases with most important question which the Committee had had to deal with was upon what conditions and with what terms, for the protection of the existing parliamentary company, they would grant the power asked for.

The Chairman: They only consider we have to consider is whether the existing rights of the Gas Company are interfered with, and their property and their business; and we have nothing to do with gas pipes, or interfering with their supply to their customers. I do not see how the Engineer can go into those questions.

Mr. Bidder: I must lay a foundation of fact with the Engineer. You, Sir, were the Chairman, I think, of the Committee on the Stockton and Middlesbrough Bill, the opinion there being practically, though it was fought out in a different form in different years, whether the Corporation should be allowed to supply water to the ships. They ultimately obtained it, but only upon the condition that they should purchase the rights of the existing Water Company at rates which were to be settled by arbitration, or precisely in the same position as the Water Company were. We are, under the authority of Parliament, the Lighting Authority of the town of Liverpool, and nobody else can light that town. With the sanction of the Town Council themselves, and with the sanction of Parliament, our capital is practically unlimited for the purpose, and I do not hesitate to say that the most important question for you to consider in this case—when one of the two parties to that bargain is about to commence a new trade under parliamentary power that may ruin us with our business, and asking you for powers which it is admitted will make it difficult for us to earn our dividends—is upon what conditions you will grant it.

Witness: I do not admit that.

Mr. Bidder: I am assuming that lighted existing companies are preserved. This is not a screwed on the part of the Corporation to light the whole of Liverpool with the electric light.

Mr. Bidder: It is a proposal to light the streets and places of public resort, and thereby to take the cream of our business away from us.

Mr. Pope: It is no more a proposal to take the cream of your business away from you than the proposal to make a railway from Manchester to Liverpool is a proposal to take away the cream of the coaching traffic away.

The Chairman: We will leave it to the learned Counsel to pursue his own course.

Cross-examination resumed: As a matter of fact, we break up the streets ourselves, and give permission to others to do so for certain purposes. We have express statutory powers to give authority to lay down rails across the streets in places in which both sides of the streets are occupied by houses. Under those powers I have no doubt we have given authority to the Telegraph Company to lay their wires under the footpaths, but they had the consent of the Corporation.

Mr. Bidder: If they had power to do so they would not have asked you to allow them to do it.

Mr. Pope: They had authority to do it with the consent of the Street Authority.

Mr. Bidder: They had power to lay their wires either overhead or underground, and I submit the Street Authority have power to lay them underground, if they like. A different power is given to others, and it is proper to take them overhead, and not underground.

Re-examined by Mr. Pope: If we have the power to do any mischief to the Gas Company without an Act of Parliament, our obtaining that Act will not do them any harm. Another point is that, supposing, only for the sake of argument, the whole of the public lighting in Liverpool were done away with, there would be a mere trifle in the accounts of the Gas Company. Since the report of the Select Committee I have had a letter from a gentleman from Messrs. Siemens Brothers with reference to the advantage of placing the electric light at a high elevation, instead of on a level with the eye, so as to diffuse the light over a larger area, though diminished in intensity. On that point I may, however, say that there are some practical difficulties in placing an electric light very high in a town; but I think they difficulties may be overcome by diminishing the intensity of those lights which are placed at considerable heights, and making the rays, therefore, very intense as you approach them—by means of gas screens, which will not obstruct the light passing to greater distances; and then, if above the light properly constructed reflectors are placed, the whole of the light may be utilised that would otherwise be lost by passing upwards, and it may be thrown to a great distance and also downwards.

The Chairman: It is not very clear what the provisions of the Bill are. What I understand is that you propose to limit the effect of the powers in this Bill upon the Gas Company's business, at some future time to be, to petition there is a clause pointing out the effect which it is believed would be produced upon those sources by the passing of this Bill, and, therefore, that point is before the Committee. Now, as to that petition has been lodged, I understand an allusion has been made to the petition which is the foundation of my remarks—that is to say, that the Corporation should supply and sell by agreement for use in any place or places of public resort. How can anybody be injured if there is an agreement necessary?

Mr. Bidder: By agreement with the persons to whom the place of public resort belongs; not agreement with us. It means, for instance, that we should not be able to supply electricity away from the Company.

Mr. Pope: No doubt, assuming that to be the true construction of the petition, it would be competition between the electric light and the Gas Company.

The Chairman: Is there any compulsory power given to interfere with the mains of the Gas Company?

Mr. Pope: None whatever.

Mr. Bidder: That is conceded.

The Chairman: I think the Gas Corporation it would enable the new mode of lighting to enter into competition with the existing lighting by the Gas Company. If it turned out satisfactorily, without the passing of this Bill, of course electric lighting would be used instead of gas; but if it turned out unfortunately, still the Gas Company would hold their own. It is nothing but the competition of a better mode of lighting with the present mode of lighting, and not interfering in any way with the powers of the existing Company.

Dr. C. W. Siemens, examined by Mr. Pope.

I know the open spaces round St. George's Hall, Liverpool, and the approaches to the landing-stage, and I consider they are very favourably situated for trying this experiment of lighting by electricity. The result of those experiments would prove the comparative advantages and the comparative cost of the one system and the other. The question of cost is one of two elements—the one is the cost of the machinery and everything to produce the effect, and the other is the (incidental) expenses connected with its application. With regard to the first, the necessary expenditure of energy to produce light by gas and the necessary expenditure of energy to produce light by electricity are at present pretty well understood. We know how much energy is necessary, how much expenditure of coal is necessary, to produce a given amount of illuminating power by gas, and we know pretty nearly approximately how much would be necessary in obtaining the same amount of light by means of electricity. But the second question, how the new mode of lighting could be best applied under given circumstances, is a matter that can only be finally determined by experience.

Mr. Pope: We have heard something about the wastefulness of the electric light, by reason of the necessity in obscure it to make it even approximately fit for the purposes of lighting, that the greater part of it is wasted, so as to avail yourself of the whole quantity of light?

Witness: I have considered that question, and I think that the electric light should be treated very differently as regards position from gas light, which must be placed near the object lighted, because its illuminating power is limited; or even if oil or candles were used, they would have to be placed still nearer the object to be lighted. Solar light diffuses itself through space, and the sun is far removed from the surface of the earth, though the sun is far removed from the surface of the earth, its solar light, being nearly of equal intensity to the solar light, should be placed at a considerable distance from the objects lighted; otherwise the light would be in intensity artificially, to be brought to the same level, or nearly so, as gas lighting, because if that were not done, it would be intolerable to the eye. I have considered the question of electric lighting as an engineering question, and I have come to the conclusion that, looking at the practical results by means of the electric light, that light must be placed at considerable elevation, in which case it is not necessary to obscure any large portion of it by means of opal or semi-transparent bodies, because the light will be removed above the lines of vision. On the other hand, if the light were too much subdivided, it would have to be placed near the spaces lighted, and the inconvenience would arise of bringing the source of light within the range of vision of the eye of the spectator.

That would seem to me to point rather to the utility of electric lighting for large spaces, where you can diffuse the light over a large area from an elevated position, rather than for domestic use, where it would be required immediately upon the object sought to be lighted?—Decidedly. It is generally supposed that the rays of the light diminishes as the square of the distance at which it is placed; and a good deal of misconception exists in consequence of that supposition. If a certain amount of light is placed at a greater distance, less practically is produced in consequence of that distance. The portion of that light which falls upon a square foot of space, diminishes as the square of the distance, but it will be found that if the source of light is placed at double the height, it will light four times the area. Therefore, the total amount of light which is utilised is exactly the same, whether the light be placed at a considerable or an insignificant height above the ground. Those views, I think, great deference to be tried experiments such as those proposed in the large open spaces at Liverpool.

By the Chairman: The height at which the electric light should be placed depends upon the breadth of the place; is the particular locality mentioned, I should say about 60 feet. I have spoken with the previous witness that the distribution of power might take place through the same wires as the light was carried, and that it could be used at the same time.

Mr. J. Dewey, examined by Mr. Pope.

I am a member of the firm of George Forest and Co., engineers, Liverpool, and a Town Councillor and a Justice of the Peace. I have given very considerable attention to the subject of electric lighting, in the interests of the town. I desire to see all our public squares and open places lighted by the best possible means. Practically the electric light consists of the evolution of power, which will, by a building effect in so ordinary manner, be expensive and vitiates more air than the human beings in the building do.

Cross-examined by Mr. Aspinall: There is nothing to prevent the companies lighting their stations by electricity, if they wish to do so, providing they do not interfere with the public streets. I do not think it would be a fair stretching of the term "places of public resort" to include railway-stations. I have not considered the question whether those words take anything but what would be their fair and natural meaning. The purchase of the property of the Gas Company has been a subject of debate, but it has been opposed by the great bulk of the Corporation.

Mr. Pope: When the Bill was introduced it was during the "scare," when it was supposed the electric light would supersede gas. It was then suggested that a Parliament might say, "If you will not supply us with electricity, you must buy up the Gas Company," and therefore we took that power.

Mr. Aspinall: You had a Committee in 1877 to confer with the Gas Company in respect to the purchase of the works?

Witness: Some questions were asked; that was all.

Was not this the action of the Committee: "In order that this question may be determined by the Council, your Committee recommend that they should be empowered to negotiate with the Gas Company for the purchase of the gas-works at a price to be agreed on between your

and still introduced a contested special powers to the Corporation to establish the Gas Company, and to buy their property, by agreement. The Bill was originally a company one, asking for powers to use the electric light for certain purposes, and for other powers as large as they could get them from Parliament. There were a number of clauses in the Bill with regard to the purchase of the Gas Company, but they had been struck out; but it was clear that, subject to the provisions of this section, they would be for ever at the mercy of the Corporation if this section were not amended, if they manufacture, lay, or rent, and may sell or let any gas or fuel, or other matter power, and any materials or articles necessary for the purposes of this section." That clause prohibited the Corporation from manufacturing gas; but it gave them power to lay it without limitation, and to sell it for certain purposes. If the Corporation thought it desirable to set up works of their own, they could do so. It was now framed, gave them power to lay down gas mains in any district, and to supply gas to any person as they pleased, and it gave them the power to compel the transfer of undertakings, as the Bill stood. What it was a Gas Bill. That showed the great ingenuity with which the ingenious gentlemen who conducted those matters on behalf of the Corporation, Bill those things. He (Mr. Aspinall) wished particularly to impress upon the Committee that the Bill originally was a power absolutely to enable them—by agreement, certainly—to buy up the works of the Gas Company, and to carry on the business. That was the case in every borough in the country in its experiments for the purpose of seeing whether the electric light was a good thing or not, or did it point to the real intention on the part of the Corporation of Liverpool to get before everybody else, to anticipate general legislation, and to obtain by a private act of Parliament powers which should give them a footing against the Gas Company, which powers, in the first instance, would be limited, but which, if they found that the light was a good one, would also place the possession, as it undoubtedly would do, in a far better position to negotiate with the Company for the purchase of their undertaking, than if there had been no such legislation? A great amount of criticism might be offered upon the extraordinary words, "places of public resort," including possibly as much as the Town Clerk had to select those words would extend to, then being hardly anything, in fact, which they might not be empowered to light under the powers. As the Bill now stood, it was limited to the purposes of experiment, and the words to that end, and if they had gone out of the committee-room with those words as they stood, unlimited, it would have been found that they were dwelling in the first place, with the supply of the public lighting; and then, finding that the supply of electric lighting was a success, and that it was a complete it probably, they would, without further legislation, have been empowered to include themselves the various places of public resort, and so do the Gas Company irreparable injury. That was the argument to be used against the Bill. The Bill was not now in the form in which it originally they required it, it would not be necessary. If they had refused it, they might have had all their valuable buildings lighted up; they might have had a wire from the top of St. George's Hall to the top of the Exchange Building-Room, or they might have taken it under the street without the slightest danger that any gas they would be subject to as to that case which was for their benefit was for their disadvantage. The absolute want of any provision for the protection of the Gas Company was the only way in which it could be said that the Bill was framed. In conclusion, the learned Counsel said he had tried to impress upon the Committee that the proposed Bill might work a serious injury to the Gas Company, and that the anticipation of that general legislation which must take place upon the subject, and which he ventured to suggest the Committee had intended to recommend; which might possibly be quite inconsistent with the proposition which was now before them, and which was, under the Bill as it now stood, to enable the Corporation to apply the electric light to any purpose they pleased, and to place them in a position to negotiate with the Company for the purchase of their undertaking, then if there had been no such legislation? A great amount of criticism might be offered upon the extraordinary words, "places of public resort," including possibly as much as the Town Clerk had to select those words would extend to, then being hardly anything, in fact, which they might not be empowered to light under the powers. 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The committee-room was then cleared. After some time the Counsel and parties were called in.

The Chairman said the Committee had to pass the preamble, with some reservation, but the object the Committee had in view was simply to enable the Corporation to make experiments with regard to lighting by electricity, and the Committee are of opinion that the clauses of the Bill should be scrutinised with the view of effecting that object, and that the preamble should be amended accordingly.

After some conversation, in the course of which Mr. Aspinall intimated that the opposition would be reserved in the House of Lords, the Committee adjourned till Thursday, by which time the clauses to be amended in accordance with the decision announced by the Chairman.

THURSDAY, JULY 4.

Mr. Aspinall said he understood that on Monday the Committee had decided to pass the preamble of the Bill, provided certain clauses were added. The memorandum furnished to him was to the effect that the Committee had decided, and that the Committee had decided to enable the Corporation to make experiments with respect to the electric light. The Bill, however, as he drew from being amended, was not limited to experiment, but been made indefinite more objectionable. The amendments, in point of fact, were the merest evasion, and, considering this circumstance, he certainly would appeal to the Committee to say that the preamble of the Bill was not proved.

An adjournment then took place in order to consult as to the clauses. Subsequently,

Mr. Aspinall he ventured to think that the alterations which had been made had brought them nearly within the decision of the Committee, who had decided to pass the preamble with amendments. The object of the Committee in passing the preamble was solely to enable the Corporation of Liverpool to make an experiment; and he gathered that that decision was illustrated, if not expressed, by the Committee saying that what they desired to avoid was giving the Corporation power to enter into a commercial undertaking and competition with the Gas Company, but to set them experiment in electric lighting without making a profit by the transaction. The object of the Corporation would not be to make a profit, but to try the experiment for their benefit, but they desired that the clauses of the Bill to enable them to carry out that experiment should be such as to make it worth carrying out. If some fabled new electric light on the top of a post was not an experiment; and the question was, how far it would be economically used for the purposes of public lighting, and that experiment, he understood, would be tried by the Corporation. If the Committee would refer to the preamble, they would find that the second section in it was as follows:—"And whereas it was expedient that the Corporation should be empowered to undertake and carry out such supply for means of electricity in the borough;" had they proposed to amend the evidence—? Whereas it is expedient that the Corporation, for the purpose of experiment, be authorised, for a limited period, to manufacture, provide, and supply light for the purposes in this Act mentioned, but not for the purpose of private lighting by means of electricity." The words "for a limited period" were inserted for the purpose of experiment; they would not be entitled to enter into a permanent arrangement, but they must have a limited period to enable them fairly to carry out the experiments that were necessary. Instead of saying "public and private purposes," they said "for the purposes in this Act mentioned." In the preamble they had inserted the words "five years from the 1st of September, 1878," as being the limited period for the purpose of lighting the streets. The Committee had also struck out the clauses which referred to the Corporation from any control. And the result he power of the Corporation to establish the Gas Company, and to buy their property, by agreement. The Bill was originally a company one, asking for powers to use the electric light for certain purposes, and for other powers as large as they could get them from Parliament. 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SOCIÉTÉ TECHNIQUE DE L'INDUSTRIE DU GAZ EN FRANCE.

As lately recorded in the last number (see *Journal des Gaz*, p. 64), the Annual Meeting of this Society was held in the Salle des Ingénieurs, the Sixth (boulevard Sébastopol, No. 62), on the 16th and 17th of June, under the presidency of M. Mallet.

The proceedings opened on the morning of the 16th with the transaction of the usual business of the meeting, and the admission of new Ordinary Members and Associates, 22 of the former and 9 of the latter having sent in applications.

The Secretary then delivered an address, in which he referred to the growth of the Society, and the work of the past year. The experiments that had been made in electric lighting during the past year, frequently occupied their attention. They had instituted a series of trials of the Jablochkoff candle, especially investigative the various systems in use, and were on the point of entering commencing experiments to be undertaken, when one and by the City Engineer, assisted by the Municipal Council of Paris by M. Contamin, Engineer-in-chief of the Northern Railway, and the work of M. Sautiaux, the public. Those experts having failed to agree upon the terms upon which the question had arrived, and given the exact cost of electric lighting by the various apparatuses, it was necessary to put the Society in considerable and interesting position. He then referred to the loss the Society had sustained by the death of M. Pecqueur, one of whose last Magazine had been known not only in connection with the *Télégraphe au Gaz*, and was well director of several gas-works in France and abroad, but as the managing financial position of the Society, he stated that an improvement had been effected over the previous year, by means of additional grants from gas companies and other sources, bringing the amount then placed to the credit of the Society from 1875 to 1877 (inclusive). While acknowledging the Society's financial position, he urged, there was still much to be effected in the way of technical progress, and that the Society must not rest on a single paper 2300 fr., which had been offered to the meeting by the Presidency, amounting to, unequal upon the maximum, especially the younger ones, and to be awarded to such members their ideas to the Committee for the general benefit of the Society.

The Secretary then referred to the question of the illuminating power of simple coke—illuminating power not necessarily to be kept constant; a few —might have considerable influence on the future of the industry. The many practical questions which had been started in connection with the Society's establishment. It was the fate of the Society to have to struggle against difficulties due to the subject of increased illumination, either by electricity or gas—the subject which, for more than a year, had occupied the thoughts of the Society's members, and which, in 1878, would be the question of the Exhibition of 1878. Whether private minds had been greatly troubled by the enlightenment of the electric light, he was not prepared to say, but a few months ago a considerable fall took place in the value of gas securities on the principal Bourses and even the American companies had not escaped the panic. The question of electric lighting, as put forward in a very few years to the place to electricity, not only for the illumination of the public thoroughfares, but also for the lighting of private houses. However, since several gas companies, foremost among them being the Paris Gaslight Company, which occupies a high place in the industry in France, had come to the front, and their establishment in the Rue Caumartin to furnish a most resplendent light in a very simple, practical manner, and at considerably reduced cost. Their system had been carefully studied and proved to the minds of others. The President concluded by announcing that a premium of 2000 fr. had been awarded to M. Bérard, Engineer of the Paris Gas Company, at the last year's meeting, and that the Committee proposed to set aside the sum of 2300 fr. for the next meeting, to be awarded as the Society in 1876.

The usual annual business of the meeting was then proceeded with, including the election of the Committee for the ensuing year, when the following gentlemen were elected, the first two being re-elected, and the sitting closed.

The ensuing gentlemen were appointed Committee for the ensuing year:—M. Jordan, President; M. Rilleux, Vice-President; M. Rousset, Treasurer; and M. Lencauchez, Secretary.

The members re-assembled in the afternoon, and again on Tuesday morning for the purpose of reading and discussing the following papers:—

"On the Influence of the Hygrometric State of Air, Barometric Pressure, and Temperature on the Illuminating Power of Gas," by M. Bérard.

"A Constant Water-Level Gas-Meter," by M. Edmondson.

"A New Regulator for Gas-Burners, and Cock with India-Rubber Closing," by M. Guitton.

"Simplified Method of Work on Electric Lighting written at the request of the Committee by M. Durand," by M. Mimbelli.

"The Recent Improvements in Lighting Thoroughfares," by M. Sugg, Jun.

"On the Value of the Jablochkoff Candle in comparison with the Sugg Regulator," by M. Sugg.

"On the High Power Burner employed at Havre in the Comparative Trials of Gas and the Electric Light for Lighting the Port," by M. Goulier.

"On a Burner of High Power tried at Toulouse," by M. Mallet.

"Photometrical Trials made with Cylinder-coated Lamps and Argandin Burners," by M. Giraud.

"A Self-registering Indoor for Gas and Water Meters," by M. Benjimmyer.

"Facilities of Transport," by M. Jacquet.

"Leroy's New Coke-Breaker," by M. Chevalet.

"A New Apparatus for Heating and Ventilating by Gas," by M. Roger.

"On Pressure in Gas-Mains," by M. Abervelve.

"On Coke Ovens Turbine, and its Application in the Manufacture of Gas," by M. Vee.

"Bibliothèque to be established between Gas-Works," by M. Cutsoent.

"On Gas-Works Accounts," by M. Ch. Fouard.

On Monday evening the members of the Society were entertained at a banquet given by the Imperial Continental Gas Association in the Hôtel Continental, Rue de Rivoli, and presided over by M. Dereeq, the Association's representative at Lille, and the Chairman of other establishments honoured the assembly by their presence. After the toasts had been proposed, the Eagle Gas-Works, which were brilliantly decorated and illuminated for the occasion. In the yard were displayed a number of gas-burners of high illuminating power, mounted upon candelabras, so as to show of their respective merits being justly estimated. Refreshments were provided in a tent, and dancing was kept up to a late hour.

On Tuesday morning a second banquet took place, by invitation, under the presidency of M. Mallet, at which the members of the Society and several guests, including M. Dorrets, were present.

In the afternoon of Tuesday the members inspected the gas-works at Bercy, Vaugirard, Auteuil, and on the following day an excursion was made to Bruneau, for the purpose of visiting the large works belonging to the Municipality. The party, which numbered about 100, was headed by the Engineer-in-chief, and M. Aerts, the General Manager, whose valuable guidance a thorough examination of the works was made, and no one could fail to admire the colossal proportions of this magnificent establishment, which does honour alike to the Engineer who designed it and to the Municipality who, to a large extent, have provided the funds for its execution and maintenance.

On the return to Asnières of the rowing closed, and, on separating, a hearty vote of thanks was accorded by the members to the President of the Society, for the manner in which he had conducted the affairs of the Society during its term of office.

After the excursion to Bruneau, several members of the Society came on to London with the object of visiting the gas-works here, and studying the manufacture of gas lasting apparatus now so largely used in England, on their arrival in the Metropolis, they were met by Mr. W. H. Maw, the Secretary of the British Association of Gas Managers, who kindly placed himself at their disposal, and arranged for their visiting such works as the principal London works, especially the Phœnix, which members were very cordially received by Mr. Corbet Woodall, the Engineer and Past-President of the British Association of Gas Managers, and the Beckton works of The Gaslight and Coke Company, where Mr. G. C. Treweby, the Engineer, did the honours. On following day the visitors were entertained at dinner by Mr. Woodall, who hospitality to express their appreciation of the kindness with which the members of the British Association regarded the Société Technique, and to promote they would always experience in meeting any of their number who might be accessible the very kind welcome accorded to those members of the Association who visited Paris on the occasion of the Society's meeting in 1878. Mr. Woodall dwelt particularly upon the interest aroused by the arrival from a frequent interchange of communications concerning the very important questions which were brought under discussion, and the circumstance might further contribute, and expressed an earnest wish that this was shared by every member of the British Association of Gas Managers. The visit was of purely an scientific character, and the members expressed their thanks to Messrs. Woodall, Treweby, and Bennett for the cordial welcome they had received.

THE PROPOSED SUBSTITUTE FOR CANDLES IN TESTINGS FOR ILLUMINATING POWER.

The following is the letter referred to in the "Circular to Gas Companies" of the 1st inst. as having been recently addressed by Mr. A. G. Vernon Harcourt, one of the Metropolitan Gas Referees, to the Assistant Secretary of the Board of Trade:—

Sir,—I desire to call the attention of the Board of Trade to the untrustworthiness of the standard which is at present in use for estimating the illuminating power of coal gas.

I desire also to obtain the sanction of the Board of Trade to the introduction at the testing-places established for testing gas supplied by The Gaslight and Coke Company, the South Metropolitan Gas Company, and the Commercial Gas Company, of a more trustworthy standard.

Under the Acts of the above-named Companies, the Gas Referees are charged with the duty of prescribing the materials and apparatus to be used within the testing-places for testing the illuminating power of gas. Soon after my appointment, in 1872, as one of the Gas Referees, in the course of experiments upon the effect of heating gas with a view to its purification from sulphur, the inaccuracy of the usual photometric process was brought under my notice. In 1874 I began a series of experiments, with the aim of devising a more trustworthy process, which have continued with occasional intermission till the present time.

In the course of my experiments I have had occasion to make a large number of testings with candles of the kind ordinarily employed, and also with candles differing in diameter and in the structure or preparation of their wick, but coming within the definition of "sperm candles of six to the pound, consuming 120 grains of sperm per hour."

For some account of the results of these experiments, I may be permitted to refer to a paper "On a New Unit of Light," read before the Physical and Chemical Sections of the British Association, at its meeting in Plymouth, in August, 1877, a copy of which accompanies this letter.*

The existing system of photometry attempts to neutralize the variations in the amount of light emitted by standard candles by using two candles simultaneously, and by extending each testing over a period of ten minutes. The further provision that three testings shall be made daily, and that the mean result of the three shall be taken to represent the illuminating power for the day, though intended to provide for fluctuations in the quality of the gas supplied at different hours, really serves also to neutralize the variations of the standard candles.

This method of obtaining a fairly accurate result by taking the mean of a number of experimental results varying considerably one from another, is rightly used, and leads to correct conclusions, when the experimental errors are likely to be evenly distributed, and when the whole series of observations is not liable to be affected by a common cause.

Thus, if a single candle were employed to yield a standard light, and if the correspondence between its light and that of a gas-flame were observed during one or two minutes, the variations in the results obtained by the same operator using the same candle in the same photometer would be very great. In the actual mode of working, the variations are not very great. According to my experience, it does not often happen that any one of a set of three testings varies by more than half a candle from the mean of the three. This is the case even if a different pair of candles is used for each testing, when the candles are from the same packet, and the mode of operating is kept rigorously uniform.

In Appendix I., I have put together the results of a large number of candle-testings made in my laboratory with the view of obtaining a receipt for preparing a gas from hydrogen and pentane, which should have, when consumed by a standard burner, exactly the illuminating power of 16 candles.† Such a gas might be used as a photometric standard in the manner which I described and showed in a lecture before the Society of Arts on the 31st March, 1876.‡

Three testings were made of each sample of gas, stored in a small gas-holder, in quick succession one after the other, so that the light given by the gas did not vary, and the variation between the three results is due solely to errors of observation, which are inconsiderable, and to differences in the illuminating power of three different pairs of candles treated similarly in every respect. The numbers have been corrected, as usual, on the assumption that the light given by similar sperm candles varies directly with the weight of spermaceti consumed; and where the consumption of gas was in any degree greater or less than 5 cubic feet an hour a proportional correction has been introduced.

The conclusion which may be drawn from this large number of observations is, I think, that when candle testings are made with great uniformity, fairly concordant results may be obtained. It is, no doubt, owing to the fact that concordance is attainable under these conditions, that an amount of confidence is bestowed upon candle testings to which they are not really entitled. In fact, the greater pains an operator takes to obtain concordant results by working in a perfectly systematic and uniform manner, the less significant and trustworthy does his mean result become.

The result of the testing by candles of any sample of gas depends upon many conditions beyond those named in the Companies Acts of Parliament and in the notification of the Gas Referees, and is affected by causes the influence of which the actual application of the method of averages does not tend to eliminate.

I will here point out a few of these, in addition to those mentioned in the accompanying paper.

1. Since the prescription by the Gas Referees of the apparatus to be used in the Metropolitan testing-places, which included a balance external to the photometer for weighing the candles used in testing, a new form of balance has been substituted by Mr. Keates, Chemist to the Metropolitan Board of Works, by which the candles are weighed *in situ* within the photometer. The plan of weighing the candles *in situ*, or of observing, without moving or extinguishing the candles, the time required for the consumption of 40 grains of spermaceti, is both less troublesome and more accurate. Its introduction is therefore a boon to the Gas Examiners; but I believe that it is also a boon to the Gas Companies, since it is practically impossible to transfer a pair of lighted candles from a balance to the photometer without filling the cups of the candles with melted grease, and thus increasing the light of the candles, probably by diminishing temporarily the length of wick within the flame.

2. Some operators make a point of trimming the wicks of their candles; others of leaving them alone. I have known a difference of 2 candles to be made in the illuminating power attributed to a sample of gas, by simply bending down slightly the wicks of the candles between a first and second testing. A similar difference may be produced by cutting off the tip of the wick.

3. The greater or less movement of the air round the candles in an open photometer, and the greater or less movement of the candles to and fro in a box photometer, according to the habits of the operator, affect considerably the result of a testing, or set of testings. Perfect stillness is unfavourable to the development of the light of a candle; and this, I believe, is one reason why open photometers sometimes give results less favourable to the gas than box photometers.

4. The mode in which a candle has been extinguished, and the time during which it is allowed to burn before a testing is made, are also points of some importance, as to which the practice of different operators is different.

5. The age of the candles is said to make a difference in their burning. Mr. Heisch, who has had much experience in photometry, has told me that he finds it best to buy candles and keep them for some time before using them.

6. Candles with 18 threads in each strand of the wick generally burn less than 120 grains of spermaceti an hour, and candles with 21 threads generally burn more. After correcting for the excess or defect of consumption, the results obtained with the former candles are about half a candle less favourable to the gas than those obtained with the latter.

7. The candles which I have been accustomed to use, and I believe also those sent by Mr. Keates to the testing-places are made by Mr. Miller, of Dorset Wharf, Westminster. According to some recent experiments, a summary of which is given in Appendix IV., in which the same sample of gas has been tested both by Miller's candles and by those of another maker named Brecknell, the candles of the former maker give for the same consumption of spermaceti 6 or 7 per cent. more light than those of the latter.

The above list might be extended by the enumeration of other details in which the practice of one Gas Examiner may differ from that of another, with the result of producing a material difference in the illuminating power attributed to two precisely similar samples of gas.

I submit, therefore, that the standard now in use is not sufficiently definite and uniform to be maintained as a standard; and that it is desirable, if possible, to substitute for it a standard more definable in its nature, and less liable to be affected by the manner in which it is used.

In the paper "On a New Unit of Light," to which I have referred, a description is given of the standard which I propose as a substitute for the sperm candle. A more extended comparison of the illuminating power of this standard flame with that of various sperm candles has led me to make a slight alteration in the height of the flame, and in the proportion of pentane used in preparing the standard gas. The height of the flame burning from a ¼-inch aperture, which is most nearly equal to an average sperm candle flame, is 2½ inches. The volume of liquid pentane which is to be poured into 8 cubic feet of normal air is 9 cubic inches, measured at 60° Fahr.

The photometric comparison of the sample of gas to be tested with this standard flame may be made as when candles are used. But I find it more convenient, and equally exact, to keep the disc at rest in the position corresponding to the normal illuminating power of the gas (*e.g.*, for 16-candle gas, four times as far from the gas as from the standard), and the standard flame also at rest. The observation is made by regulating the consumption of gas till the disc is equally illuminated on both sides, and then ascertaining by reading the meter once or twice, at intervals of one or two minutes, what the rate of consumption is.

In the system of gas-testing used in Paris, the return made is not of the illuminating power of the gas when burning at a particular rate, but of the volume of gas required to maintain a certain amount of light for a certain time.

I venture to think that this system is more exact and more reasonable than the system in use in this country.

It is more exact because the same burner may be used with equal advantage to produce the light of (*e.g.*) 16 candles from different samples of gas burning at very different rates; but the same burner cannot be used with equal advantage to consume at a fixed rate of (*e.g.*) 5 cubic feet per hour samples of gas varying to anything like the same extent in their illuminating power.

It is also, I venture to think, more reasonable because the difference to the consumer of being supplied with a richer or poorer gas is measured, not by the illuminating power of the gas, but by the volume of gas which he requires to burn in order to obtain a fixed amount of light. For example, if on any evening the consumers in a London district were supplied with 14-candle gas instead of 16-candle gas, their houses would not be less well lighted than at other times, but they would use and would have to pay for about 10 per cent. more gas.

Considering, however, the difficulty of changing a custom and nomenclature established in popular usage and in Acts of Parliament, probably the change of system could only be effected indirectly; and the alteration I have suggested in the photometric process would indirectly effect this change, if in the calculation of the result it is assumed that the illuminating power of the gas burnt so as to yield a fixed amount of light varies inversely with the rate of consumption.

It is the case that this inverse relation exists with the standard burner for samples of gas varying from rather below 16 candles up to 17 candles illuminating power; and nearly all the gas tested at the Metropolitan testing-places falls within these limits. Thus, for the ordinary range of the testings of illuminating power made upon the gas supplied to the Metropolis it is immaterial which system is employed. If the gas supplied falls considerably below the standard quality, the deficiency appears to be greater when the gas is consumed at a fixed rate and the light which it yields is determined, than when the observation is of the rate of consumption requisite to yield a fixed amount of light. The cause of this is partly general, that comparing larger gas-flames with smaller the gain in illuminating power with the larger flame is more than in proportion to the increased consumption; in part it depends upon the particular burner employed, which is constructed for producing a flame giving a light of from 16 to 17 candles.

How rapidly with this burner the yield of light diminishes when the consumption is reduced, may be shown by making a great reduction, such as from 5 cubic feet per hour to 4 cubic feet. In this case the light is reduced from that of 16 to that of little more than 8 candles.

The numbers representing the illuminating power of gas estimated in the manner here proposed would truly represent the advantage to the consumer of the sample of gas supplied to him, as far, at least, as it is possible to infer, from any testing with one burner chosen as a standard, what the effect of a change in the quality of gas is with other burners. A fall in the quality of the gas from 16-candle to 15-candle would represent an increase in the charge made to the consumer of 1-15th, or 6⅔ per cent. For the quality of the gas thus estimated, "illuminative value" is a better term than "illuminating power."

Before a change could be made in regard to the existing standard of photometry, it is necessary not only that a more trustworthy standard should have been devised, but also that the relation between the old and the new standard should have been ascertained as definitely as possible.

The more fluctuating and uncertain the existing standard is, the greater is the difficulty of ascertaining exactly this relation.

In Appendix II., I give a summary of experiments made in Oxford with the view of fixing the exact composition of the mixture of pentane and air, and the exact height of the flame produced by the burning of the mixture, which should be the representative of a standard candle flame,

* See JOURNAL, Vol. XXX., p. 337.

† Important as are the appendices which accompany this letter, space will not admit of their being given in the JOURNAL; they occupy 19 pages of printed foolscap, and consist largely of tabular matter.

‡ See JOURNAL, Vol. XXVII., p. 620.

La Nature 12 July 1879

L'ÉCLAIRAGE AU GAZ

DE LA RUE DU QUATRE-SEPTEMBRE, A PARIS.

Depuis quelques mois, la rue du Quatre-Septembre, à Paris, est éclairée au gaz par les nouvelles lanternes de la Compagnie Parisienne (fig. 1); la lumière qu'elle reçoit est tout aussi intense que

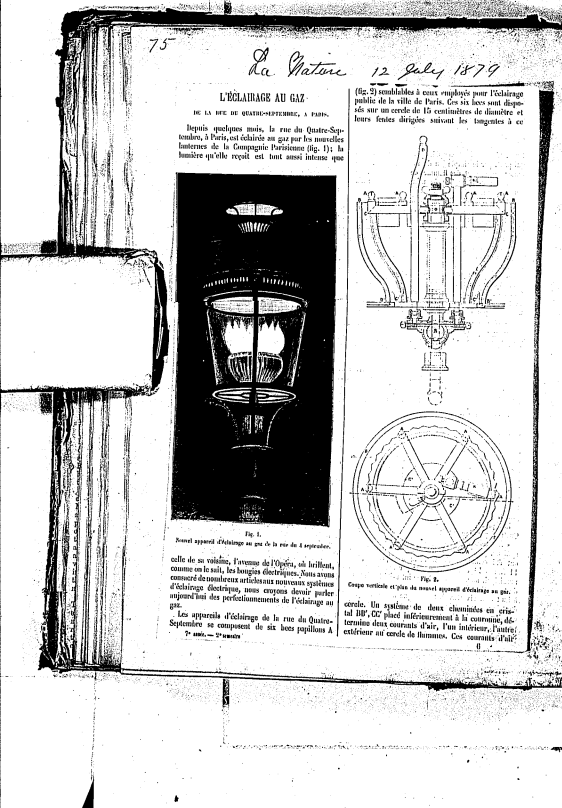

Fig. 1.
Nouvel appareil d'éclairage au gaz de la rue du 4 septembre.

celle de sa voisine, l'avenue de l'Opéra, est brillant, comme on le sait, les bougies électriques. Nous avons consacré de nombreux articles aux nouveaux systèmes d'éclairage électrique, nous croyons devoir parler aujourd'hui des perfectionnements de l'éclairage au gaz.

Les appareils d'éclairage de la rue du Quatre-Septembre se composent de six becs papillons A

(fig. 2) semblables à ceux employés pour l'éclairage public de la ville de Paris. Ces six becs sont disposés sur un cercle de 15 centimètres de rayon, et leurs fentes dirigées suivant les tangentes à ce

Fig. 2.
Coupe verticale et plan du nouvel appareil d'éclairage au gaz.

cercle. Un système de deux cheminées en cristal BB', C C' placé inférieurement à la couronne, détermine deux courants d'air, l'un intérieur, l'autre extérieur aux cercle de flammes. Ces courants d'air

Metropolitan July 19 1879

The London Gas Companies.—The appearance simultaneously of the official return of the accounts of the Metropolitan Gas Companies of the year 1878, and of Mr. John Field's admirable analysis of the same, affords us a very favourable opportunity for laying before our readers a few figures in regard to our gas supply, as at present administered (which at the present juncture may not prove altogether uninteresting reading, especially to those whose duty it has been in the past to give attention to this subject in the interests of the consumers. The accounts of each of the companies mentioned have already been given in this column more or less in detail, and, therefore, on the present occasion we propose to confine ourselves to general results, and to a comparison of these results as shown by the several companies. First, with regard to capital. The subjoined is a statement of the amount of capital each company is at present empowered to raise, the amount of capital employed in each case during the past year, and the capital employed per 1,000 feet of gas sold during the year :—

	Capital authorized.	Capital actually raised.	Capital Employed per 1,000 feet of gas sold.
	£.	£.	s. d.
Chartered	10,800,000	8,638,500	16 6
Commercial	1,130,000	690,000	11 0
London	1,256,666	1,256,666	11 0
Phœnix	1,012,000	1,012,000	14 1
South Metropolitan	1,000,000	1,000,000	11 8
Surrey Consumers	300,000	290,000	11 0
Total	15,587,666	12,887,511	13 15 9

The first point which strikes one in glancing at the above table is, of course, the magnitude of the amount shown in the case of the Chartered Company under each heading, and to this matter we shall allude hereafter. Of the total employed capital of £12,334,514, no less than £7,162,360 is entitled to a standard dividend at the rate of 10 per cent. per annum, and £1,295,029 is loan capital. The remaining sum of £3,877,125 consists of preference and other shares bearing interest at rates ranging from 4 to 7½ per cent. It is worth while considering for a moment what might have been the result if the several companies had been compelled to raise the whole of their present capital by auction. The interest now payable upon the seven millions odd entitled to a standard dividend of 10 per cent.—which, of course, means the payment in some cases of 11 and 111 per cent.—whereas, at the lowest estimate, a sum closely approaching £700,000 a year. Had this same capital been raised by auction, and at the same prices been obtained as at the recent sale of the Chartered Company's stock—and it should be borne in mind that for many years past similar prices have been obtained, although, of course, we well know that there were times when the London gas companies were not quite so prosperous—the consumers of the metropolis would have been relieved of an annual charge of something like £700,000, which represents the produce of a rate of nearly 4d. in the £. We quite admit that these calculations have only an approximate value, but in the main they are reliable, and constitute an all-important evidence of the correctness of the view—so far as the public is concerned—that has always been urged in this journal. We have also invariably contended that amalgamations, unless effected under exceptional circumstances have never resulted to the advantage of the consumers ; and we find in the above table a very significant fact, proving the accuracy of our opinion as to the inexpediency, from a financial point of view, of such gigantic concerns as that at present presided over by Mr. Hedley Thomas. The capital employed by the Chartered Gas Company amounts to no less than 16s. 6d. for every 1,000 feet of gas sold—a sum in the absence of that employed by any other company for doing precisely the same amount of work. It is not very difficult to see that, where in one case the price charged per 1,000 feet of gas has to provide interest, on 16s. 6d. of capital, and in another case on only, say, 11s. of capital, all other circumstances being equal, the consumer in the first instance must necessarily be placed at a very considerable disadvantage ; and when it is borne in mind that the Chartered Company supplies a district far in excess of that provided for by all the other companies put together, the importance of this point can scarcely be overestimated. Indeed, it is somewhat singular to notice how this proportion of capital employed per 1,000 feet of gas sold indicates the general condition of each company as far as the price charged, and the dividend it declared are concerned. The following table will show this at a glance :—

	Capital employed per 1,000 feet of gas sold.	Price charged per 1,000 feet.	Dividend per cent declared for 1878.
	s. d.	s. d.	
Chartered	16 6	3 6	10½
Commercial	11 0	3 3	10½
London	11 0	3 3	10
Phœnix	14 1	3 6	10
South Metropolitan	11 8	3 6	11½
Surrey Consumers	11 0	3 6	10

The Surrey Consumers' Company, as everybody knows, is somewhat exceptionally situated, while the Phœnix and the London Companies are not under the provisions of the sliding scale ; and when these circumstances are remembered, it will be seen that the point to which we have alluded is a tolerably correct index. Coming to the results obtained by means of the employment of this capital, we have prepared a table showing the quantity of coals carbonised during the past year, and the quantity of gas made and sold.

	Coals Carbonised.	Gas Made.		Gas Sold.	
		Thousands.	Per Ton.	Thousands.	Per cent. of gas made.
	Tons.	Cubic Ft.			
Chartered	2,208,000	11,126,993	10,089	10,634,890	95·61
Commercial	131,069	1,385,731	10,106	1,253,618	90·39
London	130,000	1,310,414	10,080	1,251,068	95·48
Phœnix	154,360	1,551,018	10,050	1,491,765	96·19
South Metropolitan	154,360	1,551,018	10,050	1,491,765	96·19
Surrey Consumers	34,211	343,092	10,031	324,253	94·51
	2,812,431	28,268,255	10,181	16,951,358	95·92

The results shown above do not differ very materially from those obtained in the previous year. There is an increase in the quantity of coals carbonised by about 100,000 tons, and in the quantity of gas made by over 1,000,000 thousands. We confess, however, that we are somewhat surprised to see a falling off in the quantity of gas obtained from each ton of coal carbonised, in respect of four out of the six companies. With all the improvements and inventions that are continually being brought forward for extracting the very last ounce of gas from the coal, one might have expected a change in the other direction. It is just possible, however, that a true economy may not lie in the employment of these inventions, which, in some cases are of an exceedingly costly character, and this view is somewhat strengthened from the fact that the Chartered Company, which is notorious for its extravagance, shows, as a result of its very large expenditure, a slightly increased make of gas per ton of coals carbonised. At the same time, we certainly think that a decrease in the make should not be shown. The Surrey Consumers' Company, for instance, last year made a smaller quantity of gas per ton than in either of the three previous years. In considering this point, there are, of course, other circumstances to be borne in mind ; but, in glancing over the figures before us, these comparisons do strike one, and they are of some value as illustrations of the general results obtained from time to time. The make of gas per ton in 1877 averaged 10,137 feet, in 1878 10,069, and in 1879 9,892. The only other matter to which we propose referring this week is the cost of coals, and on this point, we should explain, our information is obtained solely from Mr. Field's book. The accounts of the companies simply state what was paid for coals in the course of the year, and no means whatever are afforded of ascertaining for any purposes of comparison the practical value or effect of the figures given. We have, therefore, compiled the subjoined table from the figures contained in Mr. Field's analysis.

	Cost of Coals.		Less Residuals.		Net Cost of Coals.	
	Amount.	Per Ton.	Amount.	Per Ton.	Amount.	Per Ton.
	£. s. d.	s. d.	£. s. d.	s. d.	£. s. d.	s. d.
Chartered	663,231 13 3	6 0·18	384,796	3 5	321,434	2 11
Commercial	39,272	5 11·68	22,778	3 5	16,494	2 6
London	39,000	5 11·82	22,620	3 5	16,380	2 6
Phœnix	46,311	5 11	26,859	3 5	19,452	2 6
South Metropolitan	46,311	5 11	26,859	3 5	19,452	2 6
Surrey Consumers	10,263	5 11	5,952	3 5	4,311	2 6
	844,389 13 3	6 0·18	489,864	3 5	354,525	2 10

Comparing these results with those shown in previous years, we find that the cost of coals in 1877 averaged 16s. per ton, in 1878 17s., and in 1879 19s. 4d., as against 15s. 6d. in 1876 ; while the net cost of coals in 1877 averaged 6s. 6d., in 1878 6s. 6d., and in 1879 6s. 10d. One would have thought that the Chartered Company, with its extraordinary facilities for handling material at Beckton and elsewhere, and with its enormous consumption, would have been able to secure contracts for coal at prices which would compare favourably with those paid by any other company ; but instead of this we find that the price paid during the past year by the authorities at Horseferry-road, was not only not the lowest, but was actually above the average price paid by the whole of the companies, while the net cost of their coals was, with one exception, higher than that shown by either of the other companies, and nearly 4d. above the average. It may be that, in the opinion of the directors, the extra yield of a hundred feet of gas per ton of coals carbonised fully compensates for this difference in price, notwithstanding the fact that their receipts by the sale of residuals were 9d. below the average ; but it may also be a fact, as in the opinion of some competent judges is the case, that the company is not particularly anxious, as a matter of policy, to increase its condition of prosperity much beyond that at present attained, for fear that unreasonable and extravagant profits may again excite the feelings of the public in regard to their proceedings. Our own impression is that those who hold this latter view are not very far wrong. We cannot persuade ourselves that the company is striving to carry out the spirit of the Act, nor can we think that the company is disposed to give to the public that advantage in the form of a reduced price, which it was manifestly the intention of the Legislature the public should secure. We cannot of course say how long the metropolis will be prepared to put up with the present state of affairs ; but, as we have repeatedly said, while the inhabitants of places like Birmingham and Manchester can obtain good gas at prices ranging from 2s. to 2s. 3d. per 1,000 feet, it is a monstrous thing that the inhabitants of London —the metropolis of the world—should be compelled to pay these monopolists 3s. 6d. and 3s. 9d. for an article that is enriched and beautified for its purpose in the extreme when compared with that supplied to many provincial cities and towns. On a future occasion we hope to be able to return to this subject, and to submit further extracts from the accounts before us, but for the present, probably we have been able, in the figures given above, again to place before our subscribers information on the most important subject, which may prove most useful

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Hardware July 15 1879

Webster's Improvements in Gas-lighting.—At the present time if may, perhaps be affirmed that more efforts are being made for the improvement of artificial light than at any other in the world's history. Within the memory of men still living the same form of lighting was employed as well anterior for 1,000 years. Within this century coal gas, having slumbered since the creation of seas, has become our willing handmaiden, and it may be fairly said that it has withstood the efforts lately made against it by the electric light with triumphant success. This contest has, however, not been without its effects upon lighting by coal gas: we have discovered that gas may be burnt to yield no light, and that to obtain perfection in gas-lighting we must leave the most perfect supervisory indeed, it is not too much to say that the economical consumption of gas depends almost entirely on the form of burner and shade used. It is for this purpose that Mr. G. E. Webster, C.E., of Nottingham, has directed his attention, and after thousands of experiments, simple, and practical experiments, has produced the improvements we illustrate below. The first of

these, figure 1 and 2, is the Improved Duplex Burner, by which the gas is caused to flow equally, and, by means of the small orifices placed at certain angles to each other, to form—first, a hollow flame, which, by inducing a current of air through the burning gas, gives the advantage of having an Argand chimney supplied by limited air; secondly, by the arrangement of the holes the principle of diffusion is made use of, and the black and heating zone so familiar to all in the gas flame is done away with. The global accompanying this burner is made with a larger opening at the bottom than the top, and thus the light which is ordinarily thrown up to the ceiling and wasted is reflected downwards, where most wanted. Where a paper shade is used an improvement termed a

"protector" is applied. This prevents the shade from being burnt or blackened, and consists in having a ring of tin fixed on the wire frame at a little distance from the shade, so that a current of air is induced between the shade and the protector, cooling both and preserving the shade. A triangle or gallery for supporting the globe consists of a cast tripod, which is shadowless; it fastens in a very simple and secure manner with one screw. Mr. Webster also manufactures a burner which is novel and peculiar in its action. It consists in a burner with a loose cone, having a hollowed conical top with a slit in it. When burning the flame takes a direction exactly across the slit. The shade is of opal glass, and combines the advantages of a globe and paper shade. The improved street lamp is triangular in plan, and has an opal top. Its advantages are—less first cost, and more economy in use, there being one less pane of glass to clean, &c.

Hardware July 1879

Messrs. Barwell, Son & Fisher, of the Worcester Works, Birmingham, will make a principal feature in their exhibits at Sydney of their new system of lighting by the patent duplex burner, and a new form of shade and shade-holder. The duplex burner (already illustrated in our "Novelty" columns), has four holes, which produce two flames, so inclined to one another that they blend into one. The air entering between the flames at the openings in the burners causes perfect combustion, so that a maximum of light is produced with a minimum of heat and smoke. A five-light chandelier, fitted with duplex burners, and with suitably-shaped globes, carried on holders which intercept hardly any of the light, will be shown side by side with a similar chandelier, fitted with Bray burners of the fish-tail type, and the ordinary shades and shade-holders. The comparison as to the illumination is decidedly in favour of the new system; while the introduction of the Bunsen photometer shows that there is a saving in the quantity of gas consumed to the extent of about 25 per cent. The firm will also show a new shade, with flat plate underneath for Argand burners. It is an idea borrowed from the method of enclosing the electric light, and is well adapted for offices, banks, and shop windows. A burner, which is constructed on the most approved "Bellenes" system, will also be shown, as well as a collection of metal chandeliers and miscellaneous goodsings. Ironmonger July 1879

Coal Trade Journal July 30 1879

PRICES FOR GAS COALS, AT NEW YORK.

Penn and Westmoreland, $1 90 ; (At Amboy $1 80, at Philadelphia, $2 75.)
Boston Coal Company, $1 80 ; (At Philadelphia, $2 75; Manhattan $1 80.
Waverley Youghiogheny, $1 80 ; (At Baltimore, $2 25.).
Murphy Run, Newport, Fairmount, Monongahela, Newburgh Crest, Tyrconnell, Palatine, Pinnickinick, etc., etc., $1 65 at New York ; $2 25 at Baltimore.
Canaston gas coal, $1 65 ; (At Richmond, $2 75.)
Chesapeake and Ohio Agency, gas coal $1 50.

Peytona and Gauley Coal, quoted at $2 per ton at New York—shipped at Richmond Va. Red Ash Cannel, $4 50 per ton,—$4 50 f. o. b. at Philadelphia.
Newcastle $3 50. Liverpool Orrell-Arley $11. Dove Hall Cannel, $15—for gas $4 50
Scotch, $7 50. News, nov'ls, $2 75 to 4 00 as to quality, weight, &c.

Engineer July 12 1879

The eighteenth annual meeting of the North British Association of Gas Managers has been held at Edinburgh, under the presidency of Mr. Alex. Smith, of Aberdeen, who, in the course of his address, gave it as his opinion that gas was hardly yet beyond the age of its infancy, and had nothing to fear from the electric light. Mr. Peter Watson, of Stirling, gave the results of his experience of the effects of frost on gas apparatus during the recent severe winter. Mr. Wm. Young, of Chopens, contributed a paper on "Gas Engines and Gas Motors," and Mr. Carpenter on "Illuminating Gas," and "The Percentage of Non-luminous Gas in relation to its Illuminating Power." Mr. Jas. Colville, Dalkeith, read a paper entitled and described his meter gas governor; Mr. Neilis, of Forfar, spoke in favour of gas engines and governors, letting out gas to consumers free of charge; and Mr. Jas. Gilchrist, of Dumbarton, read an interesting paper on "Circumstances affecting the Price of Gas." A committee was appointed to confer with a committee of the West of Scotland Association of Gas Managers, with a view to the amalgamation of the two societies. Mr. Jas. Reid, of Islington, was elected president for the ensuing year. Subsequently, Mr. Thomson, of Messrs. Laidlaw and Sons, read a paper on "A Gas Compressing Engine for the Recovery of the Light Spirits in Waste Shale Gases." Mr. Wm. Cowan, of Hillsborough, exhibited and explained his automatic pressure changer—a machine which is found to do automatically an important part of the work hitherto performed by the gas manager or his deputy. Next annual meeting was fixed to be held at Perth.

Engineer July 15 1879

American Machinist July 26 1879

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Cheap Fuel and Light. 1879

American Gaslight Jour

We have before us a report lately made by Gen. Herman Haupt, on several patents and processes for producing cheap hydrogen for light and fuel and utilizing it in a wide range of metallurgical operations. Gen. Haupt has made extensive investigations as to the working of these processes, and has prepared a valuable report, from which we make the following extracts, and will continue them in a future issue.

REPORT.

These patents embrace a very wide field, and the operations which they include may be divided into several classes.

1. Processes for the manufacture of illuminating gas.

2. Processes for the manufacture of a combustible gas for heating and culinary purposes.

3. Processes for the manufacture of cheap hydrogen, or combined hydrogen and carbonic oxide, for metallurgical purposes.

4. The use of hydrogen, carbonic oxide, carbonic acid, carbureted hydrogen gases, air, hydro-carbon vapors and super-heated steam, in various regulated proportions and combinations, for a wide range of metallurgical operations.

WHAT IS CLAIMED AS CAPABLE OF ACCOMPLISHMENT BY THESE PROCESSES.

1. The production of illuminating gas of superior uniformity, brilliancy and purity, at lower cost than by any other process, and not poisonous.

2. The production of a heating gas of uniform composition, possessing greater heating power, at a cost not exceeding that of the inferior gases produced by other processes.

3. By the application of gases and vapors as proposed it is claimed as results :

The dessiliation of ores of iron.

The production of sponge iron of great purity directly from the ores, which will need recalcine in cooling.

The production of iron and steel of all the various grades directly from the ores, and of determinate and uniform composition.

The production of bar iron, steel, boiler and armor plates directly from the ores.

The hardening of the surfaces of iron manufactures to add to their durability and usefulness.

The softening or annealing of the surfaces of cast iron and steel manufactures, to increase their toughness and ability to resist percussive and other forces.

The treatment of manufactures of iron to give them a permanent property of resisting all corrosive influences, including that of salts and acids, enlarging greatly the field of specialties and opening up new manufactures.

The production of steel from ores or from crude cast iron without the use of spiegeleisen.

The removal of impurities and the preventing of oxidation in the processes of heating and forging masses of iron for the manufacture of shafting and other machinery, in the processes of re-heating and rolling iron and steel plates and bars, of annealing iron wire and its plates, and manufactures of sheet iron with smooth and bright surfaces that will effectually resist corrosion.

The reduction of refractory and titanic ores.

The separation of impurities, the desulphurizing of ores of the precious metals, and the manufacture of superior iron and steel from inferior stock.

The attainment of all these objects by processes more economical than those now in use.

These claims cover a wide field. In reference to them I will observe:

First. As to the processes for the manufacture of illuminating gas.

These processes are very numerous at the present day. A large number of machines have been set up in our large cities which depend upon the use of gasoline vapor diluted with air. They are used extensively for suburban residences, and give satisfactory results.

A water gas produced by the decomposition of super-heated steam is now coming into very general use under the name of the Lowe gas. The process has been improved upon by Strong, of New York, who claims the ability to produce 1,000 cubic feet of gas from 10 lbs. of coal, at a cost of eight cents. This gas is not suitable for illuminating purposes, but by the use of naphtha, petroleum, or hydro carbon vapors it can be enriched at a cost, it is claimed, of 27 cents per 1,000 feet, and yields a gas said to be superior in candle power to ordinary coal gas.

The Gill process claims similar results, so far as concerns cost of production, but a gas of greater uniformity, brilliancy and heating power, consisting largely of hydrogen, while the principal constituent of ordinary water-gas is carbonic oxide.

To understand on what this claim is based a brief description of the process is necessary.

The Strong and Lowe gas is produced by passing super-heated steam through a furnace containing incandescent carbon, previously heated, by which means the steam is decomposed, the oxygen absorbed by the carbon forming carbonic oxide with some carbonic acid and hydrogen liberated, so that the resulting gas is a combination of which the following is said to be the average composition of one pound, as given in a printed report on the Lowe and Strong process:

OVER

Oxygen	.0174
Carbonic Acid	.0627
Nitrogen	.8690
Carbonic Oxide	.7007
Hydrogen	.0747
Marsh gas	.0466

The oxygen, carbonic acid and nitrogen have no heating or illuminating properties, and the carbonic oxide, of which there is 71 per cent., develops in combustion only 4225 units of heat per pound, while hydrogen, of which there is only 7½ per cent., yields 62,000 units per pound.

In this process, moreover, the temperature is constantly changing, the incandescent coal is gradually cooled so that its power to decompose steam is less lost, and the operation must be suspended while the furnace is reheated.

The Strong gas requires for combustion 69 pounds of air, and develops 7727 available heat units per pound.

The steam coming in contact with 50 pounds of incandescent coal carries off a much larger proportion of sulphur and other impurities than if the quantity of coal were less.

In the Gill process for producing gas from the action of super-heated steam or incandescent coal, the production of gas is represented as continuous and not intermittent, and the product uniform instead of being variable. It differs from the Lowe and Strong in this, that the coal required to decompose the steam is contained in close fire clay retorts, heated from the exterior and not from the interior, and the heat maintained with uniformity. The steam or air come in contact with not more than 20 pounds of coal or coke per 1,000 cubic feet of gas inside of the retort, and the fuel required outside is 20 pounds of coal. The total amount of coal, therefore, is less than in the Strong and Lowe process, but there should be no very material difference in the cost of the water gases for equal volumes. A pure water gas, produced from the decomposition of water and the complete combination of the liberated oxygen with the carbon, should consist, by weight, of 1 part hydrogen, 8 of oxygen, and 6 of carbon, thus being the constituting equivalents, and the resulting gas should contain 6.6 per cent. by weight of hydrogen which is nearly the per cent. given in the analysis of the Strong gas. The specific gravity by calculation is .912.

The specific gravity of hydrogen is .07, and the heat units developed in the combustion of 9ss pound 62,000.

The specific gravity of carbonic oxide is .972, and the heat units developed in the combustion of one pound — 4225.

But, .0742500 — 4240 units,
And .9722 4225 — 4241

So with equal volumes the heat units are nearly equal under equal pressure.

It is necessary to distinguish between quantity and intensity of heat, and I was surprised to find so much confusion of ideas and diversity of opinion amongst practical metallurgists and scientists on these subjects, and especially in reference to the temperature of furnaces. Mr. Gill claims to have discovered the errors of the usual theoretical formulæ for temperature, which give carbonic oxide an intensity in combustion of over 3000°, and hydrogen of only 4000°. The absurdity of this result is apparent from the fact enunciated by Bunsen, that carbonic acid is dissociated or resolved into its elements at from 1832° to 2192°, and consequently at or above this temperature carbonic oxide cannot undergo combustion at all, which contains in conversion into carbonic acid. Vapor of water is also said to be dissociated at 4532°, which is the highest temperature from combustion of hydrogen, and the highest possible in a furnace.

Further, the average heat of a furnace must be less than the maximum heat of combustion of the gases, for all the heat communicated to the substances acted upon must be deducted from the source of heat, the combustion of the gases. The temperature of combustion given by writers is purely theoretical, and would appear to be erroneous.

Mr. Gill claims to have demonstrated, not only theoretically, but practically, that the intensity of combustion of hydrogen is much higher than that of carbonic oxide, and has deduced formulas which give results consistent with experiment and observation, and which he proposes at a proper time to publish.

I will only add that I am unable to perceive any flaw in the reasonings and conclusions of Mr. Gill, who impresses me as a thorough expert on the subject of temperatures.

Admitting that the same quantity of heat may be developed by the combustion of equal volumes of carbonic oxide and hydrogen under equal pressures, it must be observed that a gas consisting chiefly of carbonic oxide is poisonous and too dangerous for domestic purposes, while for metallurgical purposes the intensity of combustion and the affinity of hydrogen for sulphur and the phosphorus as well as for oxygen render it a more useful fuel than carbon or oxides.

Plumbers & Sanitary Engineer

April 1879

The following are the debts of three English cities, and the proportion due to establishment of gas works:

	Total Debt.	Spent on Gas Works.
Bolton,	£1,655,000	£164,700
Bradford,	2,266,132	341,577
Leeds,	3,237,059	505,939

George Westinghouse, inventor of the air brake, has proposed a new method of lighting railroad cars. His air-brake plans a supply of compressed air at disposal; current of this is passed through carburetters placed under the cars so as to produce an air gas, which is used for lighting the passenger cars.

The semi-annual meeting of the New England Association of Gas Engineers will be held on the 13th and 14th days of August. The members and guests will meet at the Narragansett Hotel, Providence, R. I., visit the Gas Works, and have an excursion productive of the usual quantities of pleasure found at those meetings.

Last month the Dartford, Eng., Gas Company's new gasometer, 74 feet in diameter and 26 feet in height, blew up, the whole falling with a tremendous crash, the columns and massive sides being carried a great distance. The night watchman was seriously injured and had his collar bone broken. The gasometer had been in use only a week.

Philadelphia wants gas cheaper, to judge by the papers. There is plenty of grumbling against the Gas Trust there, editorially and by letters from the people.

The Gas and Water Committee of the Ramsgate, Eng., Local Board have decided upon letting gas cooking stoves on hire on the three-years' purchase system.

From the annual report of the Metropolitan Board of Works of London, Eng., it appears that during the last year the number of gas meters tested was 80,447.

At a late meeting of the Philadelphia Public Building Commission, a proposition from a gasoline company to erect gasoline lamps and keep them in order for $20 per lamp yearly was postponed.

The Providence, R. I., *Dispatch*, of July 6th, contains an article of some length describing one of the Otto gas engines at work in Kelleg's printing office, 19 Washington Street, in that city, and giving a short interview with Mr. Kelleg.

Dr. Samuel S. Cruy was, trying in the beginning of July, to introduce a process of making gas from crude petroleum into the gas works at Glens Falls, N. Y. It is the same process in use at the Delavan House, Albany, N. Y., already noticed in the Meteorites.

Coatsville, Pa., Gas Works are to be improved by substituting clay for iron retorts.

The Common Council of Plainfield, N. J., has suspended lighting the street lamps for three months.

The property of the Fall River Gas Light Co., was bought in for the creditors of the company at the beginning of the month for $30,000.

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In New York city gas is now furnished at $2.00 a thousand feet; in Lancaster in this State it is supplied by a private company at $1.80; in other towns at equally moderate rates. In Philadelphia, the Gas Trust, a corporation existing under the city government, and controlling an influence up to this time stronger than public opinion and the press, demands and receives $2.15 for every thousand feet of gas. No support, no competition, no argument, affects this defiant monopoly, and in self-defence many citizens are trying other processes to light their dwellings and factories. Hence the deep interest with which Edison's magnificent movements are watched by hard-working, enterprising Philadelphians.

Progress July 12 1879

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, AUGUST 6, 1878.

Circular to Gas Companies.

It is extraordinary to notice the opposition shown to Gas Companies as regards their obtaining powers to supply the electric light. It would be difficult to explain the reasons for this antagonism but for the statements made by Mr. D. Chadwick in the House of Commons on the 29th ult. This gentleman argues that every additional privilege granted to a Company will enhance the value of their undertaking when a question of purchase by a Local Authority is considered. We shall not attempt to controvert this argument; still it appears to us to tell nothing against the right of a Gas Company to possess the privilege. As matters stand at present, the day appears distant when the electric light will become a thing of profit to either Gas Companies or Corporations. It might, therefore, have been safely left for time to settle the relative positions of those bodies. But as the Committee on Lighting by Electricity decided that Gas Companies should not possess the exclusive right of supplying the electric light, we must accept our position with the satisfaction of thinking that our interests are not at all interfered with by the refusal. Local Authorities are perfectly welcome to expend the ratepayers' money in making experiments with the electric light, which, for the most part, will prove abortive. Gas Companies may, therefore, patiently wait, and quietly pursue an industry which, with careful management, is always profitable, and capable of development as their district extends. There is then, in our opinion, no reason to regret the decision of the Committee of the House of Commons; on the contrary, we think Gas Companies may be congratulated on the result.

The Liverpool Lighting Bill has now passed the third reading, and will, no doubt, receive the Royal Assent this week. All Town Councils are now up for the holidays, and we do not suppose that we shall hear until next year what steps the Liverpool Council intend to take to carry out the exceptional powers they have obtained.

The Preston Corporation are angry with the Gas Company for remunerating the Directors for their labours in preparing and seeing through Parliament their Act of the present session. The Corporation, it is said, spent between £1000 and £2000 in opposing the Bill, and no doubt a part of this sum went—and, it is true, into the pockets of some of the Councillors, but to the advantage of some of them. Of course, the Council have no power to vote themselves any money reward for the labours they perform, but they ought not, on this account, to envy the Gas Directors the remuneration which the Shareholders have awarded them. Matters of this kind are a constant source of squabbling between Local Authorities and Companies. The former look with a jealous eye upon every appropriation of profits which is not made to the direct advantage of the consumers. In the long run, however, we think it will be found that the Preston Gas Act will operate favourably to the interest of the public. Some members of the Corporation threaten an attempt to make a compulsory purchase of the Gas Company. They will find this a difficult and very expensive process, and if they should succeed, the troubles of the Council will only be begun. It must be admitted that Preston is extremely well served with gas at a very moderate price, and nothing but forbearance and courtesy are required to establish relations which would prove beneficial to both parties. Nothing is to be gained by violent opposition on the one side, and dogged resistance on the other. Let each party approach the other in a friendly spirit, and gas and electric will come in Preston.

The half-yearly meeting of the Cambridge University and Town Gaslight Company was held on Thursday last. It is hardly necessary to say that the Company are still in a highly prosperous condition. The revenue account shows a large excess of income over expenditure, and, considering the prospect of a continuance of cheap coal, the Directors have resolved to reduce the price of gas threepence per thousand feet from Michaelmas last. While having regard to the consumers interests, the Directors are not unmindful of their duty to those Shareholders who invested their money when it was less productive than it is to-day, and they accordingly set aside 10 per cent. for the payment of back dividends to the proprietors of consolidated stock. It ought always to be remembered that the first Shareholders had to bear the burden and heat of the day. They obtained but little for their investment, and now that times are become more propitious they deserve to be rewarded for the sacrifices they made in earlier days. At the meeting a doubt was expressed by a Shareholder not interested in the latter distribution, as to the legality of the payment; but we may assure him that there is no doubt whatever about the matter. The Directors have not only the right, but, in some respects, it is a duty to allot unappropriated balances for the payment of back dividends. We miss on this occasion one of those admirable speeches with which the Chairman so commonly gratifies the whole gas world. There is, however, no "burning topic" on which to expend his eloquence, and, with stone regret, we wait for an occasion which may once more induce him to speak.

The annual meeting of the Reigate Gas Company, Limited, was held last Thursday. In a thriving and rapidly improving district like that occupied by this Company, it is not surprising that a high degree of prosperity should be enjoyed. It appears that from the workings of the past year a dividend of 15 per cent. might have been paid; but although a limited Company, who could pay what dividend they pleased, they keep back some of the profit for the benefit of the consumers, and make a reduction in the price of gas. The Company pay 10 per cent. dividend, and put £300 to the contingency fund, carrying forward £201 to the next account.

We omitted last week to remark upon the half year's working of the gas undertaking of the Birmingham Corporation.

Concluded from page 1.

In the two last volumes of Encaustica, considerable space has been devoted to the description and illustration of the various methods that have been proposed or adopted for the purpose of adapting electric lighting to the illumination, not only for large spaces, but also for the halls, work-shops, and private dwellings. Our columns have afforded abundant statistics and reports on that question. For the present there is no doubt but that the electric light stands on its trial. It has been put into competition with gas, especially in a financial point of view. The gas companies throughout England become alarmed, and to some extent, when in the shares of these companies sustained heavy depreciation. But, as will the Gas Companies' for 1878, presented last June pursuant to Act of Parliament, they have had as little to fear as they have had to suffer.

The business of the gas companies in the "Gas Light and Coke," which supplies about two-thirds of London, embracing also the City proper. The following statistics relate to the half-year ending December 31, 1878. The varieties of capital, and the Acts under which they were created, are numerous for detail. It appears that the total paid-up capital amounts to £5,705,000 and there remains £1,160,000 to call up; giving a total amount of authorised capital of £6,865,000. In regard to the loan capital, it is allowed of £1,681,260 having £1,000,000 to be borrowed. Of this loan capital, £981,300 is paid at the rate of 4 per cent. interest, and £937,200 at 3 per cent. The total expenditure on capital account amounts to £8,424,421, leaving a balance to capital account of £305,918 or a grand total of receipts of £8,726,000.

The receipts to revenue the half-year ending 31st of December, 1878, amounted to £1,728,932. Of this £178,315 was produced by the sale of gas, £1,455,000 from sales £861,307 was derived from common gas at 3s. 6d. per 1,000 and £593,944 by the sale of cannel gas at 4s. 6d. Lighting under public Acts produced about £60,000. The sale of residual products afforded £85,000, of which coke amounted to £124,027; tar, £36,571, and ammoniacal liquor, £56,382. The remainder of the income is derived from various sources. On the side of expenditure is charged £857,070, the chief items of which are:—Coals, £135,772; repairs, £145,271; salaries and wages, £89,000; cost of purification, &c., £36,012. The cost of the distribution of gas amounted to £56,621; meter rentals, £11,000; rents and taxes, £11,100; general management, £36,212; besides minor items, leaving a balance of £370,213 to be carried to net revenue account. It is stated that the reserve fund account amounts to £137,788 and the insurance fund to £12,250.

The total amount of coals carbonised during the half-year was 657,339 tons of common and 41,000 tons of cannel. Of coke 229,236 chaldrons were made, 148,141 used, and 150,761 sold. In regard to quantity of gas there were made (in thousands of cubic feet) 5,246,556 of common, and 328,648 of cannel. The total quantity sold was 5,219,117 of common and 317,648 of cannel. There was an unaccounted for loss of 256,751 of common and 14,208 of cannel gas. The total number of public lamps was 50,000.

The usual annual dividend of 10 per cent. was paid on the ordinary share stock.

The remainder of the London Gas Companies may be briefly dealt with, as they have not as a rule a small consumers trade to extend and developed, and it is more than probable that amalgamation will speedily reduce their number to unity.

The accounts for the half-year ending December 31, 1878, of the South Metropolitan Company were as follows:—Total paid-up capital, £500,000; loan authorised, £700,000; total of loan capital established but not borrowed, £500,000; total expenditure on capital account, £482,725. The receipts from sale of gas, &c., was £78,995; of residual products, £20,738, and the total expenditure was £71,400, leaving a balance of £28,270 to net revenue. The total of coals carbonised was 56,120 tons; the quantity of gas manufactured is 518,113 thousands, of which 302,611 were sold and 40,000 not accounted for.

The Commercial Gas Company's accounts for the half-year ending December 31, 1878, were as follows:—Paid-up capital, £200,000; authorised, £210,000; loan, 670,000, paid out of £700,000 authorised. Total expenditure of capital, £658,107. Revenue from gas, &c., 118,081; residual products, £21,707, leaving a balance of £18,900 to net revenue account. The total of coals carbonised was 70,469 tons; of gas made, 7,000 thousands, of which 29,879 were not accounted for.

The accounts of the three following companies are made up for the year ending 31st of December, 1878.

The London shows a paid-up capital of £709,462, with £878,812 authorised; of loan £160,543 paid up, and 673,205 remaining to be borrowed. The total expenditure of capital was £842,175, revenue from gas, &c., £216,460, residual products, £61,209. The total expenditure was £206,158 leaving £71,681 to carry to net revenue account. The amount of coals carbonised was 132,122 tons, of gas made 1,312 114 thousands.

The Phœnix Company had a capital paid up of £1,137,000, authorised £1,241,000, and of paid up loan £76,000. The total expenditure on capital account was £1,122,518. The sale of gas brought in £277,856; of residual products, £77,460. The total expenditure was £356,463, and of net balance carried to revenue £107,121. Of coals 174,200 tons were carbonised, and the quantity of gas made was 1,701,038 thousands, of which 81,902 were unaccounted for.

The Surrey Consumers' Company shows the following results: Paid up capital, £230,000; authorised, £250,000; and of loan, £60,000 paid up. The total expenditure of capital was £248,932. The sale of gas produce d £94,850; of residual products £25,467; the total expenditure was £93,150, leaving £31,633 to carry to net revenue account. The amount of coal used 54,912 tons, and of gas made 544,898 thousands, of which 29,393 were unaccounted for.

The following was the revenue charged per 1000 feet at the end of last year for common gas by the

Gas Light and Coke Company	3 6
South Metropolitan	3 6
Commercial	3 6
London	3 6
Phœnix	3 6
Surrey Consumers	4 0

For the present we shall make no further remarks on the above statistics, except in observing that with the exception of water shares, there seems no more safe or profitable investment than in gas companies' shares. In our last volume reports of the half-yearly meetings of each of the above companies were given, and it will be found that in most cases, the directors have resolved to extend their operations to lending by gas for domestic purposes. This will doubtless still further add to the prosperity of the companies.—*Engineering.*

We regret to notice the serious illness of G. B. Mansel, a leading coal operator of the Lehigh region.

The Pierce colliery, near Archbald, Pa., has resumed operations after a month's strike. The dispute was about dockage and unfair weight, which has been amicably arranged.

WATER-GAS AND THE GAS WAR.

Every one knows that a short time ago the price of illuminating-gas was unexpectedly reduced to $1.50 per M by one of the large New York companies. So unlooked-for an event as a gas company voluntarily reducing the price of gas was at once interpreted as the proof of a break in "the ring," and we need now no longer doubt that "honest fellar" was likely to have some show for their rights. The primary cause of the rupture was, no doubt, the Municipal Company, which, manufacturing a water-gas by the Tessié du Motay process, that far exceeded in illuminating power the coal-gas of the old companies, was making serious inroads upon the business of its near neighbor, the New York Company. The old and so often successful policy of the great monopoly over which the pre-Adamite Father Roosne has presided from time immemorial, and which consisted in "squelching," as he beautifully expresses it, all those "upstart schemers" who propose to reduce the cost of gas by introducing improvements in its manufacture, or in substituting electricity for gas in illumination, could not be applied in the case of the Municipal Company. There was too much capital behind that enterprise, and it distinctly declined to be "squelched," but, on the contrary, "carried the war into Africa" (the dark domain of old-fashioned 12-candle gas), and threw a new and popular (23-candle) light upon the gas question. The "squelchers" had to come to terms and, we understand, have bought out the Municipal processes at the handsome figure of $200,000 cash. This, however, would not dispose of the water-gas question. The Lowe-Strong process, a simpler, more economical and efficient system, has attained in so many districts that success which we have in these columns always predicted for it, that it is no longer possible effectually to confound the "squelching" process so long and vigorously applied to it by the monopolists. Water-gas alone can fight water-gas. So, we shall doubtless see the old companies, whose managers have long and violently abused this greatest improvement of the age in gas-making, forced to seek its aid to save their heavy investments from impending annihilation.

As the ENGINEERING AND MINING JOURNAL years ago pointed out to those gentlemen, the great question of the future—ay, and of the present—is the distribution of a cheap fuel-gas, and those who are wise will shape their course toward accomplishing this. The electric light, though still in the experimental stage, and not yet adapted to domestic purposes, will doubtless become the light of the near future. Enough has, we believe, already been done to justify this prediction; but, aside from this source of anxiety and danger to the gas interests, the fuel-gas question will be a far more important industry than has ever been that of manufacturing illuminating-gas, while the benefits which will result from it can not be overestimated.

The general use of cheap fuel-gas will indeed create a very revolution in the industries of the world and will produce results of the extent and importance of which here as yet scarcely been conceived in the most sanguine of the most sanguine advocates.

When water-gas practically pure hydrogen and carbonic oxide) can be manufactured at a cost of about ten cents per thousand feet, as can be done by the very simple and efficient Strong process, it would seem as though no further improvement in that direction were needed to secure its general adoption as soon as its economical distribution is secured. That the gas companies should so long have not only neglected, but actually discouraged and opposed, the use of fuel-gas, seems incomprehensible to the unprejudiced, and indeed, without a knowledge of the vested interests which revolve in the gas-ring, it could be accounted for in no more rational way than that "whom the gods wish to destroy they first make mad."

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.

Meeting held in Edinburgh on Aug. 1, 1878.

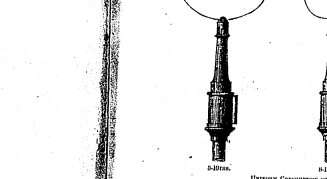
Mr. D. Bruce Peebles (Edinburgh), after reading the address of the chair, which was most satisfactory and was unanimously approved of, made the following remarks on

THE SIEMENS CONVERTER, ETC.

I beg to be allowed to state that I intended to read a short paper to-day but having been from home for some time past, the date of the meeting having gone from my memory, and I was too late in sending the title of the paper to the Secretary, he having sent out the notices of the meeting before my head for the day. I am sorry for not having a paper, therefore, I would simply ask you to allow me to make a few experiments, which, I think, will interest you, although I should have preferred having spoken with less gaseous, or steam, on the odor of the proceedings in any way, without your permission.

I may explain that I had the honour, some time ago, of reading a paper before the Royal Scottish Society of Arts here, the subject being "The Needle Converter, and its application to Gas Illumination." Several members of that Society, who were also members of this Association, desired me to take this opportunity of bringing the subject before you to-day, as being interesting and instructive in connection with the development of the illuminating power of coal gas; and seeing that our esteemed member, Mr. Yorke, has chosen a subject to which that point will play a very important part, I should be glad if he had an opportunity of seeing those experiments, as they have in reale his pair, and if you are there and in next there, he may give us, say not, in a certain degree, locally some of the ideas regarding the enrichment of gas, which he will bring before us in connection with the illuminating power, and you may be better able to discuss what I am sure will be a most interesting paper.

The first thing I wish to show you is a simple arrangement by which two rat-tail burners may be made to come together, so that the flames may combine and form a centre jet, which arrangement may be useful to any of you who may be giving lectures, &c., and may wish to show how two long flames may be made to change their shape and combine to form a compact



Uniform Consumption of Five Cubic Feet per Hour, at Varying Pressures.

We have here four needle governors, with different sized burners and to which the pressures at the point of ignition given in Mr. Mitchell's table. The first is adjusted to the 5-inch pressure, the second at 8-inches, the third at 13-inches, the fourth at 17-inches, and each of them passes exactly 5 cubic feet per hour. Now, gentlemen, you will see by the table that the light increases as the pressure is increased, and you will also see that when I saw this for the first time, I would not believe that the fourth burner was really passing 5 feet per hour, and it was only after I again and again tested each burner, and the rate per hour, that I was convinced.

The results are so startling that I think if the public could only see the experiment as we see it here to-day, that the Gas Companies would gain and save many complaints about bad gas. With the present burners the results are quite as convincing as these, but they are open to doubt by those who do not understand the method of testing the illuminating power. With the four lights burning simultaneously, the first giving a 5-inch pressure, the second the same, the second third descending by two-inches, the fourth has a thin white and feeble flame, all doubt as to the deleterious effects of low pressure is removed. Now, gentlemen, we are hardly justified in these gas companies should so long have not only neglected, but actually discouraged and opposed, the use of fuel-gas, seems incomprehensible to the unprejudiced, and indeed, without a knowledge of the vested interests which revolve in the gas-ring, it could be accounted for in no more rational way than that "whom the gods wish to destroy they first make mad."

clearly flame having a much greater illuminating power. The apparatus usually made by fixing down two union jet burners in the direction of the length of the box of the small boiler is left; then forming "each fixed into a tube, and making them work on a pivot, so that the Bunsen can be expanded or screwed up at will, and can be used certainly. Wires brought together or separated, have the same effect produced, with a great increase of light from the same quantity of gas.

The next experiment is the bringing together of two small union jet flames, and we see that the moment they are brought in contact there is a great increase in the illuminating power. I am inclined to think that the cause of this increase in the illuminating power is that when the flames are separate there is a certain amount of cooling effect produced by the air. When brought together there are only two sides that expose. Less egress, therefore, is applied to the hydrogen, and more carbon is liberated, which, being raised to whiteness by the increased temperature, gives a corresponding increase in the illuminating power.

The next thing I have to bring more particularly before you, and to show you by experiment, is the different rate at which the pressure at the burner is increased. Dr. Wilson, of Leeds, has made a number of experiments, and Mr. Mitchell of the Barnsley Gas Works, has made experiments in connection with this, and tabulated the results, which prove conclusively that gas should be burned at a low pressure. This paper read by Mr. Mitchell last year at St. Andrews may be found in the minds of many of you here, and the experiments in the table because he adopted a certain stated delivery of gas per hour at the burner in all his experiments. Here is Mr. Mitchell's table giving the results of burning 5 cubic feet of gas at different pressures:—

5 cub. ft. of gas are at 0·5 pressure	28·25	candles illuminating power.	
"	" 1·0 "	29·07	"
"	" 1·5 "	27·27	"
"	" 2·0 "	11·25	"

The only difficulty in making the experiments here in getting a burner of the exact size to burn the exact quantity at the given pressure, and then to be sure that there is no leakage. This difficulty is by a number of fixed different sized burners from one gallery, and succeeded in getting the exact quantity at a given pressure, and by the aid of the needle governor I had no difficulty in maintaining that pressure.

I would have the greatest tendency to deposit carbon, simply because that flame is nearest the smoking point. With ordinary English coal gas the difference between the flames would be more apparent than it is here, because with cannel gas of 28-candle power we can afford to use a lighter pressure without losing light. When we come to gas of 14 or 15 candle power, the loss of light by the increase of a few inches pressure is much more apparent, and consequently the difference in the flames is more marked.

Mr. Mitchell: I understood that the slab was to be held over the flame at the same level in each case.

Mr. Peebles: The only effect of bringing the slab down would be to cool the flame, and the carbon burning at the low pressure would be more readily cooled than that at the high pressure, which is partly burned as it goes.

Mr. J. McGlashan (Penicuik): Where does the carbon go to? If it is collected on the slab from a burner at low pressure, and escapes in the other, it is not burned, and it is not collected. Where does it go to?

Mr. Peebles: Dr. Menzies's explanation answers your question. In the one case the hydrogen and carbon do not separate, but are burned as a gas, there being a full supply of air; in the other case, the hydrogen is burned by itself, the carbon being heated to whiteness by the burning of the hydrogen and escapes as a solid particle.

Mr. Macfarlane: Is there a new gas formed in that flame.

Mr. Peebles: Certainly not.

Mr. Macfarlane: Am I to understand that oxygen and air combined with carbon form a new gas?

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, JULY 21.

The following Bills received the Royal Assent by Commission:—Arlecdon and Frizington Water, Belfast Water, Birmingham Gas, Cardiff Corporation, Gas and Water Provisional Orders Confirmation, Lancaster Gas, Mirfield Gas, Morecambe Gas, Newcastle-upon-Tyne and Gateshead Gas, Plymouth and Stonehouse Gas, Preston Gas, Queenstown Gas, South Shields Gas, Wisbech Gas.

Liverpool Lighting Bill,—reported, with amendments.

TUESDAY, JULY 22.

Blackpool Extension and Improvement Bill, Leicester Corporation Bill,—read the third time, with the amendments, and passed.

THURSDAY, JULY 24.

The following Bills received the Royal Assent by Commission:—Alliance and Dublin Consumers Gas, Rotherham Borough.

Nottingham Corporation Bill,—read the third time, with the amendments, and passed.

HOUSE OF COMMONS.

MONDAY, JULY 22.

Water Supply (Metropolis).—A petition for inquiring into the water supply of the Metropolis was presented from the Vestry of St. George-the-Martyr.

Journal of ~~Gas Lighting~~, ~~Water~~ Supply & Sanitary Imp. July 29 1879

HOUSE OF LORDS COMMITTEE.

MONDAY, JULY 21.

(*Before Earl* SPENCER, *Chairman; Earl* DUNDONALD, *Lord* SOMERTON, *Lord* WAVENEY, *and Lord* NORTON.)

LIVERPOOL LIGHTING BILL.

Mr. POPE, Q.C., and Mr. PEMBER, Q.C., appeared for the promoters; and Mr. MICHAEL, Q.C., Mr. ASPINALL, Q.C., and Mr. BIDDER, Q.C., for the Liverpool United Gaslight Company, petitioners against the Bill.

Mr. POPE, in opening the case for the promoters, said that the Bill proposed, among other things, to authorize and empower the Corporation of Liverpool to manufacture and provide, and exclusively to supply, light by means of electricity within the borough of Liverpool, and also to provide and supply heat or motive power by application of the electricity by which they produced or supplied light. The time limited was five years, and it was sought to borrow £50,000 for the purpose of the experiment, the lighting to be confined to places of public resort. The petition of the Liverpool United Gaslight Company stated that previously and up to the year 1848, light for public and private purposes had been supplied within the borough and the townships adjacent thereto by two separate and independent Gas Companies, which were then amalgamated and consolidated, and the concern became vested in the petitioners, who were the only company authorized to break up the streets and lay pipes for the supply of gas or for the purpose of lighting in Liverpool. That was the only monopoly they enjoyed, and the customers could please themselves. Among other things, the petitioners were required to light the public lamps within the borough, and the quality and the price of gas to be supplied were prescribed by the Act. If they were called upon by the Corporation to do so, they were bound to light at such times as might be agreed upon, and there was no arbitration. It was a pure question of agreement, and they did not propose to interfere with their rights and liabilities, but they simply proposed to do that which they had a right to do. They did not wish to be the sole suppliers of the electric light; and if any other company chose to supply it they could do so. If the experiments were allowed it would be an enormous advantage in the public interest. The Bill was of the simplest character, and he asked the Committee to decide that the petitioners had no *locus standi* to be heard.

Mr. MICHAEL urged that if the Bill passed it would act in a detrimental way to the Shareholders of the Gas Company, and tend to enable the Corporation to acquire the property of the Gas Company at an inadequate price. It was contrary to the spirit of the provisions of the Municipal Corporations (Borough Funds) Act, 1872; and, if passed, would lead to undue and unfair competition, and be inexpedient and contrary to the policy of Parliament. The undertaking was of an entirely novel and experimental character, and of doubtful utility and practicability, and would necessitate much additional breaking up of the streets. It would likewise interfere with the traffic along the road, and with the mains and pipes of the petitioners, and would cause inconvenience and expense to the public, and also loss to them. The promoters sought to go beyond the law; and he contended that his clients were strictly in order in insisting upon *locus standi*, especially as there would of necessity be a great deterioration of their property. The sole motive was, by some means or other, to injure the Gas Company, and so acquire a power which had never previously been granted; consequently they had a right to be heard, to see how far their property would be injured.

Mr. POPE contended that the Bill did not interfere with any of the rights or property of the petitioners, and therefore they had no *locus standi*. They had no property or vested right in lighting a theatre or a railway station. The truth was that they did not interfere any more with any property than was the case in any question of improvement. If they were afraid of the result, that must not give them a *locus standi*. Every ratepayer in the community was bound by the act of a representative body, and the Gas Company had no more right to object to the act of the Corporation than any other individual ratepayer had. If, however, their lordships thought that it was intended to interfere with the rights of the Company, then by the statutory enactments the Gas Company had the right to *locus standi*.

The committee-room was then cleared. After consulting together for a few minutes, the public were re-admitted, when

The CHAIRMAN said the Committee admitted the *locus standi* of the petitioners.

Dr. C. W. Siemens, examined by Mr. PEMBER.

I know the open spaces in Liverpool, which are very well situated for making the experiments suggested by the promoters of this Bill. Those experiments would show the comparative advantages of the electric system, as compared with the gas system, and also the comparative cost. As a principle, the electric light has been proved; but it has not as yet been proved as a practical mode of illumination, which could only be done by a lengthy trial, conducted with all the guarantees necessary to make it a fair one. My view is that the electric light should be placed differently from gas, in order to distribute it from each centre over a larger area. Gaslight is of a certain intensity, and, therefore, should be placed at a greater distance from the place to be illuminated than oil; and for the same reason electric light should be placed at a greater distance from the surface to be illuminated. It therefore requires investigation and study of how the electric light should be distributed in the case of a public place or street, and also in the case of a hall or railway station, in order to distribute the light with advantage as to cost, and also in such a way as to be agreeable to the public, who are to benefit by it. The sites we propose to light are particularly advantageous for trying the electric light under those different circumstances. I think it would take a period of five years in order to establish the question upon practical grounds, especially when the dynamics of the science of electricity are proceeding at the pace they are now doing.

Cross-examined by Mr. BIDDER: The experiments on the Thames Embankment are limited to one apparatus; but it is probable that *in carrying out experiments by an independent body like the Liverpool Corporation, they will be carried out without regard to any particular apparatus* or mode of lighting. The question of electric lighting is a very large one, and will never be decided in one or two places. It should be tried in a great many places, and under the most advantageous circumstances. It will, of course, try the question of lighting a large space; if carried to a theatre, it would establish the question of cost, and also its sanitary advantages; and, if the railway station is lighted, it will settle the question whether that can be done with advantage.

Mr. BIDDER: If it is really meant simply as a *bonâ fide* experiment, what is to prevent it being done now without any Bill, so far as the mere experiment is concerned?

Witness: The mere experiment will not decide the practical question—viz., the expense.

Why? Have not the Metropolitan Board of Works, in their experiments on the Embankment, and the City Authorities in their experiments on the Holborn Viaduct, been making very careful observations and calculations, and obtaining very carefully analyzed results as to the cost of lighting?—Yes, and the result has been somewhat unfavourable to the electric light; but whereas, on the other hand, it can be shown that the electric light *per se* is much cheaper than gaslight *per se*, therefore a great deal has yet to be done in order to harmonize those two contradictory results.

Are experiments any the less trustworthy because they are not carried on under an Act of Parliament? For instance, if the Corporation of Liverpool choose to light up St. George's Hall, what is to prevent them doing it without any Bill at all?—The disadvantage would be, that in lighting St. George's Hall it would be a limited experiment; whereas, in order to test the commercial question, the experiment should be tried upon a larger scale.

Supposing it is thought that the experiment would be on too limited a scale in St. George's Hall taken by itself, what is to prevent their extending the experiment, and lighting all the streets round about it at the present moment?—I hear that they require an Act of Parliament in order to raise funds.

Cross-examination continued: I am not aware that any authority is needed for carrying the wires through the air, and I do not know of any reason why it should be more difficult to do so in Liverpool than in London. No doubt theatres, railway stations, hotels, and other places of public resort, are important customers of the Gas Company.

Mr. BIDDER: As a commercial man, what do you think would be the effect upon the value of the Gas Company's shares, of a Bill authorizing the Corporation to compete with them in the lighting of those places?

Witness: They would lose those particular customers; but, on the other hand, they would gain enormously through the fact that the public would get accustomed to more intense light, and the total consumption of gas would not be diminished. There are also many other applications for gas—for instance, in the working of gas-engines, and in order to produce the electric light, and for heating purposes, and so forth. For the moment it would, I have no doubt, tend to depreciate the value of the shares; but I do not think that would be the result in the long run.

Let us go a step further. At the time that it depreciated the value of the Company's shares, it would enable the Corporation to negotiate for the purchase of the Company on better terms, would it not?—If the Gas Company were to give way from fear, or panic, or anything else——

If the market value of their shares were reduced, any negotiation for the purchase of those shares would proceed with reference to their market value, would it not?—As I understand the question, it is only one of experimenting, and surely it is the interest of the public, and of every one, to ascertain the truth.

Are you aware that the quality of the gas supplied in Liverpool is 20 candles, and do you think that is an economical sort of fuel to use with the dynamo-electric machine?—Yes, experiments have shown that more light is obtained by burning gas in an engine than in consuming it in burners direct. Gas of a high illuminating power will give a greater heating result than that of a lower power; it will give more heat as well as light.

The Bill proposes to authorize the Corporation to let out dynamo-electric machines. What is to prevent their doing that at the present time?—The breaking up of the streets, I suppose.

But surely you do not want to break up the streets to let a man have a dynamo-electric machine on his own premises?—Yes; if you let out the power you have to work the machine at a central station, in order to lead the electric current to the place where the power is to be utilized.

I thought the more economical way to do it, electrically speaking, is to provide him with a gas-engine to work his own dynamo-electric machine?—Certainly, in that case he can do it himself.

Or the Corporation can do it for him?—Only he would have to use the light to a considerable extent, or else he would subdivide it again to such an extent as to make it unprofitable.

It is one of the features of this Bill that the Corporation propose to raise £50,000, in order to try this experiment; but there are plenty of companies at the present time who are only too ready to undertake electric experiments, are there not?—Those companies advocate particular apparatus—some one kind and some another; but the Corporation wish to be quite independent of any particular description, and they wish to try it on a large scale.

Re-examined by Mr. PEMBER: The very essence of the experiment which the Corporation wish to make, is the establishment of a central motive power at St. George's Hall, and the distribution from thence to the theatre, to the hotels, to the Free Library, or to the Picton Reading-Room. There is already a steam-engine at St. George's Hall, which is available for the purpose. I believe all the experiments which have been made in London have been conducted separately and in isolation—that is to say, the lighting on the Thames Embankment has been disconnected with the lighting on Holborn Viaduct. We want a combined experiment on a large scale extending over several years. I believe the Jablochkoff light is the only one that has been tried in the public streets.

Mr. PEMBER: It would not do for the Corporation to have, first of all, to hand over their site to a company to try one thing, and then to have to remove that apparatus, and try another; it is much better for them to be upon the spot themselves, and make any experiment they may be advised to try?

Witness: In order to try the experiment fairly and independently, it [is] an essential condition.

(From the London "Journal of Gas Lighting.")

British Association of Gas Managers.

Annual Meeting at Newcastle-upon-Tyne.

Mr. W. Sugg (London) read a paper on

Lighting by Gas and Electricity.

In the early part of last year it was proposed to light the Avenue de l'Opéra in Paris by means of electricity instead of gas. Already the Jablochkoff electric candle had been shown to a few scientific men, and a new incandescent light—Werdermann's—was apparently producing an electric light which, in simplicity, rivalled—if not surpassed—the well-known Serrin electric lamp, to which scientific men had long pointed as the point of departure in electric lighting, and as such it was hailed by many men.

It was not at first seen that electricity would enter into competition with gas as a means of street lighting, but as soon as the company was formed for the new exhibition of the new electric light were given at the works of the company in the Avenue de Villiers, and comparisons were instituted between the new light and gas light. The comparisons, as I then saw, were most unfairly made, the gas being placed at about 15 feet from the floor of the room in which the trials of the lights were conducted, while the electric light was only 7 feet from the ground. Four of the new lights were placed on 6-foot standards, and two large chandeliers, each having a number of common iron burners of the most gas-destroying type, were hung from the ceiling; the lights being, as I have said, about 15 feet from the ground. Supposing the two chandeliers were hung from the ceiling so that the lights were at the same level as the electric lights, I think the amount of light given by them would have been equal to that given by the electric light. But it is clear that in the comparison made, at the distances I have mentioned, the gas was most heavily handicapped. I do not mean to infer that the electric light company designedly selected the worst burners to try against the electric light; on the contrary, I have reason to believe to the contrary, as such as might be bought anywhere in Paris, and, in fact, were still as were generally used in cafés and other large public rooms. As gas is but of an ordinary type, it was fair to take them as samples. The only other part of the comparison was the manner in which the gas was placed in the competition with electric light. I more particularly mention this circumstance, because I have found since, in almost every case in which experiments have been made by electricians against gas, there have been equally unfair means taken to depreciate gas and show an untrue effect with electric light.

Similar experiments made in this manner are bitterly unworthy of scientific men, and the effect of such one-sided work is to debase science in the eyes of the general public. Gas and electricity must stand or fall by their merits, and it is of no more use to endeavour to bolster up a defective system of lighting by false statements and one-sided experiments than to stand idly by and let the public be misinformed without an attempt to put them in possession of the true facts of the case.

One thing is certain, and that is that, after the preliminary trials I have referred to, both scientific men and the public, overlooking all its defects, were said to be of a temporary character, were entirely carried away with their enthusiasm for the new light. It was resolved by the Municipality of Paris to place leaving lamps with the new light during the Exhibition, and a fixed price having been agreed upon between the parties, this magnificent new street was at the opening of the Exhibition supplied with 62 of the Jablochkoff candles.

Notwithstanding the lamentable mistakes of the electric light, it found favour with the public, because it was immensely superior to the ordinary yellow gas lights. It evidently fulfilled a latent desire on the part of the Parisian public for more light in their most frequented thoroughfares. The oxygen light of Tessie du Motay, which had been without a short trial, had left them unsatisfied, and till the advent of the electric light a considerable time had elapsed without any imitative having been taken by the Paris Gas Company to show an improved system of gas lighting.

Therefore it was, I think, that the electric light, thus answering to the great desire on the part of the public, met with a more enthusiastic reception than it otherwise would; more even than it merited, for the light was not of a few minutes. Indeed, it cannot be said that even for a single hour it was constant. A large gas light working on a very bad meter or electric light than anything else. The illuminating power of these lights was stated to be equal to that obtainable from 700 or 800 candles. I know that this was a gross exaggeration, but it illustrates how much

scientific men were carried beyond the power of reason by their enthusiasm for the new light. As a mode of street lighting it failed in a most important requirement: It was not continuous between the hours of sunset and sunrise. At midnight it was extinguished, and the regular gas lamplighters were called into requisition to carry on the lighting till sunrise. The double system of gas lighting and electricity had to be maintained.

Some among us had the pleasure of visiting Paris after the meeting of this Association last year, in company with three American gentlemen—Messrs. Greenough, and Pownall have left behind them as set agreeable memories as we have. We now feel that in all our meetings they will be present with us in thought, and in our work and discussion we address ourselves to them as well as to those who are present. In company with these gentlemen, and others, including your late president, Mr. C. Woodall, who has devoted considerable amount of time and trouble to the investigation of the most of electric and gas lighting in use, we made a careful examination of all the systems of electric lighting in use in Paris at the time of our visit. We stated to be given by the electric lights did not appear to be proportionate to volume of light fell far short of our ideas of what it ought to be, if the statements made by the electricians were correct. We soon came to the conclusion that they were not correct, and subsequent experiments, by M. Tolmer, the Chief Gas Examiner of Paris, have confirmed us in our idea of the small illuminating power given by the electric light. We thought that the amount of light could not exceed at any time more than 150 candles. The public were therefore misled by the statement made at the first presentation of the electric light.

I regret to have to say that even at the present time electricians do not seem to have made up their minds to state with anything approaching to accuracy what is the real illuminating power of their lights. It is next to impossible to obtain any reliable information as to the cost or illuminating power of any of these systems. I will mention an example of the nervousness of electricians as to this question of illuminating power. At the recent exhibition of electric lighting apparatus at the Albert Hall, there were two electric light photometers exhibited—one by Mr. Keates and the other by myself. Although the authorities invited the electricians to bring their lamps to be tested, so far from illuminating power, and Mr. Keates' assistant kindly attended to try them, yet it was found impossible to get the electricians to be ready simultaneously with the exhibitors of the engines which worked the electric machines. When the engineers were there, the electricians were not, and vice versa; so the trials had to be given up. I have, therefore, in the interests of this paper, compared the sometimes slightly conflicting evidence of those who have made trials of the electric lights in various places, in order to give you the best idea of the relative positions of the two lights as they stand to each other at present, and I then propose to make some remarks upon the future of the gas and electric light.

First I will take the Avenue de l'Opéra. There are in all 62 electric lamps in the Avenue. The machines setting in motion by gas engines strictly producing the light were what are called the "Double Gramme." The length of the Avenue is nearly 1,000 yards; the width of the road from house to house is 90 feet; the width of the carriage-way is 30 feet. The Place de l'Opéra, at its intersection with the Boulevards, is 200 feet by 150 feet, and 450 feet long.

This Place is lighted by 22 Jablochkoff lamps, and the machines producing the electric current creating the lights is worked by a 25-horse nominal engine fixed in the basement of the Opera House. The next section of 16 lamps is worked from a Double Gramme machine, driven by an engine of 20-horse power fixed in the Rue Caulles. The next section, also of 16 lamps, is worked from a Gramme machine and a 20-horse power engine fixed in the Rue d'Argenteuil. The last section consists of the lamps in the Place du Theatre Francais. They are 14 in number, and the engine and the machine for them are fixed in the basement of one of the houses of the Avenue. Each of the lamps is provided with four candles, only one of which is burning at a time. The whole four are inclosed in an alburine or white glass globe, about 18 inches in diameter. One of these candles burns a little over an hour. At the end of that time the current must be switched off from the one which has been burnt down to the fresh one next it. So it is necessary that an attendant shall go to every lamp once in an hour, and turn on the current to the new candle. The lamps are lighted at about an hour after sundown, and are all extinguished at midnight. They are not already lighted up, must then be put into requisition to carry on the lighting till sunrise.

According to the official report, from the 30th of May to the 10th of October, 1878, a little over four months, there were no less than 60 extinctions, lasting from 1, 2, 3, 5, or 10 minutes up to 15, 30, or 45 minutes. The Company, it is said, hopes to do better. There are no fines to pay if they do not

...gas at present consumed, it would be possible to give more light ...ation of improved burners, and more effective illumination by abol... among the shadows. He was quite sure, however, that there would eventu... ally be an increase in the consumption of gas in the public streets. Of course, it would not come all at once; no public improvement ever did. First the crossings would be improved, and then other places would by degrees receive attention.

[The other papers read will follow in due course.]

Gas Companies and Consumers.

For several weeks a discussion, has been going on in the *English Mechanic* on the question as to whether economy affects the consumers' accounts. Writing on the subject, Mr. J. B. Warren says:

From the tone of "Lofluman's" last letter I am led to infer that he objects to reduce his pressure by the main tap, on the assumption that the pressure being reduced before the gas enters the meter, the gas expands and is increased in volume by the reduction of the pressure, so causing the meter to register in favor of the company. I do not say that this is not the case, but I will endeavor to show him the increase in volume is so very small that his gas bills cannot be effected thereby.

It is a well-known fact that the volume of gas is inversely proportional to the pressure to which it is subjected. If we increase the pressure the volume is diminished, and by diminishing the pressure the volume is increased. If we take a volume of gas measuring, say, 100 cubic feet—the pressure being equal to a column of mercury 30 inches high—then, according to the above law, if the pressure is reduced to 29 inches, the volume will be increased to 103·4 cubic feet. I need scarcely inform "Lofluman" that to distribute gas it must be subjected to a pressure greater than that of the external atmosphere, or it would not flow through the pipes and escape through the burners for combustion. This pressure to which the gas is subjected is measured by the height it will support in a column of water, expressed in 1-10ths of an inch. And in correcting the volume of gas for pressure, this pressure should be reduced to its equivalent height in mercury and added to the pressure given by the height of the barometer. Mercury is 13·6 times heavier than water; therefore, a column of water 1-10th of an inch high is equal to a column of mercury 0·00741 inch in height. We will now assume "Lofluman" to have his main tap turned full on, and that the pressure at the inlet of his meter is 15·10ths, the pressure to be regulated anywhere he thinks proper beyond the outlet of his meter, to 1·30ths, and that his meter has indicated a volume of gas equal to, say, 1,000 cubic feet. We will now suppose he takes the advice given by the gas man, and reduces the pressure at the inlet of his meter, by means of the main tap, to 2·80ths, all the burner taps in use to be full open. His gas is now passing through the meter at a pressure equal to 10·30ths less than it was in the first instance, which will cause the gas to expand, and to have increased in volume to *x* cubic feet, which, of course, his meter will indicate. We can easily find the value of *x* by the law given above—taking the barometer as standing at 30 inches—as follows:

$$\frac{(30+5\cdot10\text{ths})\times30\cdot10\text{ths}}{(30+15\cdot10\text{ths})} = \frac{32\cdot11115}{30\cdot11115} \text{ or } \frac{1\cdot0667}{1\cdot000}$$

$$\therefore x = \frac{1\cdot0667 \times 1,000}{30\cdot0665} = 1,002\cdot46$$

"Lofluman" will thus see that by taking the advice of the gas-men his meter will have registered 1,002·46 cubic feet, which is ·2646 per cent. in favor of the gas company; but I think he will agree with me that this is not worth a single sou very much on the stretch after all, and that his economy will not suffer to so great an extent as he imagines by taking their advice, especially when we take into consideration that the "Sales of Gas Act" allows a meter to be stamped as correct with a range of 5 per cent. in its registration, namely, 3 per cent. slow and 2 per cent. fast. We also see from the above that, practically, it does not signify whether the pressure is reduced before the gas enters the meter or after it has left it. It is best to use a governor for the purpose of regulation, because the governor, being self-acting, requires no attention. Where a governor is not used I should advise the regulation to be made by the main tap; I see no objection. I always advised the regulation to be made by the main tap; it answers to perfection, and saves the expense of having an extra tap fixed elsewhere.

I think I have now said enough to convince "Lofluman" that he is in error in charging the gas-men with fraudulent intentions, the increase in the registration of the meter being too small to justify him in bringing such a pretension I made, that consumers would gain largely by taking their advice. I have adopted the same premises I used in my previous reply, because I consider 15·10ths to be a more than sufficient maximum pressure to be given by any gas company at their consumers' meters, and for the minimum of 5·10ths, because it is the standard pressure used under the "Sales of Gas Act" for testing meters, and, further, it is the least pressure that can be used with economy for illuminating purposes where common burners are used.—*Journal of Artificial Light and Sanitary Gazette.*

Coal Gas versus Water Gas.

The recent gas controversy has brought to mind many important matters connected with its consumption and relative cheapness, as compared with other illuminating substances, as well as its safety under its several forms of manufacture.

—With a view of determining the position that the gas companies occupy with regard to the general public, we propose to show, in brief, the value of the claims set forth by the water gas companies with respect to the wonderful illuminating power obtained for the substance distilled from hard coal and petroleum or the products of the latter.

In a circular recently issued by one of the companies organized under patent having in view the manufacture of gas by such means, it is boldly set forth that their gas has very much greater illuminating or candle power than gas manufactured by the ordinary process from bituminous coal, and that by their method a saving was effected to the consumer of from 25 to 50 per cent.

This is truly a wonderful discovery. It calls to mind the anecdote of the miserly farmer who, after repeated experiments, thought he had hit upon a plan for keeping his stock in good condition at a very small cost. He tried the experiment first upon a favorite white horse. This animal was fed upon nothing but bean straw for several days without any apparent loss of strength. The farmer was in high glee over the experiment, and invited his neighbors to come and view the result. The barnyard was sought and by the assemblage, when lo, and behold! old White was found in a horizontal position, stiff and dead.

"How is this?" asked the farmer of Dick, the hired man, as he turned his eyes up with unmixed sorrow at his loss.

"Don't know," said Dick, "but I gave him all the bean straw he would eat."

"Aye, I see," said the farmer, with a sigh and a moan, "you must be more careful next time, you fed him altogether too bountifully!"

It only requires one more discovery—patented, of course—on the part of the water gas companies to save the lucky consumer the remaining 50 per cent., and his gas bill would be wiped out altogether.

But what are the facts? Take, for instance, the Manhattan gas at a nominal standard of 100, flowing through a four foot burner, and the Municipal at a standard of 75, passing through the same-sized burner, the average candle power is 16 for the former, and 22 is claimed for the latter, but allowing for the difference in gravity and actual illuminating realties and the Municipal gas is actually only about an average of 12 candle power. The two being in every case equal, the result must prove substantially correct.

The apparent difference that the water gas company's claim arises from the different-sized burner, less volume of consumption, greater impurities, the shape of negative illuminant properties, and a marked difference in specific gravity as compared with coal gas. For instance, coal gas contains six per cent. of illuminants will furnish 16 candle power, while water gas with 18 per cent. of illuminants, will give only 22 candles, showing that it requires 200 per cent. increase of illuminants for 87 per cent. increase of light.

All the rest of what almost proves beneficial is acquired by the large proportion of carbonic oxide and other impurities, which enters into the elements of its production. These non-illuminants are absorbents as is related by a pale blue flame.

An actual loss of about 20 per cent. takes place in bringing water gas to a good standard of excellence. Gas made from bituminous coal contains about five per cent. of carbonic oxide, while water gas contains, by analysis, from 20 to 30 per cent.

If this statement is true, as is vouched for by eminent chemists, the question of illuminating power is not the only one to be considered. It is repeatedly been ascertained that about five-tenths per cent. of this poison will kill birds and small animals, while its presence in slightly increased quantities is likely to prove very injurious to human health, and even destructive to life.

This is especially very likely to happen with persons of weak habit, as those fields to affections of the heart, or laboring under pulmonary difficulties and affections of the throat and air passages.

Water gas is no new thing; patents for its manufacture date back to 1830, and it has at various times been introduced both in Europe and America, but generally with doubtful success. Selligue obtained permission, in 1840, to use the gas in the towns of Dijon, Strasburg, Antwerp, and also in Paris and Lyons.

At Strasburg an accident occurred which put a stop to its use. The gas

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TO CORRESPONDENTS.

Notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 25, 1882.

Circular to Gas Companies.

The Metropolitan Board of Works have, in compliance with the application of the French Société Générale d'Electricité, agreed to make a more extended trial of the electric light. It is proposed to have twenty more lights, some in Northumberland Avenue, if the consent of the Vestry of St. Martin's-in-the-Fields can be obtained, and some on the Waterloo Bridge. The charge for the lamps, after the expiration of the present contract, is to be only threepence per hour per light. The French Society wished to have the experiment continued for twelve months; but the Board determined, at their meeting on Friday last, that a six months experiment would be sufficient for their purpose. The fall to threepence per hour per light is a considerable drop; but it will scarcely induce the Metropolitan Board to continue the experiment unless better results follow than have hitherto been obtained. We are not told for how many hours in the evening the light is to be used, nor how far it will require to be supplemented with gas. Hitherto, wherever the light has been applied, it has been extinguished early; and, for the illumination of the really dark hours, gas has always been employed. It says but little for the new light, that it cannot be made continuous; but if it could be, the expense, even at threepence per hour per light, would militate against its general employment.

Sanguine expectations are, however, now entertained that the electric light is the public light of the future. It seems that the twenty new lights which are to be installed by the Metropolitan Board will be actuated by the same 20-horse power engine as was employed for the original twenty lights, but with an enlarged Gramme machine. With this addition or substitution, very long circuits, it is alleged, may be maintained. Some, indeed, have an opinion that all the principal streets and open spaces in London may be illuminated by a common centre of force at Charing Cross. Others prudently recommend that several centres should be established. It is perhaps premature to express any opinion as to the complete success of this large extension of electric lighting until we have the results of the experiments about to be made by the Metropolitan Board. We have said all along that much, if not all, would depend on the relative cost of electricity and gas. An opinion seems to be gaining ground that, light for light, electricity may in a short time be able to hold its own against gas; but the fact has yet to be proved. We have at present no four of witnessing gas supercedid in London streets. It will not be until we have seen the electric light maintained in operation during all the hours requiring artificial lighting, that we shall have any apprehension of gas being supplanted in our thoroughfares. Supposing, however, such a result to happen, Gas Companies, as we have said before, have nothing to dread, and public lighting, we all know, brings an infinity of trouble and very little profit. Perhaps if all the streets of London were lighted by electricity, the Gas Companies would not regret the change. Their strongholds lie where electricity is not likely to penetrate for a very long time; and if they be only true to their own interests, the consumption of gas will go on increasing as fast as it has done during the last few years.

From New York we learn that Mr. Edison has, after all, but yet perfected his invention, or rather brought it into a condition for general use. He still finds platinum too dear for his purpose, and is now hunting all over the continent of America for new supplies of the metal. California will, of course, receive a large share of his attention, and by-and-by, some years hence, we may hear that the metal has been found in sufficient quantities to make its use in electric lighting remunerative.

The Liverpool Lighting Bill has passed a second reading in the House of Lords, and stood for Committee yesterday. Rather late in the day, the Gas and Water Companies Association issued a form of petition which Companies were recommended to sign and transmit forthwith for presentation. The Bill, as it left the Commons, gives the Corporation of Liverpool power to supply the new light to places of public resort, such as theatres, music-halls, &c., and to private establishments, such as railway stations, &c.; and it is against the granting of such powers that the Gas and Water Companies Association very properly protest. They further set forth in the petition that the Bill, as it now stands, will only confer power to make experiments with money which must, in the long run, come out of the pockets of the ratepayers. The Corporation of Liverpool have large private funds, but they do not propose to expend any of them in experimenting with the electric light. It is the ratepayer who is to pay for all, and he is forbidden to profit by it, while he will be required to make good any loss the Corporation may sustain in the course of their investigations and in their pretended endeavour to provide a better illuminant. The Bill is so far inimical to the interests of the Liverpool United Gas Company, that strenuous opposition will be made to prevent its further progress. More than this, if it be passed it will constitute a precedent of a most dangerous character. It will be the first time that a Corporation have been granted power to make experiments at the expense of the ratepayers, for the purpose of bringing to a successful issue a purely commercial undertaking. We regret that this petition was not circulated at an earlier date, and very extensively signed. Gas Companies have a special interest in endeavouring to restrain power being granted to Local Authorities to encroach on their rights and privileges.

[Since the above was in type, we have learnt that the Lords Committee passed the preamble of the Bill.]

It would appear that no alterations in the *locale* of the Metropolitan gas-testing stations, which would remove them beyond the distance from the works now prescribed by Act of Parliament, can be made without the authority of another Act; and therefore the Board of Trade have recommended that the Corporation of the City of London should confer with the Metropolitan Board of Works, and promote a Bill to which the Central Authority have promised to give their support. It is, of course, the thousand yards distance, prescribed by previous Acts, which stands in the way of any change of situation. We do not know how far the Gas Companies concerned will be inclined to give up the limit, which was established after long and careful investigation. It seems

[illegible] position they were in at [illegible] The 10th [illegible] seen, and they [illegible] the same [illegible] relating to the [illegible] into the Bill as the Metropolitan [illegible] the principal [illegible] against the Staffordshire Gas

tions to share, in the prosperity of the gas undertaking, because, when that prosperity enables us to make a reduction, we make a proportionate reduction to Northfield and Yardley; and we have, since the undertaking passed into our hands, reduced the price of gas in those two districts. We finished here a little to deal contrarily and liberally with a public authority, and made the price for the public lamps in Northfield the same as we charge in the city of Birmingham.

Two who attend the meetings in Birmingham and those outlying districts to be added together, and the Corporation will have a majority. I never some sort which effected periodically the consideration of the Bill. Cases which has been brought to the notice of the Committee in that of the Great Western Railway, and there the Committee sat from day to day after the sittings within the district of supply of the Birmingham Corporation Gas Company, and the same course pursued, and the same reward obtained, as I have taken pains to negotiate every small case required for these local sittings. That was a great saving of time, and the Committee, I am sure, appreciated the trouble to which we were thereby relieved in the loss of our professional.

Another important case, where a tradesman living in Birmingham was interested, was on his consumption in Acock's Green, to come up to the amount of consumption which would entitle him to the allowance, and we have included the whole of Acock's Green in the district. In that case he was charged at rates according to the local consumption, and he was charged at a differential rate with regard to it supply in Acock's Green.

Examination continued: With respect to the Hilton Company, my reasoning a very considerable quantity of coke in their disposal; and when the negotiations commenced, the Corporation were very much troubled with the question, what their object was in obtain a sale to their Company. In the course of the negotiations it was suggested that they would take their gas specially from us, and that they would be in a position to be able to use the coke during the daytime, when they were not employed for any considerable consumption, to convey the gas to Hilton, and they would have a stock of gas for use at night, and in the evening, and it would be no increase of expense to us to supply them in this way. We have supplied them in this way, and we have made a profit upon it. With holder, at the time we made the agreement, and we said, under all the circumstances, if they would take gas[illegible] we would supply them at the lowest rate in bulk. It was a specially from us, we would supply them at a differential rate.

Mr. Macnay: In your opinion, are there any circumstances which would make the sale of gas in Northfield and Yardley, supposing a separate district were constituted for the purpose, objectionable for the supply from the Birmingham district at ballast?

Witness: Yes. The Corporation come to Birmingham, and could get their gas at a[illegible] there were very careful calculations showing that the maximum cost in those districts would be 2s. 6d. per 1,000 feet; and at the differential rate charged to Northfield and Yardley, and filled them with the greatest possible profit to the Corporation, and the greatest benefit to themselves on behalf of the inhabitants, that we had no power to charge the differential rate in those districts, because they were not such districts as we could, and they were obliged to charge the rate to that within the borough. Respecting the necessity, which there is for the rate to that within the borough, the necessity which there is for the rate to that within the borough, is supplied at a higher rate than that charged to Northfield and Yardley from the works, I have caused inquiries to be made, and I believe that before the Corporation of Birmingham came to the city, and in fact, they were charging at as low as two miles from the works, while the higher rate is charged at a distance of three miles from the works. That is the reason for that.

Mr. O'Hara objected to the evidence, as each of those cases was under an Act of Parliament which specially dealt.

Mr. Macnay said he would not press the point. (To witness:) There is the maximum prices charged over the Corporation Act make any difference in the[illegible] Yes, it did; it reduced the maximum price.

Mr. Macnay: Then it reduced the maximum price to 2s. 6d. It was 3s. 6d. and 4s. 6d., and lower in and 5s.; but the actual price was 2s. 6d. when the Act was passed?—Yes.

Cross-examined by Mr. O'Hara: My impression is that the maximum price with the Corporation was 3s., and with the Staffordshire Company 4s. 6d., and with the Staffordshire.

Mr. O'Hara: You have said you think it fair to charge a different rate for all persons residing distant. Did you not think it fair that representation to the Committee in 1875?—Certainly not.

Mr. O'Hara: Did not the Committee inquire that what you charged locally by the Corporation you should charge outside?—No; it was put in what the Corporation charged, and it was offered by me personally and by the[illegible] according to premises.

Mr. O'Hara: Is it not the fact that you were only asked to supply Northfield and Yardley are no better off than all the other districts?—I[illegible] I have no means, no matter what it was.

By the Chairman: The capital invested in the gas-works does not belong to us, and we do not pay interest upon it. We have borrowed 42,000,000, and have made somewhere about 2½ per cent against that sum, and a little more. In how many years will you be obliged to put something by towards the[illegible]?—Is there not a sinking fund?

Mr. Macnay: We are bound to repay the whole of the capital in a certain time.

You said you looked for an increase of profits, and you hope you will gain more and more every year?—I said I expected, and you hope you will gain more. The Bill was under consideration by the Committee of the two Houses of Parliament for eight days.

—Did you not think it a very good bargain?

—I did not think it a bad bargain.

Mr. Macnay: Mr. Sheridan: If we were obliged to give up any portion of our[illegible] to a[illegible] municipality, it would be a[illegible] sell it this week as[illegible] a parliamentary title which would be[illegible] Corporation was in full possession of all the facts.

Mr. Macnay: I had some extracts from the evidence given in 1875, and which I thought it was evident that the whole matter was before Witness said that was so.

Mr. Macnay: And the Committee themselves pointed out the[illegible] Mr. Sheridan: And you said that the[illegible] Witness: Yes; and taking it away at the time would involve a loss of £25,000 to the Corporation of Birmingham, either as representing the ratepayers, or as representing the consumers.

If taken away, might it not be[illegible] to have been taken away when they would have let you claim a corresponding sum[illegible] from the Gas Company?—Yes.

Mr. H. Hack, examined by Mr. Michael.

I am one of the Gas Engineers of the Corporation of Birmingham, and was formerly Engineer to the late Birmingham and Staffordshire Gas Company, and I was one of the Engineers who prepared the Bill which was passed in the third Session of the Birmingham Corporation Gas Act, 1875, under which the Corporation purchased the undertaking of the Company. The Bill was opposed by the Corporation of Birmingham, and I was one of the witnesses called in support of it. The Birmingham and Staffordshire Company had a trunk main for the supply of Yardley and Northfield. Enough being conveyed in order to supply those districts. The purpose of the Company to expand that money. But for that in. I should have recommended the Company to go to King's Norton, which is a populous district, and so is Northfield and Yardley, except in certain small districts, which are not suitable for the supply of gas. The total length of mains laid to the end of that year was 630 miles, and the total length of mains laid to the end of the year was 1,000 miles. The number of lamps in Yardley in 1876 was 16,563,500 cubic feet, and the number of lamps was only 673. The consumption per mile of main there was 26,000 feet. I have made an estimate of the cost of the mains, meters, and services, and I estimate the cost at £1,000 per mile. I estimate the cost of the mains at £1,000 per mile. I estimate the distance from the gas-work to the nearest boundary of Northfield at 2½ miles. The consumption there is 26,000 cubic feet, and the number of consumers 250, giving a consumption per mile of mains of more than 1 million cubic feet. On the basis of the consumption there at Northfield £500 has been expended, equal to £937 per million feet a year. Supposing there is a population of 1,250 in a fair area to allow for distributing pipes, in my opinion, the circumstances of the case warrant in additional pipes, and the cost of the mains in Yardley, and I consider it to be a very fair area. I have made out a scale for the supply of these two districts is 16 inches diameter, and it is calculated to meet the increase in consumption for very many years.

Cross-examined by Mr. Cleveland: I have not worked out the figure with regard to Sutton Coldfield, which is a fairly-populated district. I have not, Bromwich state that, assuming the obstruction of this differential rate, I have not done so. I have not worked out the question of charge per 1,000 feet in this district, and Yardley; but it will be about that. It must be very long time before the two districts will be supplied to the extent that the consumption might be increased; but I think it could be very rapidly increased. There is no other Gas Company in those districts which have gone through that place, because it is within the limits of our supply. To[illegible] of[illegible] Yardley, and I think it is a very fair area to supply. The entire extent of the[illegible] is a mile into Sutton Coldfield, but since May, 1875, they have been extended. The[illegible] supply was given, but not to the[illegible] to the south of the[illegible]. There are 67 yards of 3-in. main at 2s. 3d. per yard, 66 1-in. 1½-in. 253 yards of 4-in. main at 2s. 6d., 267 3s.-in. main at 2s. 9d., 1,584 4-in. main at 3s., 1,767 yards of 5-in. main at 3s. 3d., 2,240 9-in. main at 3s. 6d., 1,848 yards of 9-in. main at 3s. 9d. 1,257 yards of 12-in. main, 1,848 yards of 15-in. main, 1,848 yards of 18-in. main, 1,848 yards of 21-in. main, 1,848 yards of 24-in. main, 1,848 yards of 27-in. main, 1,848 yards of 30-in. main, 1,848 yards of 33-in. main, 1,848 yards of 36-in. main, 1,848 yards of 39-in. main, 1,848 yards of 42-in. main, 1,848 yards of 45-in. main, 1,848 yards of 48-in. main, 1,848 yards of 51-in. main, 1,848 yards of 54-in. main, 1,848 yards of 57-in. main, 1,848 yards of 60-in. main, 1,848 yards of 63-in. main, 1,848 yards of 66-in. main, 1,848 yards of 69-in. main, 1,848 yards of 72-in. main, 1,848 yards of 75-in. main, 1,848 yards of 78-in. main, 1,848 yards of 81-in. main, 1,848 yards of 84-in. main, 1,848 yards of 87-in. main, 1,848 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1,848 yards of 1,020-in. main, 1,848 yards of 1,023-in. main, 1,848 yards of

other means of lighting or heating authorized by the said Acts or any of them.

The CHAIRMAN: The question is whether a certain number of ratepayers have any right to appear.

Mr. HERBAGE said that his friend Mr. Michael had gone into the merits of the case, and, therefore, he must beg to be entitled to be heard in reply. He contended that, *prima facie*, the Corporation represented the ratepayers.

The CHAIRMAN: If a certain number of ratepayers meet, and pay their own dissentient, are they justified in appearing to oppose the Bill?

Mr. HERBAGE thought that it should be shown who were the ratepayers, and that a certain number only were in the gas concerns of Dublin. This petition was signed by 25 persons.

The CHAIRMAN: Is it not proposed that they are a committee to represent the whole body of consumers?

Mr. MICHAEL: Look at paragraph 18 of the petition, which states that "on their own behalf, and on that of the general body of consumers of artificial light within the city of Dublin and the neighbourhood, your petitioners submit that the grant of such extended powers, and the establishment of such new monopoly, or quasi monopoly, with regard to the supply of artificial light, would be greatly to their injury, and against the interests of the citizens of Dublin and other residents within the gas limits of the Company."

The CHAIRMAN: Can it be shown that there has been any public meeting held on the subject?

Mr. HERBAGE said he could show that meetings were held, representing the consumers of gas.

The CHAIRMAN: Can you show that the petitioners are a committee representing a large body of ratepayers?

Mr. CLIFFORD: We are prepared to show that.

Mr. HERBAGE submitted that it would be a dangerous precedent to grant the petitioners *locus standi*.

The CHAIRMAN: Supposing they could say there was a meeting held on the 1st of March?

Mr. HERBAGE: If you think it necessary to show that public meetings of citizens were called, and that certain resolutions were come to sufficient to set aside the legislative sanction, I cannot object.

The CHAIRMAN: But what about 1875?

Mr. HERBAGE: In that year there was a large representative public meeting on the subject, and the resolution, it was stated, was adopted at a meeting of gas consumers.

The CHAIRMAN: Do you mean to say that a number of ratepayers are dissatisfied with the agreements between the Corporation and the Company. The question is, can you show that you represent a large number of ratepayers were dissatisfied and had a right to object?

Mr. MICHAEL: A committee was appointed to watch over the interests of the ratepayers. I can file further evidence to show the constitution of the Committee.

Mr. HERBAGE submitted that it was not a case for evidence. The Committee were in possession of all the facts.

The CHAIRMAN: Sir Arthur Guinness is not a petitioner.

Mr. MICHAEL: I thought it better that an independent witness should be called to speak as to the status of the petitioners' Committee.

After some further discussion, the room was cleared, and the Committee retired for a few minutes. Upon the re-admission of the public,

The CHAIRMAN said: The Committee have decided that the petitioners have an *locus standi*.

[The Bill, as unopposed, afterwards came before Earl Redesdale, and the preamble having been proved, it was reported to the House.]

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Journ. of Gas Lighting, Vol. 3, 1878, p. 27.

GAS APPARATUS AT THE ROYAL AGRICULTURAL SOCIETY'S INTERNATIONAL EXHIBITION.

SECOND NOTICE.

Next to the gas-engines, in point of interest to those who advocate the extended use of gas, come the steam-boilers which are designed to use gas as fuel. There were several of these shown by different exhibitors, yet this branch of gas development was not so well represented as it might have been. Although the nature of things forbids the attainment of such a high duty from a given quantity of gas by this method as from an equal quantity consumed by a direct gas-engine, still there are simple but powerful reasons in favour of the latter being generally more easily gas-heated boiler. Chief among these is the fact that, compared with steam-engines, gas-motors are as things of yesterday, and a knowledge of their construction has not yet reached the great majority of engine-fitters and handy men throughout the country, most of whom are able to do small repairs to any ordinary steam-engine, and there is no doubt that the fear of having to send a machine in the maker in the case of a break-down, deters many otherwise willing purchasers in small or inaccessible towns. Here it is that a gas-heated boiler, which without sacrificing the simplicity of the steam-engine possesses the advantages of not requiring stoking, with regular steaming, cleanliness, and absence of smoke, would frequently find favour, despite its increased cost, which, after all, would still be covered by the saving in labour. It may, however, be said that many progress has not been made in this line. There is still too great adherence to the general idea of the forms associated with the use of solid fuel. It will be a considerable time before boiler-makers will be able to divest their minds of the memories of large fires and a heating agency of great bulk, and confine their designs strictly to the problem of making the most of a flame of comparatively small size, intensely hot, but deficient in radiating power, such as that of the Bunsen burner and its modifications.

Messrs. Blake and Co., of Manchester, had a 2-horse power gas-heated boiler, which was also capable of burning solid fuel; and the General Engine and Boiler Company, of 9, Union Court, Old Broad Street, E.C., had two engines, of 1-horse power and 3-horse power each, fitted with gas-heated boilers. Mr. R. S. Hindley, of Beeston, Derby, showed a very neat little 1-horse power engine and gas-boiler.

Messrs. Thomson, Sterne, and Co., Limited, of the Crown Iron Works, Glasgow, showed a gas-heated boiler of somewhat singular design. This was in connection with an implement which was styled a domestic machine for driving churns, &c. In this little machine, which was nothing more nor less than a miniature steam-engine of peculiar design, the steam was generated in a small gas-heated boiler, passed through a form of gas, and the water was pumped through this "boiler of forced circulation" by the cylinder, the necessary arrangements and appliances for maintaining this action being very curious and beautiful. The example shown was 4-horse power, and consumed one gallon of oil per hour, thus taking one-fifth of a gallon per horse power per hour. The machine altogether, appearing, as it did, refulgent with nickel plating, and with all its guards and rods and pumps going with easy and precision, was more like a specimen of elaborate clockwork than a real machine in the working world. It was a machine which few visitors to that part of the yard could fail to notice, for it arrested general attention in a rather original way, and probably most of the people who inspected it had discovered its wheelbarrow by *following their noses*.

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Gas-stoves for cooking and heating were represented in only two stands, and of these the display made by Mr. T. G. Potter, of 17, Oxford Street, W., was confined to four examples of Williamson's manufactures which call for no special remark. Messrs. Billing and Co., of Smart's Buildings, Rosemary, W.C., and 90, Hatton Garden, E.C., showed a good collection of 72 stoves of various kinds, which well maintained the reputation of the firm for careful workmanship. There were no particular novelties among the exhibits, but it was satisfactory to see that the firm were alive to the desirability of giving the greatest possible amount of accommodation without unnecessary bulk, in stoves intended for small families where probably no servant is kept, and where the convenience of gas is so powerful a recommendation as any anticipated economy. It is among this class of consumers that gas-stoves ought to make great way; but there is danger lest buyers should be attracted by cheap articles, which might, by failure, cause disgust. Messrs. Sidney Leoni and Co., of 31, Strand, W.C., who were down in the catalogue for a great display, were, on the ground, conspicuous by their absence. It was unfortunate that none of the French manufacturers of gas-stoves were represented, as the comparison of their renowned goods with those of the best English makers would have been instructive.

Useful in hotels, &c., would be the gas calender of Messrs. Thomas and Taylor, of Stockport and Salford, by which one person can calender the largest table-cloth without assistance. It is probable that there would be found a considerable field for gas calenders for domestic purposes, if the matter were taken up and properly pushed by a few enterprising firms.

Although the list of gas-consuming apparatus was not particularly long, there were shown a great many implements and appliances of interest to manufacturers of gas. The stands of steam and general machinery, in action and otherwise, which could be said to appeal to gas engineers as much as to any other frequenters or users of power, were, as might have been expected, numerous and important. Boilers of every type, engines in endless variety, and pumps enough to be sensibly lowered the Thames, were to be seen ranged in lines that might have been measured by miles.

Messrs. Gwynne, of Hammersmith, had a fine show of their well-known centrifugal pumps, which were lasting examples of dirty water into an extemporized reservoir in a style which evidently aroused in the spectators a desire to see them employed in draining the Show Yard. The nicest character with this firm now fit to their centrifugal pumps, the object of which is to obviate the troublesome process of charging the pump, is a very neat arrangement, the value of which will doubtless be fully appreciated by any one who has ever sunk a draining well with the old pattern pumps. A portable centrifugal pumping-engine and boiler, with shelter and delivery pipes made to swivel to any angle required, was a conspicuous article in their stand.

Messrs. G. Waller and Co., of Holland Street, Southwark, had several of their compact and well-finished manufactures on view, ranging from engines and gas-motors through various descriptions of utility in water and sewage or drainage works, although they did not send such a collection of articles germane to gas-works as they might have done, if the general scope of the exhibition had been more favourable for their display.

Messrs. Tangye Brothers and Holman, of 35, Queen Victoria Street, E.C., had a very extensive stand, filled principally with examples of this firm's well-known types of steam-engines, then which none are stronger or steadier, and with their "Special" direct-acting pumps, description of which is superfluous. Quite a new departure for this firm are the centrifugal pumps of their manufacture which were exhibited. They had an arrangement whereby either the disc or spindle could be removed without disturbing the pipe-connections. Several hydraulic lifting-jacks, similar to those in the aid of which Cleopatra's Needle was raised, were also shown.

The Savile Street Foundry Company, of Sheffield, were well represented. We may mention particularly the new blower and gas exhauster made by this firm, as a promising apparatus deserving careful attention.

Messrs. Hayward Tyler and Co., of Whitecross Street, E.C., were well represented by a list of 55 entries. The curious hot-air engines, Hibbert's patent, which are manufactured by this firm, were shown in three examples. One in action was worked by gas, but it does not appear likely that such a method of working would be very economical. The "Universal" direct-acting steam-pumps, of which there was a good show, attracted considerable attention. There is no doubt that as this type of pump becomes generally known it will be preferred for most purposes to the more cumbrous barrel and crank pumps.

A great show was made by the Fulcometer Engineering Company, of 61 and 63, Queen Victoria Street, E.C., who showed 19 pulsometer steam-pumps, besides other articles. These machines may certainly claim to be the most direct-acting pumps in existence, and with fewest working parts, save only Giffard's and similar injectors. The valves are made in various patterns for special purposes. For excavators use, the pump has met with considerable favour, from its simplicity and freedom from liability to get out of order. The Hydrotreplex (boiler-feeder), which is a lineal descendant of the pulsometer, was also exhibited. It was claimed for this little apparatus that it could be regulated for continuous or intermittent feed, and required no attention. This firm also showed a rotary cleansing water filter, for cleansing large quantities of water for boilers, &c.

The "Comet" pump was exhibited by Messrs. Bartram and Powell, of 35, Queen Victoria Street, E.C., and is claimed to be very reliable especially for slow speeds. In appearance it is somewhat similar to Beale's exhauster, but in the present case the slide is fixed to the bottom, and the eccentric drum on the shaft moves around the inner surface of the case.

Messrs. Joseph Evans and Sons, of Culwell Foundry, Wolverhampton, showed a combined pump, termed the "Suitable," specially designed for pumping tar and other thick liquids, the valves being mechanically actuated. A particular feature in this was the reversing gear, by which a back current through the pump could be set up at any moment, with the view of clearing an obstruction from the valves or suction-pipe.

Messrs. Schiffer and Budenberg, of Manchester, had a modest stand of really valuable articles. Besides their well-known steam, vacuum, and hydrostatic gauges, and the strangely-shaped "Bose" governors, and numerous other engine and boiler mountings, they showed an ingenious invention—Doyle's patent swivel union for gas, water, or steam pipes. By means of a diagonal bolt and groove in the joint, the same fitting was adaptable either as a straight, elbow, or skew union at any angle; and by adhering to a uniform size of bolt and nut, one quarter is rendered available for all-sized unions. The chief drawback to these appliances would appear to consist in the bolt, which crosses the bore, and might prove an obstruction.

In various parts of the ground there were a number of appliances in connection with domestic water supply; but the important branch of waste-preventing apparatus was but scarcely represented. Messrs. Yeloe, Godfrey, and Co., of Broad Street, Bloomsbury, showed several varieties of their new "Hydrostatic" valves, and a water meter designed on the principle of the hydrostatic paradox. Messrs. A. Barr and Co., of Anderston, Glasgow, showed a compact and strongly-made water-pressure engine, in several sizes, which are better known and appreciated in Scotland than further south. Where water in bulk can be bought cheap, as in Glasgow, the simplicity of these machines would lead to their frequent use. With the pressure of 90 feet head, which was available for a yard, it was a pity that one of the engines was not shown in action.

Messrs. F. H. Atkins and Co., of 62, Fleet Street, E.C., the well-known makers of filters in infinite variety, exhibited a novel water softening and purifying apparatus, which was calculated to extend the benefit of Clark's process to small, or rather private establishments. It was ingeniously constructed to ensure a regular admixture of lime solution to the water-cistern, and the strainer could be readily cleansed of the precipitate, which, with the carbonic matters, has eliminated the noxious impurities which the water might previously have contained. A filter completed the outfit, and completed the process, and the purified water was wonderfully soft of hard water, but, for all that, a soft smooth water is a great luxury during it otherwise unattainable.

In conclusion, the exhibits of the so-called portable gas-making machines of Mr. R. L. Muller, of Birmingham, and the firm of Sugg, Pneumatic Lighting and Heating Company, of Newcastle Street, E.C., whilst quite a lighting medium by passing air over volatile hydrocarbons without much heat, and that of Mr. F. W. Clark, of Great Queen Street, W.C., who heats his material, were worthy of notice, as showing the popular appreciation of the convenience of gas lighting, and the consequent desire to obtain it even where coal gas is not obtainable. We may also mention the exhibit by Mr. J. C. H. Clare, of 39, Queen Victoria Street, E.C., of an assortment of "Victoria" leather belting. It was of English make, and certainly, if we might judge by appearances, was some of the best we have ever seen.

BRITISH ASSOCIATION OF GAS MANAGERS.

(Concluded from page 1214.)

Mr. L. Mabe (Lincoln) proposed the following paper, which was read by Mr. W. Carr (Belfast), Mr. C. Carpenter, Jun. (Southampton), and Mr. SOUTH (of the Kent Coal Exploration Co.) also joined in the discussion:—

HOT CLINKERS.

As the durability of gasholders differs so very much in various districts—lasting less in hot climates than others—and various opinions having been given to those appeared in print on the subject; and as it is an important and often very annoying subject for not only directors, shareholders, and managers, but also for the public who use gasholder manufacturers, it occurred to me, during the delivery of that excellent, instructive, and interesting lecture, at the evening sitting of the Institution of Gas Engineers, by Dr. Percy, Mr. C. Wilke, on "The Products of Combustion," and partially a solution of the hitherto apparent mystery, and I thought it would take place—that is to say, all chemical action whatever by lowering down to a sufficiently low extent the temperature of those products of combustion.

Another interesting subject on such occasion as this, and witnessing the experiment, my opinion was confirmed, that the question of the greater or less durability of gasholders in various climates was entirely a chemical question, as it evident, by the last paragraph, and the experiment, as well as the same may be, by the absence of sulphur and ammonia allowed to get into the gasholders, especially in hot climates; and not, as frequently supposed, by the mechanical action or swelling of the materials, that the iron was not, or should by no means, another cause, in transit, or carelessness in erection, seriously affecting or causing the decay of some of the greatest nuisance in the world.

If I recollect rightly, the Messrs. Morrison, Bombay, and Calcutta Companies have had serious losses from the decay of their gasholders, consequent from the action taking place—as stated, in my humble opinion, by the sulphurous fumes and ammoniacal salts so commonly used in the United Kingdom, and which are conveyed frequently through the gas after such gas comes out, instead of a few hours, as at present, but after many days consumption, and, as I have stated, after the gas has been purified, which, I suppose, is the case, with ordinary management, that, with ordinary care, the gasholder, though getting leaky, would not require renewal for some years, is followed by the decay of the whole of the iron, and the gasholder is absolutely worthless, and requires more than a new purification, and, as I have stated, frequently upsetting the calculations of directors, and causing them to look upon the gasholder manager's reports as unreliable.

A very curious, in confirmation of what I have stated, that when in Bombay, I was informed by Mr. Hewett, the engineer of the work in hand was removing the iron and two top rows of the sides of an 80-feet gasholder, and the crown of another, which had been in use since lighted in 1854, and which, in the opinion of the engineer, was the fourth time new crowns had been put on, and the second time of renewing the sides, and which was required, and got so, also a new crown for a 50-feet holder erected in 1852, and which, I was informed, required renewal in 1862-4 or the first time, although a possible case of the erection of gasholders of similar capacity in England, of the best description, and which, I am sorry to say, is owing to politics, and the Italian Government into force a short time ago, and which works with 100-feet gasholders immediately erected. There the gasholders are to be of the size of 140 feet, or as I am informed, nearly so, and the difference between the contractors and the gasholders being sufficiently large and most elaborate, whereas the contract is very small indeed.

I now come to the question of the "residual" value of the iron of gasholders, as the seeming proof of this. These must expire at the end of the sun, and especially the crowns, and the present and older schemes of the gas-plays with the greatest effect for the longest time, require renewing from time to time, requiring, and as fast when it commences, that the ordinary Colonial lists and tenders are required by the press, and soon the crown is not safe to walk on, and the sides, and, in some cases, the floor of the tank, being entirely gone, and simply the foundation or cable steps left. Even inside, for, a portion of the framing sometimes remaining 10 years work. Further, be it the consideration of Companies in the process of electrical energy by means of the intense heat on the crowns, and the consequent destruction; if it is this must be the task?

We have a question, What is the remedy? Would steel plates, charcoal iron sheets, or the best galvanized iron be the means of preserving iron from corrosion, or even diminish it in the water in the tanks prevent oxidation; or, is it necessary to cover the iron in cement with bosses. And what is it, if any, that the engineer is to be allowed where the purity of the gas entering the gasholder is beyond question?

I now come to the question, in connection with this subject, that when at Aberdeen, at the works of Messrs. De Bruyn and Sons, a galvanized iron crown, 50 feet diameter, of Macquaire's gasholder first diameter, of 50, 14, and 20 gauge plates, belonging to position, the only one I have ever heard of. On inquiring as to reason for such construction, Mr. Howard, the maker, replied that in his long experience of 40 years as a gasholder manufacturer, it was the only galvanized iron one that he had met with, it was the opinion of the Engineer that it was very desirable and a matter of economy to have it galvanized; and he had received no complaint or information from him as to the results up to that time. Probably the Engineer considered it necessary, on account of the rapid corrosion of gasholders by the use of brackish water in the tanks, to consume there.

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... of the past financial year, now submitted to this meeting, show ... considerable improvement has been realized in the affairs of the Company, whi[illegible] tinue to be affected, to a limited extent only, by the unfavourable circumstan[illegible] have weighed for a long time on various branches of trade in all countries.

On March 31, 1878, the total net profits at the stations were £59,666 3s. 6d.; 31st of March last, £62,007 2s. 7d.; increase on the year, £2340 10s. 1d.

Satisfactory as this result appears, it would have been still more so, but for charges operating adversely on the returns. The rate of exchange between [illegible] and France unfortunately ruled high during those months when the largest rem[illegible] to this country had to be made, and extra expense was thereby incurred. Th[illegible] tion in the value of coke produced for sale during the year is equivalent to a sum o[illegible] and although this has been compensated in some degree by the lower cost of [illegible] a considerable balance remained uncovered on the 31st of March. The expe[illegible] insurance, superannuation, income-tax, depreciation, and sundry other items [illegible] importance, have also been more considerable than in the previous year.

On the other hand, the gas-rental for the year shows an improvement of 5 per [illegible]

Of the extensions previously reported to be in progress, some are nearly co[illegible]

galvanic action between the cast and wrought iron, unless there was something in the water to promote that action. What Mr. Monk contended for was—and that had been clearly proved to be the case by Mr. Hammond and Mr. Foster—that there was evidence of a slow combustion of the iron, and it was well known that combustion always took place more rapidly at a high temperature than at a low one. Mr. Monk's contention was that the excessive heat to which the crowns of the gasholders were exposed promoted a greater degree of corrosion, or greater rapidity of combustion than occurred here, and that it was not the quality of the iron that was at fault; otherwise it would be a very curious set of circumstances which occurred in Rome, for instance, where they must have had bad iron five or six times successively. Besides, he did not know that bad iron was more liable to corrosion than good iron, and was rather of opinion that all classes of iron would rust pretty nearly alike if exposed to the same conditions, unless subjected to some particular kind of protection. He was glad Mr. Cleland had referred to the coating of iron with magnetic oxide, and if there were any preparation to which iron could be subjected with a view to preserving it in a hot climate, it would be a great boon to all those who were engaged in those distant parts of the world. The causes which Mr. Monk referred to were those in which the crown went first, while the sides remained tolerably sound, and in some cases the crown had to be renewed several times, which was a great misfortune to the gas company, because of course that would not be done until the company had lost a great deal by leakage.

The PRESIDENT said there could not be a doubt that it was a most important matter, and as yet, neither by experience nor theory, did anything appear to have been started which would fully explain it. Mr. Monk's experience showed him that the tops of the gasholders were affected most by this action, whatever it might be, whilst Mr. Newbigging's was quite the opposite. With regard to the quality of the iron, one could not think for a moment that there could be such a great difference in the quality of iron used here and abroad, although it might possibly be that the surface was in the transit destroyed or injured.

[illegible] J. DOUGLAS (late of Portsea) prepared the following paper, but owing [illegible] of time it could not be read. Mr. F. W. HARTLEY, however, gave [illegible] short description of the various forms which were exhibited of apparatus [illegible]

THE ALBO-CARBON LIGHT.

Although for the moment the electric "scare" has subsided, the lessons to be learnt from it by gasmen should not be lost sight of. We manufacturers of gas have learnt, in the first place, that there is on the part of the public an appreciation of, and a demand for a more brilliant and intense mode of illumination than that derived from the commodity in which we are interested. In the second place, we have learnt that chemically the utilization, for the purpose of producing light, of the heat derived from the combustion of air gases is the weak point in the principle on which our industry is founded; and so long as this can be asserted of gas-making, it is idle to close our eyes to the fact that there is always a possibility of electric lighting becoming the mode by which the conversion of heat into light may be most economically effected. No doubt the substitution of any other agent for gas must be a very gradual process, not only because vested interests, with all the modes of living and the habits of thought and customs bound up with them, die hard, but because the amount of machinery and expended capital engaged in the industry is so large; but if a real saving be once effected in this direction, which for the moment appears to be far from the position of affairs, the laws of political economy will make the extinction of gas lighting inevitable.

Having come to this conclusion, it is natural on the part of a gas manufacturer to inquire if no means can be found by which the conversion of heat into light can be more economically effected. To put the problem in other words: Given the heat produced by the combination of given volumes of hydrogen, carbonic oxide, marsh gas and oxygen (as in common coal gas) do any means exist of converting this heat into light more effectively than at present? I think it was Mr. Sugg who ascertained that the light obtained from an effective combustion of a given quantity of gas in proper burners was as great as that obtained by the use of the same gas by means of a good gas-engine to produce the electric light. But this only proves that the known means of utilizing gas by direct combustion are superior in efficiency to those for converting gas into force, and thence into electricity.

It is generally accepted, notwithstanding Dr. Frankland's experiments, that the heat produced by the combustion of the complex gases in coal gas yield light by the raising to incandescence of the particles of carbon mechanically held by the gas, and the answer to the above problem has been repeatedly and successfully made by methods of adding additional carbon particles to those ordinarily existing in the gas. Carburation of ordinary gas is undoubtedly a very old process, and there are few in this room but are familiar with some form or other of its application. It would serve no useful purpose at the present moment to traverse the numberless proposals for carburetting coal gas, but we cannot but be struck by the fact that of all these numberless processes there is not one sufficiently successful in its application to retain a semblance of vitality.

If the true answer to the gas manufacturer's problem, as stated above, be, "By carburation," it is worth while to inquire for a moment why all the methods proposed have practically failed. They have nearly all been based on one common principle—viz., that of exposing large surfaces of material, covered or saturated with liquid naphtha, to the action of the gas passing through the carburator. Generally speaking, the apparatus was placed near the meter from which the gas passed into the carburetting vessel, where it became saturated with the naphtha, and was carried through the pipes on to the burners. It is evident that the success of this form of carburation depended entirely on the natural volatility of the liquid used, and thus the essential quality of the whole arrangement became the chief element of danger, because unless it were kept undisturbed in close vessels, the vapour escaping at ordinary temperatures formed with the air an explosive mixture so dangerous, indeed, that it has become necessary not only to prohibit the liquid being stored in large quantities, unless under special conditions, but to limit its sale to the hours of daylight. This very volatility also introduced an element of uncertainty into the carburation; for not only did the degree of carburation vary according to the seasons of the year, but as the gas which passed first absorbed the most volatile portions, at the end of a given time the vessel contained only the non-volatile oil, which it was necessary to run off to make room for a fresh supply. In addition, the pipes throughout the building, unless carefully arranged, accumulated condensed vapour, which stopped up the flow, and completely destroyed the whole lighting arrangements.

The volatile oils having such serious drawbacks, together with the economy being questionable, carburetting by means of the dead oils has been tried with only partial success. Bowditch has the merit of being the first, if not the most intelligent worker in this direction; but, being more of a chemist than an engineer, he failed, principally in the construction of his carburetting vessels.

It is surprising that it has been left to the present time to utilize naph-

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[illegible]ined with the naphthaline vapour. It was not so much keeping in the gas that was the necessity, but the naphthaline found its way through in most minute quantities, and created an unpleasant smell in the room. At last it was found that asbestos washers answered most effectively, and the joints are now made in that manner. At the bottom you observe another ornamental knob, the end of which is made taper, so as to fit into a small socket; this socket is a little larger than a gas-burner, and has a burner thread upon it, so that it may replace an ordinary burner where the albo-carbon light is wanted. The apparatus is simply dropped into this socket, just as a stopper is into a bottle, and a perfect gas-tight joint is made.

The gas supply-pipe in the interior of the vessel is carried sufficiently high to be above the melted naphthaline, and is bent down or a hole made on the under side of the pipe, so that the gas shall blow directly on the surface of the carburetting material. The outlet-pipe is taken from near the top of the ball, and is bent downwards four or five inches, and again bent so that a burner may be fixed in a vertical position. From one side of the vessel, and immediately above this burner projects a blade of copper, which, being heated by the flame, conducts an amount of heat to the body of the vessel sufficient to vaporize the naphthaline. The height of this copper blade from the flame, and its width, are such as experience has shown to be the best for the purposes intended. The diameter of the ball and other conditions have also been determined by experience.

This vessel here is charged with about 5 oz. of naphthaline, and will carburet the gas from this burner for 20 hours. It will therefore require filling twice a week. There is no wick to turn and trim, as in a lamp, nor any delay in pouring in liquid oils. Indeed, the process is so simple that a child can do it, and it is absolutely free from danger.

The burners recommended are No. 1 Bray's, consuming from 2 to 3 feet per hour, according to pressure, and giving with 14-candle gas little or no effective light. When the gas is first lighted, the material in the vessel is in a solid form, and it requires several minutes before the effect of the carburation is seen; but gradually the light assumes, as you see, a peculiar brilliancy, and the illuminating power is raised rapidly to about [illegible]7 candles. After the carburation is once in force, less gas passes through the burner than when first lighted, because, the orifice remaining the same, [illegible]d the gas and vapour passing together through it, the quantity of gas [illegible]ust be slightly reduced as well as the pressure. There is nothing more [illegible]markable than the way in which the vapour of naphthaline appears to [illegible]eady the flame, producing a pleasing contrast to the flame of ordinary [illegible] burned in a bat's-wing or fishtail burner, as against the beautiful and [illegible]ady flame of the albo-carbon light.

[illegible]or lighting on any larger scale, a similar vessel, but of somewhat [illegible]ater dimensions, may be arranged for several lights; but where more [illegible]ners are required to make up a large group, a different form of appli[illegible]ion of heat is required to vaporize the material, as may be seen by the [illegible]aratus on the table, which has 12 burners. Instead of the heat being [illegible]ducted by a metal plate, it is derived from a small supplementary [illegible]ner, which is turned full on when the gas is lighted, in order to get up [illegible] carburation more rapidly, and afterwards turned down to a small jet. [illegible]s, of course, would require personal attention; but the patentees have [illegible]ceeded in making a very simple automatic regulator, which is acted [illegible]n by the heat of the material inside the vessel. This important addi[illegible] is of great value in maintaining a regulated heat. They have also [illegible]npleted an arrangement applicable for one or more groups of lights [illegible]ving a supply reservoir sufficiently large to contain a week's supply of [illegible]terial, and yet so arranged that the lights are fully carburated in a few [illegible]inutes. These two instruments are of so recent a date, that I am not at [illegible]erty to do more than casually refer to them. The carburated lights [illegible]ay be applied to a long line of pipes—the whole length of this room, for [illegible]stance—by fixing the burners at about 8 inches apart, with the flame [illegible]rranged a little lower than usual, so as to heat the pipes and thus prevent [illegible]ondensation. Steam may also be employed as a means for vaporizing [illegible]e material, and to keep the pipes warm for almost any distance; but the [illegible]etails of these and other applications are much greater than I am able to [illegible]eal with in this paper. No doubt they will be fully described at some [illegible]ther time.

As a practical illustration of the successful application of the albo-carbon [illegible]ight on a large scale, I may instance that of the eastern section of the [illegible]Vestminster Aquarium, which has now been lighted up for the last five [illegible]onths by this process. Before the introduction of the new light, this [illegible]art of the building was illuminated by 500 (Bray's No. 4) burners, but is [illegible]ow lighted by 200 burners only (Bray's No. 1), and I am informed that the [illegible]olume of light is more than double what it was previously. The amount [illegible]f naphthaline consumed, taking the average of summer and winter, is [illegible]bout 12 lbs. per day, and so successful in point of economy and improved [illegible]llumination has been the experiment, that I understand the Directors [illegible]ave decided to introduce it throughout the whole building.

Results.—I have now traversed exhaustively—perhaps too exhaustively—the details of this new, and, as I think, successful method of carburating [illegible]rdinary gas, and we are now prepared to see how far it supplies the [illegible]olution of the problem stated in the opening of this paper—a problem of [illegible]finite consequence to our manufacture. By means of this cheap and [illegible]fective hydrocarbon, not only can ordinary gas be manipulated so as to [illegible]eld a white light equivalent to 500 or more candles, but, what is of even [illegible]ore consequence, without any increase in the cost, so as to put it beyond [illegible] reach of ordinary commerce, but, as will be seen from the following [illegible]ures, a considerable economy will be effected:—The value of melted [illegible]phthaline in the form recommended is about 4d. per pound, and it may [illegible] reckoned that to carburet 1000 cubic feet of gas will require 4½ lbs. of [illegible]phthaline, or an addition of 1s. 6d. per 1000 cubic feet to the cost of the [illegible]. If we reckon the illuminating value of 1000 feet of gas at 14,000 [illegible]ndles, taking the ordinary average of 14-candle gas, then the addition of [illegible] lbs. of naphthaline, costing 1s. 6d., will increase that value to 40,000 [illegible]ndles; that is to say, the same volume of carburetted light is given for [illegible] that would cost 10s. 6d. for ordinary gas, and in such a convenient and [illegible]cticable form that it may be obtained in any workshop, warehouse, or [illegible]gazine in the proportions in which it is desired. A light of 40 candles [illegible] 500 candles may be obtained as readily as one of 10 candles. No [illegible]ht its use very extensively in a single town may *pro ratâ* diminish the [illegible]tity of gas consumed alone; but that is no unmixed evil if the system [illegible] inclination on the part of the public to rely for the most economical illuminating results on an agency which involves the continuance of gas manufacture.

I have left till the last part of my paper a suggestion that may be of no great value in the British Islands, but in the Colonies, where coal is scarce, and where gas has become a necessity, may be of immense importance.

Bunsen, in his "Researches on the Combustion of Gases," has shown that the combination of air and hydrogen yields a temperature of 2044° Fahr., and air and carbonic oxide 2402°; so that if the old process of water-gas were revived, and the carburation were carried on as here detailed, a rich and effective illuminating gas could be obtained, and at a very small cost. I am not quite certain, but, if my memory serves me, the New Gas Company, from whom so much was at one time anticipated, produced their heating gas at a cost not exceeding 8d. per 1000 cubic feet, and if the

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carburation on the above basis cost 1s.6d. per 1000 cubic feet with an illuminating value of 28,000 candles, it would revolutionize the gas manufacture in every a district, town, and introduce it, with all its civilizing advantages, into many places where it is now unknown.

Discussion.

Mr. G. B. Isaacs (Gosport) said that last year Mr. Bourbouze (President of the Portsmouth Literary and Philosophical Society, and Electrodectory address was on the subject of artificial lighting. Among other things shown on that occasion was the albo-carbon light. He had seen it exhibited in the Westminster Aquarium, and considered it gave a very good light. The only objection to it was that there was a slight effluvium from the burning material.

Mr. W. Cross (Bristol) said he had had one or two of the lights in exhibition at the gas apparatus exhibition at Halifax. They were known rather as a curiosity than otherwise, because he did not think it would answer his purpose much to introduce the albo-carbon lights, seeing that it was his special business to increase the quantity of gas rather than thought gas was sufficiently good for all ordinary purposes, and people did not get light enough, he would rather encourage them to use a little more gas. It was continually struck with the smokelessness of the gases, and this small light was a great deal smokeless than many of the lights they were examining, which he supposed to the result of imperfect combustion. The albo-carbon is was a beautiful improvement. The effect produced with the small burners used was simply marvellous, but it ought to be pointed that those burners were not at all well adapted for light-giving purposes. Ordinarily speaking, they were about the worst class the company could use for common coal gas, and therefore the contrast shown between the albo-carbon and common gas was very great; but if one of those burners with the unpleasant burning in it was connected with a good flat-flame burner he thought the light would be found to be pretty useful. His own impression was that a light was better for the consumers to use a 5-foot flame than have small burners and be troubled to fill the albo-carbon burners, and should do it wherever it required attention. He should like to know whether it would be cheaper to use the albo-carbon illuminating by the use of the albo-carbon light, or to use the additional quantity of gas (take, for example, London gas, and, if so, how much more gas would be required to produce the same amount of light as that of the apparatus used for albo-carbon. It was important that they should be supplied with some particulars as to the quantity of coal, light for light, of that supplied by the albo-carbon gas and by ordinary coal gas, otherwise they might be admiring a beautiful effect without knowing the cost of it. If the cost for a given amount of light by albo-carbon was less than that produced by coal gas, the Albo-carbon Light Company had a very valuable property on hand, but the cost must be considerably less than gas, in order to enable it to compete with it, and to undergo the trouble of fixing up the apparatus and attending to it. He thought it was very likely to be a little more rain, but if it were cheaper to consume the extra amount for naphthalene—which was a product of coal tar—and the increased quantity of tar produced, which would result from the increased use of this naphthalene, would naturally tend to raise the price, and thus make the gas more expensive compared with gas consumed in the ordinary way.

Mr. S. Aisbitt, who had been exhibiting the light, said it had been found at the Westminster Aquarium that 240 burners, fitted with the apparatus, did the work of 300 supplied with ordinary coal gas, and consumed 5,000 cubic feet of gas per hour, whereas 6,000 feet were consumed by the ordinary burners. Generally speaking, after the cost of the naphthaline used was allowed for, the consumption of gas showed a result that of the gas ordinarily sold for. For example, if 6,000 feet paid £300 a year for gas, he could, if using the albo-carbon apparatus, consume 5,000 feet, pay £250 for gas and naphthaline, and adding £50 for the extra purifying material, the expense would come out to about one-half the previous amount. The light from the burners they was exhibited in burning under the apparatus was of a beautiful penetrating material had the peculiar property of steadying the gas-flame. It was proposed that they could use, as an ordinary gas-burner, the flame from a No. 1 Argand burner; they must employ 5 flat-flame burners to produce the same light as that of a single Argand, supposing the latter to consume 5 cubic feet of gas per hour. The flame of a single Argand burner was equal to that of 20 candles, calculating for burning sulphur 16 candle gas, was about 20 candles, calculating for burning sulphur 16 candle gas, was about per hour. This was the new burner which was probably used more frequently than any other by gas consumers, and which was the best to be taken as the standard of comparison, instead of the Sugg burner. The best burner for albo-carbon, instead of the Sugg burner. The best burner for albo-carbon, instead of the Sugg burner, was the burner which was found to be the lighting power of such a burner, the between 10 and 20°, or 20° to the naphthalising process was the difference flame as much light as the ordinary gas, which was naphthalised gas gave 21 cent. It was also found that the increase of light was an increase of 107 per cent. when the flame was 1 inches, and when it was only obtained by three inches high, if the pressure was 1 inches, there was an increase of 107 per cent. when the same burner non-carbureted; but if the pressure was in excess of 1 inches, there would be as much as ten feet of flame 10 inches were used. The greater the pressure the more naphthalin-flame could be conveyed through the flame, and therefore the higher the illuminating power obtained.

Mr. Dunn wished to explain that his remarks did not apply to Mr. Bray's burners in general, but simply to the size of the burners used on the present occasion.

[16270.]—I, LIKE many others, have found that any gas bills have been increasing in amount of late years, and this has caused me to look about for something wrong somewhere, as in my office and warehouse I have, wherever I could, substituted petroleum oil lamps for gas. When you have a large number of lights burning, the saving is great, as I at others instead of gas-lights, so that now I can say to yourself that it is blazing" hence I think the great outcry against the gas companies; but those who wish to fix the blame on the companies must remember that as a certain quantity of their profits includes the gas consumers, and I think gas consumers should think twice before practically adopting that a kind of conspiracy has been entered into by the gas companies to increase the price, instead of as opinion of the gas consumers. Let my say fact first out if it is not to consumers who are, after all, really the guilty or faulty parties. I remember thinking, after carefully reading all the correspondence that has appeared in your columns lately on this vexed subject, that the difficulty has to be met and contended against in the *entire pipe after* the gas leaves the meter, for years past great complaints were made against the inferior quality of the gas supplied, or want of sufficient pressure of gas. The companies appear to have met the complaint of the consumers by putting down larger mains, and thereby giving the extra pressure that was demanded of them; but the consumer in most cases, I expect, has done nothing with regard to regulating the supply to his burners, but has left the matter entirely to others. I feel, then, perhaps that in this case we are getting a larger amount of gas forced through the meter, and causing flaring and setting and a great waste of gas? I propose to put a regulator on to the outlet pipe in my warehouse, and have just recommended to try Bowditch's patent mercurial gas regulator, Mitcham, I understand, has been put up by the Mitcham Board of Works in the series in Tooley-street, and I shall be glad to hear if any of your readers have tried this or other regulators, and with what results.

W. Shevelinhaven Jones.

GAS-METERS.

[15571.]—SIR,—I HAVE just examined the inside of our gas-meter yet, notwithstanding I had some notion of how it was done. The drum, the greater and description by J. H. Warren, latter 1871, p. 105-6, I find the partition-plate, *a* in Fig. 1, is not fixed, but therefore, would be kindly explain it. In Way the axis of drum Fig. 1 supplies the gas, and passes it into four chambers, as fixed in Fig. 2 is shown as a simple spindle? also, how it could be seen as there represented when the partition-plate is fixed, and also in gas-light communication with said axis? 2. Is the "dip" of the partitions as set at one-fifth of the internal diameter of drum parallel to it, and if so, why? 3. It does not seem to me that the "dip" of the ends or side of meter can in anywise be evidential, as I have asserted in Fig. 2, the bench marked S ought evidently to be parallel to the axis of the meter, but as shown, it would have considerably fit the seats water less W, and if the meter was filled to the seats water bottom of the meter, as represented, it is not easy to see how the gas could dislodge the water in the space, without taking the whole of the water-revolving meter. 6. How is the space made to fill with water? Is it done by water without leakage (space) if the meter be caused a little on one side, would not gas escape at the water-line? 7. What is the water-level space, as shown in Fig. 2, also the rectangular piece marked A in Fig. 2? 8. How is it regulated that each chamber is "certain" to be "full" of gas, at a uniform pressure at each delivery? 9. It appears to me that the meter would not work much easier when all the lights were burning, than when only one was burning, because there would be less back pressure, one light will pass through a burner when lighting, as well as 100 lights and the tap left open, but the meter-index will not register (*total, my*) all, one and that with all the burners lit up, and it is possible for the drum to minutes under any circumstances, without perfectly filling the chambers with uniform pressure? There is probably a somewhat prevalent opinion that gas bills are much heavier than they ought to be, but I would ask that, as far as my experience goes, few people that

fill the meter from the street main, consequently the meter is probably never quite at rest, as there is the main leakage and the loss in the meter itself, through faulty fittings and incompetent fitters. It would be well to have a test-meter between the main and the meter, to ascertain the exact amount of leakage, and if the fittings are extinguished, and the meter is at rest, then the fault lies elsewhere, and I fancy that it would tell a tale in most cases.

A., Liverpool.

[16005.]—SIR,—In a letter p. 465, I asked a "Consumer" how he knew that he was paying for more gas than he used? I have since received a letter, which, I have no reason to suppose, in some obscure reticulations, remarks which set closely resemble those of your correspondent, that I could almost think he is the writer. I would suggest now, that a "Gas Consumer" should produce his "index card," stating the exact amounts of gas consumed during the last year, and the amount of gas he has to complain for consumed during the previous periods. Failing the production of evidence which a meter, who makes grave charges should only be too ready to supply, your reviewer will be able to form their own opinions. I commend to the attention of a "Gas Consumer" the remarks of Mr. Glover, of Manchester, and Mr. Liverpool, in the last quarterly, that will at least be useful to the consumer, and, failing other aid, it is not impossible that it may be his fittings that are at fault." For myself I am wondering whose pamphlets instance it is to be at the weeks to attempt to defend the consumers. I don't see who, otherwise it would be to the manager, and a director I am sure they're not, and the shareholders I don't suppose they are not sufficiently sober and methodical to be entering the last from the coals before selling them? I know mines are not lated or long this summer as they generally do. It has been previously pointed out in the columns of gas companies are public property, and are annually published, and I should think that the "Gas Consumer" alluded to, if he

IMPROVED PUBLIC LIGHTING OF GAS IN PARIS.—The Place du Châtelet d'Orléans is now lighted with the improved gas burner and burners similar to those employed by the Paris Gas Company for the lighting of the Rue du Quatre Septembre. There are 72 burners in the Place, and the gas consumption of this former being 60 cubic feet, that of the latter 30 cubic feet per hour. The amount of light produced by each is equal to 75 candles and 82 candles respectively, and the effect produced is very creditably beautiful. The area now selected for the Company's experiments is the most favourable illumination in competition with the electric light is of greater extent than the thoroughfare in which their operations were first conducted, and consequently the effect of the gas lights is much less intense. Nevertheless the Company have achieved an undoubted success, which certainly justifies the hope that at the Halles Centrales—the only remaining locality allotted to the Company by the Municipality for conducting their experiments—the improved lighting by means of gas will prove also an experience. The original intention of the Municipality was to divide the lighting of the Place du Châtelet d'Eau by placing upon it 30 electric lights of 2000 candles each, or 60,000 candles in all, and furnished the light of about 2000 candles. The Paris Gas Company therefore proposed to light the area with their new burners, which, with a consumption of 30 cubic feet per hour, produced a light equal to 82 candles, at the cost of 9c. 6f. 12c. per hour. To produce an equal illumination by electricity would, it is calculated, cost 38c. an hour.

THE ACTS OF PARLIAMENT which regulate testing for illuminating power in London, state in express terms that the light given by the gas is to be that of so many sperm candles of sixty to the pound, and remember well when Mr. Forster's Committee sat in 1872 the introduction of the mode of testing was noticed, and they refused to make any change either in the substance or wording of the acts. It happened in the year 1876, Pole, one of the gas referees, was engaged to watch the proceedings of the before the Committee, and when the clause in question was arrived at, he went to the chairman and suggested a change in the wording of the act, in lieu of "the light of 16 candles," he proposed that it should be "a light equivalent to that of 16 candles," so as to allow, if desired, the use of some other spermaceti than the candles, as hitherto. At that time a lamp, Mr. Reader or some other, was what was contemplated in lieu of candles; but of course, had the terms of the act been so changed, it would have allowed of Mr. Harcourt's new process being adopted, or any other. But the fact is that the alteration proposed by Mr. Pole was decisively rejected. It was opposed by Mr. Cripps, on the part of the Corporation of London, and no repeal was at once rejected by Mr. Forster and the Committee. This is a fact worth remembering.—*Gas Trade Circular and Review.*

PETERBOROUGH GAS COMPANY.—With reference to one of the paragraphs in our "Trade Notes from Scotland," in the account of Alex. Mc. Alexander, Chairman of the Directors of the Company for the past year, writes under date of the 10th inst.: "In your Notes from Scotland you refer to our annual meeting, and you say 'that the affairs of the Company are in a more prosperous condition than at any former period.' That is very true, but I should like, however, your correspondent makes a mistake when he credits it to the Manager—Mr. Thomas Nicolson—by whose faithful services, for the past twenty-one years, the energetic Collector and Secretary, and a thoroughly good men for his Assistant-Overseer, not nothing to do with the management of the works, which are under the immediate care of Mr. David Stevens, as Manager, with a Works Committee of three Directors, to whom special thanks were accorded. To Mr. Nicolson, however, is due the accomplishment of the most tangible was immediately noted of the year's results, in consideration of their services in the Company's interests. I should not have referred to this matter, but I observed not long since an interview with the Manager's friend or relation on his pre-retiral, and also to short next year, and, thereby a small works. It may be of our balance sheet for, in forwarding a wholesome rivalry." From the abstract of accounts for the year ending 31st January, for the year ending the 31st of May last, 13 realising 2956 lin. yds. mains, 1 of gas were sold at 6s. 8d. per 1000, produce and sundry receipts of 110 1780 yds. 4d. made a total charge of £7790 Against this there was a discharge of £1209 2s. 6d. for coals and £2301 1s. 3d. for purifying material, wages, &c.; and £200 for dividends. The capital of the Company is £20000.

DUNDEE GAS COMMISSIONERS.—At the meeting of the Dundee Gas Commissioners, held Thursday, Mr. Russell, in moving the adoption of the Treasurer's report, and the reduction of the price of gas from 3s. 2d. to 3s. per 1000 cubic feet, made a few remarks on the prosperity of the the town first had an interest in them, was £8593; in 1850, when they passed into the entire control of the Commissioners, the revenue from this source was £15,661. In 1861 the price was 4s. per 1000 feet, in 1870 it was 3s. 2d. From 1845 to 1875 the works were managed by a Joint Board of the Town's Trust and the Shareholders, and in that period the works yielded surpluses to the extent of over £20,000. The sum, £10,000 was transferred to the extension of the works; £10,000 was divided in the shareholders' stock; and the balance was handed over to the Trust in the shape of a loan. Since 1859 they had surpluses to the extent of £16,000 and £7000 has been placed to the sinking-fund. At present they had £7000 less debt to the Commissioners than in 1875, with appliances for making quite in a position to reduce the charge for gas to 3s. per 1000, and they might expect a surplus for the year as large as £4000, even at this rate. —Sir Alexander Grant, M.P., moved that £7000 carried to the sinking-fund. Bailie Hallow seconded the adoption of the minutes, and the recommendation to reduce the price of gas, both of which were agreed to. It was afterwards resolved to set aside £1000 of the gas profits for street improvements.

SALTCOATS GAS COMPANY.—From a statement of the affairs of this Company, presented to the Shareholders at their meeting on the 6th inst., it appears that the consumption of gas during the year ending the 30th of April last was exactly 4,190,000 cubic feet, which, at 4s. per 1000 feet, realised £8380 which, with residual products sold for £107 12s. 10d. The expenditure included £2000 for coals, the quantity of which was equal to 1s. 7½d. per 1000 feet of gas used; the total ordinary expenditure being £747 16s., equal to 3s. 6½d. per 1000. The "Abstract of Accounts and Product of Gas," which is appended, shows that during the year 4251 tons of coal and shale were used, estimated to produce 4,359,655 feet of gas, 4,190,000 feet, actually made, as indicated by the station-meter, was 4,359,655 feet, leaving a loss over 4037 feet per ton. The gas used by consumers amounted to 3,980,500 feet, as shown by 21 street-lamps, 12,500 feet; and used at works, 40,000 feet; thus the unaccounted-for gas was 692,000 feet, or 19·04 per cent. of the make.

EXPLOSION OF GAS IN THE METROPOLIS.—On Friday evening last, an explosion of gas occurred at the New Cross Station of the London, Brighton and South Coast Railway, resulting in considerable damage to one of the waiting-rooms, and injury to five persons, who were slightly burned about the hands and face.—On Saturday morning, about eleven o'clock, an explosion of gas took place in the gas-meter and paint store-room at Somerset House, by which a number of gas-fitters were at work with a naked candle in the room, which is said to have caused the amount of the building. They detached a pipe from the meter without first turning off the gas at the main, and the gas pouring out, became ignited. The window was blown out, and the gas, which was blazing fiercely, set fire to the contents of the room, and created great alarm. Several fire-hose belonging to the Strand Union were brought into use, and two or three engines of the Fire-Brigade were also soon on the spot, one of them commenced playing upon the room. In less than an hour from its outbreak the fire was completely extinguished, leaving less confined to the place where it originated.

ATHENS GAS-WORKS.—We hear that Mr. Charles H. Hutchinson, son of Mr. John Hutchinson, of Barnsley, has retained his appointment as Engineer to the Athens Gas Company, and will shortly return to England.

PEMBROKE GAS COMPANY.—At the half-yearly meeting of this Company, held on Monday, the 16th inst.—Mr. J. H. South in the chair—the ordinary dividends of 3l per cent. on the A stock, and 7 per cent. on the B stock were declared.

makes a profit. All things considered, the Corporation may engage in the supply as a matter of fact, they have not encouragement, and this is antagonism to the interests of the Gas Companies.

It was very well and fairly put before the Committee of the House of Lords, when it was said that the object of the Bill promoted by the Corporation was simply to cheapen the undertaking of the Liverpool United Gas Company. We question whether, in their hearts, the Town Council of Liverpool have the smallest intention to seriously experiment. They have five years before them, but at the present time only one invention offers itself for public and partially internal utility. That is the Jablochkoff system, which Mr. Deacon saw in operation in the Avenue de l'Opéra, at Paris, and did not report on in very favourable terms. This system is still on trial on the Victoria Embankment, and the results of the extended experiment we shall learn in about six or seven months time. Beyond this, two or three other schemes are offered to the Corporation for experimentation. There is, for example, the Lontin light, which, we are bound to say, answers remarkably well in single instances, but has not succeeded so far as to induce Mr. Hollingshead, of the Gaiety Theatre, in the Strand, to push it into public notice. Then there is the Rapieff system, which commands attention in some interiors, and promises to be effective. Lastly, we have the Werdermann light, which offers the advantage of a more minute subdivision of an electric current, so that smaller lights may be available for internal illumination without much loss of power for the supply of larger lights exteriorly. We need scarcely mention Mr. Edison's invention, for it seems to exist only on paper—at all events, while inventors come from all parts of the world with their electric lights, Mr. Edison stays at home with his. So far, then, the Corporation of Liverpool have a choice of several systems with which they may set to work at once. There is the Picton Reading Room, about the lighting of which they are so anxious; there is the St. George's Hall, with the steps up to the roller, and the large space in front of the building, which are particularly still we are told, delays. If the Corporation are anxious to assist in developing the [illegible] they might begin the work [illegible] Society associated with the Legislature, [illegible] antagonism to the Gas Company in Parliament, [illegible] not see they have gained much. The privilege [illegible] a profit can hardly be considered as worth [illegible] Nevertheless this would appear to be all that the [illegible] have received for their money. The rather wide [illegible] powers they have obtained for [illegible] we do not suppose [illegible] much drawn upon, though it may be that at the end [illegible] years a quantity of old pipes will be found in the [illegible] market.

[illegible] question whether gas loses in illuminating power by [illegible] through long lengths of mains, is likely presently [illegible] a good deal of attention. It is proposed to abolish [illegible] thousand yards limit, at which distance all Gas Acts now [illegible] the places where examinations shall be made. This limit, [illegible] believe, first settled—we write from memory—upon [illegible] the result of experiments made by the late Dr. Letheby, on [illegible] the Great Central Company, as it travels from [illegible] King station, on Moor Common, to the terminus [illegible] Street, City. Within these limits, far exceeding [illegible] mile, no appreciable loss of power was [illegible] these experiments was, namely, we do not remember that any have been carried [illegible] having a special reference to the alleged loss of power, [illegible] certain observations [illegible] shown that little or no deterioration of [illegible] takes place even when long lengths of mains are [illegible] stressed. The gas of the late Birmingham and Staffordshire [illegible] Company was tested at stations several miles apart, and [illegible] little or no loss of power was observed. So, too, in the [illegible] of the Chartered Company's gas, which was tested by [illegible] Independent Examiners at Beckton within the thousand yards [illegible] and at Cannon Street, City, six or seven miles distant [illegible] the works. Here, again, the reports of the two Examiners showed great uniformity. While, then, we strongly object to any alteration of the law which affects the limit, and think that the Companies ought to oppose the Bill to be brought in on each occasion to extend the distance, which, for all that we know, might prove prejudicial to their interests, the matter may be found of little importance.

History repeats itself at the police courts and in the newspapers. A man who gets into houses under the pretence of being sent to examine the gas-meter, is constantly figuring. We notice a recent case for the sake of a suggestion made by a newspaper correspondent—namely, that the servants of the Companies should be provided with some token of identity,

Gas Lighting Experiments.

Colonel Haywood, C.B., the engineer to the City Commissioners of Sewers, London, has reported to them the results of an experiment now being made in a portion of Queen Victoria Street, between Mansion House Station and the Poultry, with new gas burners, by the Gas Light and Coke Company, at their own expense.

The experiments commenced on the 6th March. The Gas Company mixed with Sugg's London Argand "Governor" burners with glass chimneys. The first three sets of one consuming 22 cubic feet of gas per hour, the other 20 cubic feet. The gas is consumed in the smaller burners in two concentric coronas or rings of flame, and in the larger burners in three rings. The burners are so arranged as to be self-lighting when the gas is fully turned on. They are in lanterns of an improved description, the smaller in lanterns octagonal in plan, and the larger in twelve-sided lanterns. Both lanterns are larger than those ordinarily used, and have the upper parts glazed with a new kind of white glass, which partly reflects and partly transmits the light. The lower portions are glazed with ordinary clear glass. Proper means are provided for ventilation, and preventing down-draughts. There are 36 of the smaller and 6 of the larger lamps, and they supersede 55 ordinary lamps. The length of the street lighted is 333 yards. The burners consuming 22 feet of gas per hour have an estimated illuminating power of 80 candles, and thus 36 lamps are equal to 2880 candles. The 20-feet burners have a power of 70 candles, and 6 lamps are thus equal to 1260 candles. The ordinary lamps formerly superseded are equal to 720 candles, or 15 times less than the experimental lamps. The cost of the 55 ordinary lamps superseded is £1 7s. 6d. each per annum, or £393 2s. 6d. in all. The cost of the smaller experimental lamps is £1 17s. each per year, and of the larger £11 5s. 6d., or £777 2s. 6d. in all. The new system, therefore, is nearly three times more costly than the old. The general result, therefore, is that the new system gives nearly 4½ times as much light as that in general use, and costs about three times as much. It should be added that the experiment is being conducted at the sole cost of the company.—*London Paper.*

It is thought that the heavy reductions in the price of gas made recently by the New York City gas companies will tend to foster the introduction of gas engines for light work into hundreds of shops and stores in this city. Thousands of these engines are in regular use for such purposes in England and European cities generally, but the extraordinary rates demanded by the gas companies in American cities have heretofore been a great hindrance in this country, a state of things not entirely profitable to the positive [illegible] ity of the gas company managers.

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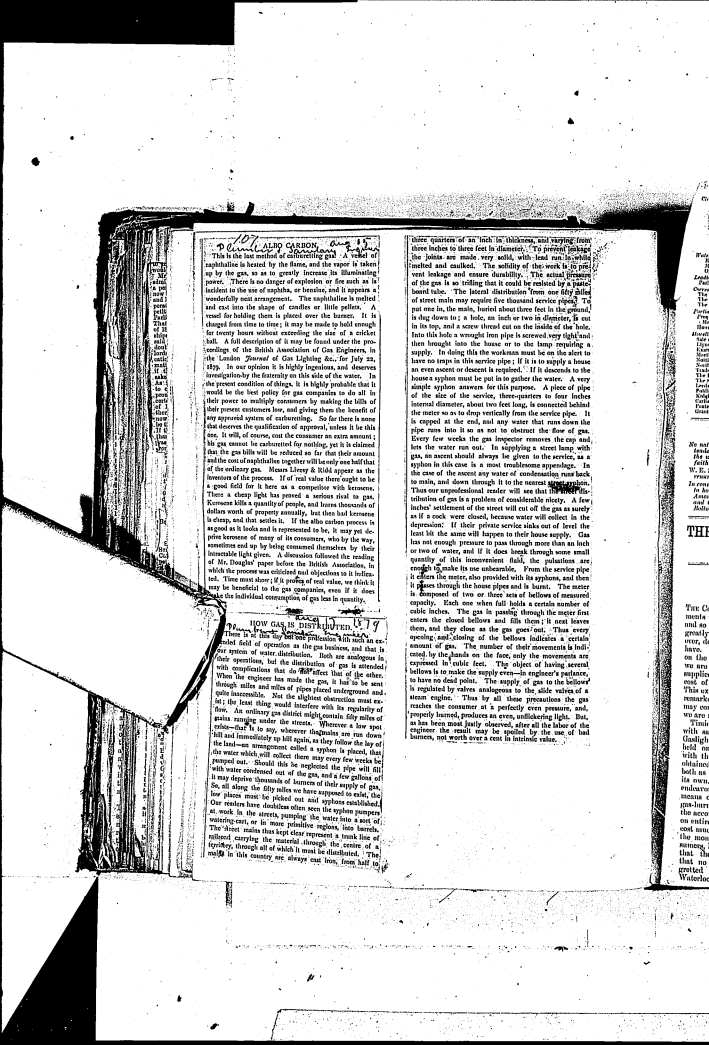
THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.
TUESDAY, JULY 1, 1879.

Circuit of the Gas Companies.

Our readers will [illegible] read from our Liverpool Correspondence that the Lighting Bill [illegible] Committee of the House of Lords yesterday week, so [illegible] was then mentioned, and it may now [illegible] part of the law of the land. Under [illegible] Liverpool Corporation have power [illegible] It empowers them to make experiments [illegible] which may extend over five years, [illegible] obtain any profit by a supply of [illegible] which may be open to them. Thus the Corporation may illuminate any public streets or areas and interiors, property belonging to themselves, at a cost price which can be easily estimated. But the Bill gives further power to the Corporation to supply places of public resort, such as theatres, music halls, and railway stations, and these must be supplied without profit. The pretence for acquiring powers of light these latter was, that the expense of the light could not be ascertained unless some of it was sold, although without profit. Now that the Corporation have these powers, we shall be curious to see how and when they will be exercised. The excuse for granting powers of this kind to Corporate Authorities rather than to Gas Companies is, that the former are likely to do their utmost to promote the success of the new light, while the latter, it is alleged, would endeavour, or at least speak, to smother an invention which professed to rival the light they already purvey. The absurdity of this supposition is palpable. If Gas Companies went in for the supply of electric light, they would do it [illegible] more, and with a vigour


ALBO CARBON, June 1
This is the last method of illuminating gas! A vessel of naphthaline is heated by the flame, and the vapour is taken up by the gas, so as to greatly increase its illuminating power. There is no danger of explosion or fire such as is incident to the use of sophine, or benzine, and it appears a wonderfully neat arrangement. The naphthaline is melted and cast into the shape of candles or little pellets. A vessel for holding them is placed over the burner. It is charged from time to time; it may be made to hold enough for twenty hours without exceeding the size of a cricket ball. A full description of it may be found under the proceedings of the British Association of Gas Engineers, in the London Journal of Gas Lighting &c., for July 1st, 1859. In our opinion it is highly ingenious, and deserves investigation by the fraternity on this side of the water. In the present condition of things, it is highly probable that it would be the best policy for gas companies to do all in their power to multiply consumers by making the bills of their present customers low, and giving them the benefit of any approved system of economizing. So far there is some that deserves the qualification of approval, unless it be this one. It will, of course, cost the consumer an extra amount; his gas cannot be carburetted for nothing, yet it is claimed that the gas bills will be reduced so far that their amount and the cost of naphthaline together will be only one half that of the ordinary gas. Means Livesy & Ridd appear as the inventors of the process. If of real value there ought to be a good field for it here as elsewhere with increasing fuel. There a cheap light has proved a serious rival to gas. Kerosene bills a quantity of people, and burns thousands of dollars worth of property annually, but then bad business is cheap, and that settles it. If the albo carbon process is argued as it looks and is represented to be, it may yet do. prive kerosene of many of its consumers, who by the way, sometimes end up by being consumed themselves by their detestable light given. A discussion followed the reading of Mr. Douglas' paper before the British Association, in which the process was criticised and objections to it indicated. Time must show; if it proves of real value, we think may be beneficial to the gas companies, even if it does the individual consumption of gas less in quantity.
HOW GAS IS DISTRIBUTED. 3 7
There is at first a bad confusion, with such an extent of field of operation as the gas business, and that is our system of water distribution. Before the beginning of their operations, but the distribution of gas is attended with complications that do not affect that of the other. When the engineer has made the gas, it has to be conducted through miles and miles of pipes placed underground and quite inaccessible. But the slightest obstruction must exist; the least thing would interfere with its regularity of flow. In ordinary city district might contain fifty miles of mains running under the streets. Wherever a low spot exists—that is to say, wherever diagonists are run down hill and through every up hill again, as they follow the lay of the land—an arrangement called a syphon is placed, that the water which will collect there may every few weeks be pumped out. Should this be neglected the pipe will fill with water condensed out of the gas, and a few gallons of it may deprive thousands of burners of their supply of gas. So, all along the fifty miles we have supposed to exist, the low places must be picked out and syphons established. Our readers have doubtless often seen the syphon pumpers at work in the streets, pumping the water into a sort of watering cart, or in more primitive regions, into barrels. The direct mains then kept clear represent a trunk line of pipe, three quarters of an inch in thickness, and varying from three inches to three feet in diameter. To prevent leakage the joints are made very solid, with lead run in while melted and caulked. The solidity of the work is to prevent leakage and insure durability. The actual pressure of the gas is so trifling that it could be resisted by a piece of board tube. The latest distribution from one fifty gallon of street main may require five thousand service pipes? To put one in, the main, buried about three feet in the ground, is dug down to; a hole, an inch or two in diameter, is cut in its top, and a screw thread cut on the inside of the hole. Into this hole a wrought iron pipe is screwed very tight and then brought into the house or to the lamp requiring a supply. In doing this the workmen must be on the alert to have no traps in this service pipe; if it is to supply a house an even ascent or descent is required. If it descends to the house a syphon must be put in to gather the water. A very simple syphon answers for this purpose. A piece of pipe of the size of the service, three-quarters to four inches internal diameter, about two feet long, is connected behind the meter so as to drop vertically from the service pipe. It is capped at the end, and any water that runs down the pipe runs into it so as not to obstruct the flow of gas. Every few weeks the gas inspector removes the cap and lets the water run out. In supplying a street lamp with gas, an ascent should always be given to the service, as a syphon in this case is a most troublesome appendage. In the case of the ascent any water of condensation runs back to main, and down through it to the nearest syphon. Thus our unprofessional reader will see that the difficulties of gas in a problem of considerable nicety. A few inches' settlement of the street will cut off the gas as surely as if a rock were closed, because water will collect in the depression! If their private service sinks out of level the least bit the same will happen to their house supply. Gas has not enough pressure to pass through more than an inch or two of water, and if it does break through some small quantity of this inconvenient fluid, the pulsations are enough to render its use unbearable. From the service pipe it enters the meter, also provided with its syphons, and then it passes through the house pipes and is burnt. The meter is composed of two or three sets of bellows of measured capacity. Each one when full holds a certain number of cubic inches. The gas in passing through the meter first enters the closed bellows and fills them; it next leaves them, and they close as the gas goes out. Thus every opening and closing of the bellows indicates a certain amount of gas. The number of their movements is indicated by the hands on the face, only the movements are expressed in cubic feet. The object of having several bellows is to make the supply even—in engineer's parlance, to have no dead point. The supply of gas to the bellows is regulated by valves analogous to the slide valves of a steam engine. Thus by all these precautions the gas reaches the consumer at a perfectly even pressure, and, properly burned, produces an even, unflickering light. But, as has been most justly observed, after all the labor of the engineer the result may be spoiled by the use of bad burners, not worth over a cent in intrinsic value.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

W. E. S.—If it be an ordinary allotment of shares, a letter or form of renunciation will be quite sufficient.

In consequence of pressure on our space to-day, we are reluctantly obliged to hold over till next week much interesting matter already in type, including a report of the meeting of the Surrey St. Saviour's, Lambeth, and Kingston Gas Companies, the Colne Valley Water Company, the Holton Company, &c., &c.

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.
TUESDAY, AUGUST 9, 1859.

Circular to Gas Companies.

THE Corporation of Liverpool have commenced their experiments with the electric light, at the Picton Reading-Room, and so far, according to newspaper account, the results show greatly in favour of electricity over gas. The report, however, does not give us all the particulars we should be glad to have. The Gas Companies of Liverpool are, it is said, in favour of the scheme; but it was said to be expensive. Electricity, we are told, gave an admirable light; whether equal to that supplied by gas, it is not said; but it is reported that the cost of the former was only one-third that of the latter. This experiment is only a small matter; but it deserves to be very much spoken. There is, of course, a prospect that electricity may come into some sort of use as an internal illuminant, but we are not at all afraid of competition with it.

Timid gas shareholders, if there are any such, may peruse with satisfaction the able address of the Governor of the Gaslight and Coke Company at the half-yearly meeting, held on Friday last. This Company have experimented with the electric light, and, so far as the results they have obtained have been concerned, it was proved conclusively that, both as regards economy and illumination, gas can well hold its own. The Company have gone a step further, and have endeavoured to persuade the Local Authorities to adopt improved means of lighting while thoroughfares by the use of large gas-burners. These experiments, as our readers will see by the accounts which we publish elsewhere, have been carried on entirely at the expense of the Company. They have not cost much, it is true, and the carping critics who object that the money eventually comes out of the pockets of the consumers, have but a small grievance. The answer is it is that the public had the benefit of the experiment and that no one missed any complaint. It is much to be regretted that the trial of the improved gas lighting in Waterloo Place was stopped so soon. The motives which actuated the Vestry of St. James's, Westminster, in putting so sudden an end to the experiment, can only be guessed at. They, no doubt, surmised that the public who use that immense gas consumption would presently demand a continuation of the light, the charge for which would have to be defrayed from the parish rates. Some would, no doubt, found an argument on this in favour of shewing the whole gas supply under some municipal body, who would be able to charge the inhabitants of Hampstead the same amount for public lights as they charged those in the neighbourhood of Piccadilly. But the city has not yet arrived for this, and, probably, never will arrive. Local bodies must continue to discharge their own liabilities, and we may say in a few words that the Chartered Company acted perhaps somewhat Quixotically when they attempted to persuade the Vestry of St. James's to adopt an improved mode of public illumination.

We must turn for a few moments to the accounts of the Company, which will be found in detail in another place. The Governor referred with satisfaction to the circumstance that the gross rental during the past half year had been higher than in any similar period. To receive more than a million sterling in six months for the supply of gas, is a fact unprecedented in the history of gas supply, and it is natural that special reference should be made to the fact. The undertaking must of necessity go on increasing in size and importance, and the revenue which now excites something like wonder will presently appear to be but a small affair. Although this large amount has been obtained for gas, it must not be supposed that everything has gone well with the Company. Residuals, and especially coke, have not produced the amounts which might have been expected. Coke is, unfortunately, a drug at Beckton, and it is, we fear, likely to remain so for some long time to come. It may be broken, and its sale undoubtedly increased by this means; but marketing costs money, and the question leaves a rosiitious, conjunctively worthless. Beyond all doubt it would be greatly to the advantage of the Company if they would engage in the sale of heating apparatus for the economic consumption of coke. Cheap as the fuel is, it is only the very poorest classes who are likely to have to its ingenuities. It would be to the interest of all Companies to promote its use among middle-class consumers, who would pay a better price and use much more. It is absurd, however, to criticise the actions of Directors in such matters. They are doing their utmost to get rid of the vast accumulations of coke they have on hand, and we can only wish them success in their efforts.

We must also refer to tar, on which there has also been considerable loss. That the working up of this residual will eventually prove highly profitable to the Company, we have no doubt whatever; but at present it must be admitted that the state of the market is against a profitable exploitation. The aniline business is still in its infancy, and cannot yet command a ready sale at remunerative rates. What are called the disinfecting materials of coal tar, when obtained from coal tar, want a sharp outbreak of cholera to stimulate their sale; but the water supply of the Metropolis is so excellent, that we do not expect to have another epidemic of cholera. The manufacture of sulphate of ammonia, it seems, has been carried on with much success; but the substance agricultural, we believe, is not now in a position to purchase expensive manures. The South American markets are largely drawn on for price of our manufactured manures; but, to say the truth, we have not carefully watched the state of the markets.

As regards the appropriation of the large balance of £101,921, which remains in the hands of the Company after the payment of a ten-and-half per cent. dividend, it may be safely left to the discretion of the Directors. We are strongly of opinion that their best policy will be to increase as they can their reserve-fund. The halcyon times through which the Company are now passing may not, and probably will not last for ever. Coke, as was very properly pointed out by one of the speakers at the meeting, may become an increasing difficulty, and the future profits of the Company may, in consequence, become further abridged. As this contingency cannot be accurately calculated, all doubts as to the success of the undertaking may be set at rest. Difficulties in the management will, of course, arise; but, happily, the Chartered Company have among their Directors and Managers a class of gentlemen fully equal to grapple with them.

As we reported last week, the Gas Committee of the Corporation of Leeds resolved to recommend the Council to reduce the price of gas from 3s. 6d. to 3s. 2d. per thousand feet, and their recommendation was agreed to at a meeting of the Town Council held last Wednesday. A little opposition was made in Committee, a member wishing that, in place of reducing the price of the gas, money should be expended in

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THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, AUGUST 12, 1879.

Circular to Gas Companies.

We have no wish to suppress one atom of information which relates to the extension of the use of the electric light. The Metropolitan Board of Works, having resolved to give the light a more extended trial on the Thames Embankment and Waterloo Bridge, but having failed to obtain the sanction of the Vestry of St. Martin's-in-the-Fields to use the light in Northumberland Avenue, have cast about for some other spot in which to expend their surplus power. Under the inspiration of their Engineer and Chemist, they have determined to illuminate their Board-room by electricity, and also to place some large light over the entry in Spring Gardens. The hall is to be lighted by four lamps placed upon standards. The light over the doorway in Spring Gardens will have a manifest advantage, for a strong light has been wanted there for years. The narrow issue out of St. James's Park decidedly needs illumination, and the Metropolitan Board will be doing good work if they can effectually light up this thoroughfare. With regard to the internal illumination, we shall, of course, watch the results with much interest. It can hardly be considered a conclusive experiment, as the Board only sit for a few hours at a time; so that, as far as the lighting up of interiors is concerned, but a limited conclusion can be drawn. However, it will doubtless answer, and much will, of course, be made of the satisfactory result.

A larger experiment in electric lighting is about to be made by the Corporation of Blackpool, who, in the course of September next, intend to convert night into day on their long promenade, by the use of six naked lights, having the illuminating power of about 6000 candles, and fixed at a height of fifty feet above the pavement. This is, in some respects, a novel experiment; but it is one which should be made. Blackpool will not be converted into a summer residence all the year round, however well the *electric light may succeed. Lancashire people go to bed early, and any amount of illumination on the promenade will only induce a few to remain thereon. Hardly a word need be said about the extension of the light on board ironclads, and for the illumination of harbours. A more extended application of the light is being made in this direction, which will probably be followed up by others. In this application we see the most legitimate use of the electric light, and shall be happy to congratulate the Admiralty and all concerned on its successful employment.* In all this there is nothing to alarm gas proprietors or shareholders. We watch the developments of the electric light with perfect equanimity, certain that there is not in its use anything inimical to the interests of gas proprietors.

We believe we are right in asserting that the amalgamation between the South Metropolitan and Surrey Consumers Gas Companies will be sanctioned this week. Difficulties arose, but have now, we believe, been settled, and we understand that the Board of Trade will, in the course of a few days—subject to the approval of Her Majesty in Council—sanction the arrangements which has been come to between the Companies with some alterations of no great importance which have been made since we published the scheme.

It is now fully understood that the Phœnix Company do not propose, for the present, to enter into the arrangement intending to go to Parliament next year for, among other things, power to amalgamate with any Company whom they can persuade to unite with them. It is difficult to say in what direction they can be looking for allies. So far as can be seen, the South Metropolitan and the Surrey Consumers Companies are now closed against them. The London Company would appear to have nothing to say to any combination. In hardly any case could they fall in with the Phœnix, unless their district were divided, and the best part of it went to the Chartered across the water. It is very much to be regretted that a southern combination has not been effected; but the spirit of union which will, we hope, be sanctioned in the course of the present week, must tell greatly to the advantage of the consumers within the Surrey Company's limits. It is something to have an immediate reduction of sevenpence per thousand feet, with a prospective diminution of twopence per thousand feet more within a short period. We shall not stop here to inquire whence the profits are to come which in time will justify this reduction, and maintain the dividends at the rates proposed. It is quite clear that they cannot be derived at present from the working of the Surrey Consumers Company, and hence some uproar on the part of consumers in the district of the South Metropolitan, who imagine that the price of gas within their limits must be kept up to provide a dividend for the Surrey Consumers Company. There is perhaps a substratum of truth in this supposition, but it must be remembered that in practical life we have all to make sacrifices, sometimes large and sometimes small. The consumers in one district may not get all the advantage they might hope to derive from the independent existence of the South Metropolitan Company, but they have at the same time the satisfaction of knowing that in the course of a year or two, after aiding their neighbours to obtain the benefits of cheaper gas, they will themselves participate in advantages which could only be derived from amalgamation. It is in the highest degree essential that the two Companies to which we now allude should unite. The one, as we have said before, has exactly what the other requires, and their combination can only tend to enhance the benefits to the Shareholders and Consumers of each.

The report of the Directors of The Gaslight and Coke Company, and the accounts for the past half year, have been issued in anticipation of the half-yearly meeting to be held next Friday. It is unnecessary to say that the working results have been eminently satisfactory. From the sale of gas the Company received no less than £1,024,796, against which may be placed a cost for coals of £474,224. Meter-rents produced £18,116, and residuals £255,945, &c. The balance of revenue account shows a profit of £389,005, which, after providing for all preferential charges, leaves a balance applicable to dividend on ordinary shares of £327,216. The amount required for the payment of the dividend for the previous half year was £285,607, which leaves £101,612 to be appropriated to the reserve and other funds, and to be carried forward. This result is certainly not quite so good as that obtained in the previous half year, but the difference is small.

We have spoken of the dividends; those for the past half year amounted to 10½ per cent. on the ordinary stock, and

AMALGAMATION OF GAS COMPANIES.—On Friday last week, a deputation from the Vestry of Lambeth had an interview with Mr. Talbot, M.P., at the Board of Trade, with reference to the scheme now before the Board for the amalgamation of the South Metropolitan Gaslight and Coke Company and the Surrey Consumers Gas Company. The chief objection of the Vestry to the amalgamation scheme is that the effect of it will be to reduce the price of gas in the Surrey Consumers Company's district, and deprive the Vestry and the consumers of gas in the South Metropolitan district of the advantages they now derive from the favourable position of the South Metropolitan Gas Company. Mr. Talbot said the representations of the deputation would receive his most careful consideration.

[From London "Journal of Gas Lighting."]

The Proposed Substitute for Candles in Testings for Illuminating Power.

"Mr. A. Vernon Harcourt has written to the Board of Trade a letter which has the appearances of being a private communication, but which has been made a public document by being printed and circulated by the Board. We scarcely understand the position of his colleagues in regard to this matter. There are three Referees, whose salaries are paid by the gas companies; two of these gentlemen, the Acts of Parliament say, shall form a quorum, and concur in any recommendation and instruction. In the document above referred to, however, which we are bound to regard as of some importance, the names of Mr. Harcourt's colleagues do not appear. We are obliged, then, to regard it as a private communication. Mr. Harcourt is very much dissatisfied with the candle test, and therefore is anxious to substitute another which he considers more reliable and trustworthy. "I desire," he says, "to obtain the sanction of The Board of Trade to the introduction at the testing-places" established for testing gas supplied by the Metropolitan gas companies "of a more trustworthy standard." We may stop here for a moment to express a strong opinion that the Board of Trade have no power to change the standard of comparison. The Acts of Parliament say that the gas supplied shall have an illuminating power of *sixteen candles*. The Referees have the power to prescribe the apparatus to be used in ascertaining the illuminating value, and at that point their obligation ends. Candles are the universal standard, which can only be changed by some general enactment. We are far from saying that the use of candles gives entirely satisfactory results; but as no approach to scientific precision is possible, even with Mr. Harcourt's pentane test, we may be excused for expressing our adhesion to the old standard. And on this point we may call Mr. Harcourt himself to witness. He admits that taking the mean of three testings during the day tends to neutralize the variations of the candles; and, further, he says that, according to his experience, "it does not often happen that any one of a set of three testings varies by more than half a candle from the mean of the three. This is the case even if a different pair of candles is used for each testing, when the candles are from the same packet, and the mode of operating is kept rigorously uniform." Further than this, he admits, "that when candle testings are made with great uniformity, fairly concordant results may be obtained." Beyond this, in an appendix, he shows that when tests are made alternately with pentane and candles, the variations in the latter are really but small.

It may be asked, can we be more certain of the invariability of the pentane test, any more than that of candles? We may take it that it would be a difficult matter to answer this question. Pentane, as prepared by Mr. Harcourt himself, is a body of definite composition and great volatility; but who is to guarantee that all poured into the holder is volatilized and diffused through the bulk of air contained therein? We admit that the presumption is, of course, in favor of the perfect diffusion of the whole of the pentane vapor in the air. Still, we do not see how this is to be guaranteed; and when a second portion of pentane is poured into the holder, we deem it possible that it may meet with some residual unvolatilized pentane, and so the light of the flame may be a little enhanced. We do not put this as an objection to the pentane test; all we would say is, that the objections which appertain to candles will apply with equal force to the hydrocarbon test, which is really a candle test in disguise. Doubtless, as stated by Mr. Harcourt, the testing of gas by candles is affected by causes, the influence of which the actual Application of the method of average does not tend to eliminate. Different operators, we know, have different modes of proceeding. Some, as Mr. Harcourt says, turn down the tips of the candles; others trim the wicks. In this latter case, we hope they leave them burning for some considerable time before they begin testing, otherwise great differences are sure to be observed. Uniformity of usage with candles cannot be too rigidly enforced on gas testers; and if that be followed, as Mr. Harcourt says, "fairly concordant" results may be obtained.

It only remains to be noticed that the writer of this letter does not ask to have the system adopted on his own responsibility. He wishes to have it examined into and reported upon by a body of experienced gas examiners, who will inform the Board of Trade of the results of their examination and inquiry. Such a Committee, we believe, has been appointed, and we shall presently know the results they have arrived at.

The following is the letter by Mr. A. G. Vernon Harcourt, one of the Metropolitan Gas Referees, to the Assistant Secretary of the Board of Trade—

Sir:—I desire to call the attention of the Board of Trade to the untrustworthiness of the standard which is at present in use for estimating the illuminating power of coal gas.

I desire to obtain the sanction of the Board of Trade to the introduction at the testing places established for testing gas supplied by the Gaslight and Coke Company, the South Metropolitan Gas Company, and the Commercial Gas Company, of a more trustworthy standard.

Under the Acts of the above-named companies, the Gas Referees are charged with the duty of prescribing the materials and apparatus to be used within the testing-places for testing the illuminating power of gas. Soon after my appointment, in 1872, as one of the Gas Referees, in the course of experiments upon the effect of heating gas, with a view to its purification from sulphur, the inaccuracy of the usual photometric process was brought under my notice. In 1871 I began a series of experiments with the aim of devising a more trustworthy process, which I have continued with occasional intermission till the present time.

In the course of my experiments I have had occasion to make a large number of testings with candles of the kind ordinarily employed, and also with candles differing in diameter and in the structure or preparation of their wick, but coming within the definition of "sperm candles of six to the pound, consuming 120 grains of sperm per hour."

For some account of the results of these experiments, I may be permitted to refer to a paper "On a New Unit of Light," read before the Chemical and Physical Sections of the British Association, at its meeting in Plymouth in 1877, a copy of which accompanies this letter.

The existing system of photometric attempts to neutralize the variations in the amount of light emitted by standard candles by using two candles simultaneously, and by extending each testing over a period of ten minutes. The further provision that three testings shall be made daily, and that the mean result of the three shall be taken to represent the illuminating power for the day, though intended to provide for fluctuations in the quality of the gas supplied at different hours, really serves also to neutralize the variations of the standard candles.

This method of obtaining a fairly accurate result by taking the mean of a number of experimental results varying considerably from each other is rightly used, and leads to correct conclusions, when the experimental errors are likely to be evenly distributed, and when the whole series of observations is not liable to be affected by a common cause.

Thus, if a single candle were employed to yield a standard light, and if the correspondence between the light and that of a gas-flame were observed during one or two minutes, the variations in the results obtained by the same operator using the same candle in the same photometer would be very great. In the actual mode of working, the variations are not very great. According to my experience, it does not often happen that any one of a set of three testings varies by more than half a candle from the mean of the three. This is the case, even if a different pair of candles is used for each testing, when the candles are from the same packet, and the mode of operating is kept rigorously uniform.

In Appendix I., I have put together the results of a large number of candle-testings made in my laboratory with the view of obtaining a receipt for preparing a gas from hydrogen and pentane, which should burn, when consumed by a standard burner, exactly the illuminating power of 16 candles.*

* Important as are the appendices which accompany this letter, space will not admit of the[illegible]g given in the *Journal*; they occupy 10 pages of print of foolscap, and consist largely of tabular matter.

Such a gas might be used as a photometric standard in the manner which described and showed in a lecture before the Society of Arts on the 31st March, 1876.

Three testings were made of each sample of gas, stored in a small g holder, in quick succession, one after the other, so that the light given the gas did not vary, and the variation between the three results is solely to errors of observation, which are inconsiderable, and to differen in the illuminating power of three different pairs of candles treated simil in every respect. The numbers have been corrected, as usual, on the sumption that the light given by similar sperm candles varies directly the weight of spermaceti consumed; and where the consumption of gas in any degree greater or less than 5 cubic feet an hour, a proportional rection has been introduced.

The conclusion which may be drawn from this large number of obs tions is, I think, that when candle testings are made with great unifor fairly concordant results may be obtained. It is, no doubt, owing t fact that concordance is attainable under these conditions that an ar of confidence is bestowed upon candle testings to which they are not entitled. In fact, the greater pains an operator takes to obtain conco results by working in a perfectly systematic and uniform manner, th significant and trustworthy do his mean results become.

The result of testing by candles of any sample of gas depends upon conditions beyond those named in the Companies Acts of Parliament the notification of the Gas Referees, and is effected by causes the inf of which the actual application of the method of averages does not t eliminate.

I will here paint out a few of these, in addition to those mentioned accompanying paper.

1. Since the prescription of the Gas Referees of the apparatus to b in the Metropolitan testing places, which included a balance external photometer for weighing the candles used in testing, a new form of b has been substituted by Mr. Keates, chemist to the Metropolitan B Works, by which the candles are weighed *in situ* within the photo The plan of weighing the candles *in situ*, or of observing, without or extinguishing the candles, the time required for the consump 40 grains of spermaceti, is both less troublesome and more accura introduction is therefore a boon to the Gas Examiners; but I beli it is also a boon to the Gas Companies, since it is practically impos transfer a pair of lighted candles from a balance to the photomet out filling the cups of the candles with melted grease, and thus in the light of the candles, probably by diminishing temporarily the le wick within the flame.

2. Some operators make a point of trimming the wicks of their others of leaving them alone. I have known a difference of 2 ca be made in the illuminating power attributed to a sample of gas, by bending down slightly the wicks of the candles between a first and testing. A similar difference may be produced by cutting off the ti wick.

3. The greater or less movement of the air around the candles in photometer, and the greater or less movement of the candles to an a box photometer, according to the habits of the operator, affect cons the results of a testing, or set of testings. Perfect stillness is unf to the development of the light of a candle, and this, I believe, is or why open photometers sometimes give results less favorable to the box photometers.

4. The mode in which a candle has been extinguished, and during ...

Before a change could be made in tometry, it is necessary not only that have been devised, but also that the standard should have been ascertaine

The more fluctuating and uncertain the difficulty of ascertaining exactly t

In Appendix II., I give a summary the view of fixing the exact compositi and the exact height of the flame pr which should be the representative should furnish a convenient rate of c per hour.

In Appendix III. I give a summary ments made with a different form of p

Appendix V. contains the results of gress, made with a third photometer the South Metropolitan Gas Company

As I cannot expect, and do not wis sanction so considerable an innovatio existing standard on the evidence sup that an independent inquiry into the r and of that which I have proposed ma

If the Board of Trade should be wil men to inquire and to report to them inquiry in any way that is open to me.

(Si

(From the "Coal

Gas and G

By L. P. Gra

The average housholder, partly from dice, through personal grievances and company who supplies his dinner tabl light, as an exorbitant monopoly, com ers, and to be resisted in any way, as in somehow classed with sunlight and air of which no restraints should be laid, any one who can or cares to use it. W discovery of a cheap and brilliant subs of exultation went through the commu answer for if he wittingly deceived his ising them emancipation from an nun distempered glee, now permits them t discarded nuisance.

Much, perhaps, of this ill-natured c an insufficient sense of the privileges g and protective influence; from ignora tion that has been shown in the histo advanced state its manufacture has re It is not to satisfy any profound cravin we offer a general sketch of this indust ...is information a surprising in

[From the "Journal des Usines a Gaz.] Sept 16. 1879

Gas versus Electricity in Paris.

Am Gas Light Journal

The lighting of the "Place de la Republique" (formerly Chateau d'Eau) by the improved burners of the Paris Gas Company completes, with the greatest success, the comparative trials instituted between the lighting by gas and that by electricity. The trial in the Rue du Quatre Septembre had for its object, as we have shown in a former number, the comparison of the rival lights upon an equality as to expense per square yard of roadway. There has resulted a truly grand illumination in the Rue du Quatre Septembre, and the Avenue de l'Opera is enveloped in a moon-light not at all pleasing. The trial in the Place de la Republique had for its object the lighting of the surface of the Square with a light equal in intensity to that in the Place de la Bastile, which is lighted by the Jablochkoff candles, and to determine the comparative cost of the two systems. The gas company established 22 apparatus similar to those in the Quatre Septembre, giving to each an illuminating power of 13 Carcel lamps (about 120 candles), consuming 1,400 litres of gas per hour, and 54 smaller ones, giving a light of 9 Carcel lamps (85 candles), consuming 875 litres per hour. The lighting of the Square thus consumed per hour 78,050 litres (2,800 cubic ft.), which, at 15 centimes per cubic metre, would cost 11 fr. 70 c. ($2.36), and the intensity of the light was 772 Carcels (7,334 candles). Now, it was shown by the official report of Mr. Cernesson (Feb. 5, 1879) that a Jablochkoff candle is equivalent to 12.10 Carcels; hence it follows that to produce equal illumination, 63 Jablochkoff candles would be required, which, at 60 centimes per hour, would cost 37 fr. 80 c., making the expense of the gas only 30-100ths that of the electricity.

The question appears to us, then, settled, and if we add to this the almost daily extinctions by which the electric light is distinguished, we must conclude that this mode of lighting is yet far from meeting the necessities of practical wants.

Aug 26 1879

GAS UNDERTAKINGS AND THE ELECTRIC LIGHT.

In the *Manchester Evening News* of Monday, the 18th inst., an article appeared which displayed, if anything, rather more than the usual amount of ignorance of facts observable when writers in the general public press treat of special subjects—such as gas supply. For instance, the writer of the article referred to says: "One of the largest gaslight and coke companies in London has obtained powers to illuminate the Metropolis by means of electricity;" which is not a fact. He then goes on to remark: "Nothing much has been done as yet; but it is a significant sign of the times that such should be the case." A quotation follows from a London daily newspaper report of the speech of the Governor of The Gaslight and Coke Company at the half-yearly meeting of Shareholders held on the previous Friday, when, referring to the improved system of street lighting carried on at the expense of the Company, he said: "It is now proved that if the public like to pay for it, we can give them a better light than the electric light ever will, and at a very much reduced price." On this the writer remarks: "The views expressed by the Hon. Richard Howe Browne strongly suggest the idea that he is not entirely unacquainted with the adage, 'There's nothing like leather!' It would be difficult for the chairman of a gas company which, in bad times, pays 10½ per cent. to see anything through the medium of the electric light. And yet the efforts made and the powers acquired by the Company are calculated to excite doubts, if not of the sincerity of the belief expressed, at least as to the wisdom of the conclusions on which it is based. It is absurd to suppose that the question can be shelved, or that scientific research should fail to discover means whereby electricity may be turned to further account in the interest of mankind. The world continues to move, whatever prejudice and self-interest may assert to the contrary."

It would be difficult to find more misstatements and misrepresentations in any column of type than appear in the article in question, and it must surely be viewed as a lamentable circumstance that the leading columns of a newspaper, having the wide circulation of the *Manchester Evening News*, should be open to writers displaying so much ignorance of the subject of which they treat.

Mr. Newbigging, however, in a letter which appeared in the *Evening News* the next day and which we reproduce, ably replied to the article; and it would be well if gas engineers and others throughout the country, following his example, would make a point of writing and setting the true facts before the public, when remarks calculated to convey so erroneous an impression as the ones we have referred to, are published in local newspapers.

Mr. Newbigging's letter is as follows:—

To the Editor of the *Manchester Evening News*.

Sir,—I regret that I should have occasion to differ with many of the remarks contained in the last leading article of the *Evening News* of this day, treating of gas companies and the electric light. The tendency of such statements, if left unrefuted, is bad, and especially so in the present instance, for, under a show of encouraging and assisting the progress of scientific discovery and improvement, the claims of truth and justice are entirely ignored.

The writer expresses the belief that gas undertakings "are unlikely to

le of much service in a few years hence." Has he given the slightest consideration to the result which would ensue supposing his prognostication to be fulfilled? Why, in fact, computation there is expended on gas undertakings in the United Kingdom alone no less a sum than £50,000,000, representing an investment of capital which is constantly earning the shares or stock to that amount are held principally by the middle classes of the community, and are a measure of the thrift of the people, which we, as a nation, have good reason to be proud. A large portion of the investment is in the hands of, or in trust for spinsters, widows, and others dependent on fixed revenue, whose whole or chief means of subsistence is derived from the interest they thus receive. The result of gas-works becoming "useless in a few years hence" would be to plunge vast numbers of the most deserving of the population in penury and distress, and this surely, even if the interests of science demanded it, would be a matter for deep consideration.

But there might be some show of justification for even such a calamity as this, if it could be proved that gas directors and the officials of our companies, as a whole, are the grasping and unscrupulous knaves they are sometimes represented to be. Take the Metropolis as an example, the Gas Companies of which the writer of the article holds up to scorn and contempt. "The Metropolis," he says, "is placed in a miserable position as regards a supply of gas, and before long public indignation may rise to such a height as to render it necessary to secure the administration of London out of private hands." I deny the preposterous allegation, and challenge the writer to make good his assertion. The gas supplied in London is of the highest illuminating quality, and of a most generous character. In this respect, as well known to some of the readers of the civilized world. The purity clause in the London gas Acts is a model of its kind. In existence; in no provincial or foreign town is anything like the same surveillance exercised. Does the writer of the article refer to the "fog nuisance" of the winter? Then he is surely unaware that the public lighting is managed and controlled by the Corporation and the Vestries, and all that the Gas Companies are required to do is to furnish the necessary quantity of gas of a given illuminating power, whilst the size and number of lights in the streets are matters entirely beyond what they have no voice, and are not allowed to interfere. In all vast industrial enterprises there will arise occasional causes of distrust and disagreement, and gas undertakings will be found, in the hands of corporations, companies, they are not excelled in their management by any other industrial undertakings. Of the London and Westminster Gas Companies, after all, are the representative purveyors of the gas to the Metropolis? I can say from personal knowledge that I have less of trouble in dealing with them than with any other, for ability and integrity, are as characteristic of them as of the Bank of England.

But what has all this to do with the electric light? Surely we can be gas shareholders and gas-employés, and even gas directors, without being influenced in the progress of science. The electric light will eventually supersede gas light in the theatres of the prophetic faculty, a mere matter of opinion. I am of opinion that it never will, for many reasons of a practical character. Lighting, and I have elsewhere given substantial reasons for my belief. The electric light has its uses, but it is not in the very remotest degree a rival to gas lighting. The writer of the article quotes the illuminating of Regent Street, Sunday as a successful application of electric lighting. He could not have selected a worse example, for after dodges and contrivances, and was almost useless on every road by both the electric and the gas light at midnight. Again, the writer of the article in the most inconsistent manner, says that it is quite beside the question to discuss the "cost of the largest gas lighting compared with electricity." The truth is that of all the gas companies in England, during the year, not one of them has proved greater foes to gas than the electric light, although it would, in my opinion, have been altogether to the interest of science if they had not. Improved burners, restricted supply, but it is safe to predict they will never be the source of remarkable economy of light. Private enterprise alone can be trusted to entirely for the cheap and abundant blessing of gas light.

I am, Sir, your obedient servant,
JAMES NEWMARCH.
5, Norfolk Street, Manchester, Aug. 16, 1879.

Improved System of Street Lighting by Gas.

Coal Trade Journal 28/11/79

Mr. B. Hill, civil engineer to the Bristol, England, corporation, has invented a greatly improved system of street lighting by gas. Dealing with the present burner, which consumes five cubic feet of gas per hour, and is in general use, he divides the light into two jets, each consuming two-and-a-half feet of gas per hour, but leaves the total consumption unchanged. Between these two jets, placed in each street lamp, he suspends a double convex lens, forming a powerful reflector, and the result is found to be an increase of lighting power to the amount of fifty per cent. Ordinary bats wings burners are used, and the only care required to insure a perfect light is a due adjustment of the suspended lens, so as to get the right focus and the full reflection of the light. When this is secured the jets, even at a distance, are very brilliant and have the appearance of globes of light. They illumine the foot path between each lamp with much of the effect of the electric light. At 150 yards the light, backed by the reflector, is very powerful. As the plan consumes no more gas than ordinary and the reflectors are of simple construction and of trivial expense, the corporation of Bristol is about to put the new system into universal use in the public streets.

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TO CORRESPONDENTS.

H. M.—The consumption in the metered lamp would be rather less than in the unmetered one.

The name and address of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer—not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, SEPTEMBER 30, 1879.

Circular to Gas Companies.

THE results of the past half year's working of the Metropolitan Gas Companies, as shown in the accounts which are issued in anticipation of the half-yearly meetings of Shareholders, exhibit a continuous prosperity. Without referring at present to the operations of those Companies who are under the sliding scale, we may mention that two of those who were working under the Act of 1860 are, as may be supposed, able to pay full dividends, and carry forward a considerable balance. The London Company, for example, after bringing down the price of gas to 3s. 3d. per thousand feet, find themselves for the past half year with the balance of net revenue amounting to £30,880. After providing, out of this sum, for all preference charges, there remains to pay the dividends on ordinary capital a balance of £22,468. Now, as only £19,370 are required to meet the dividend on ordinary stock, it follows that there is left a balance of £3098 to be carried forward or placed to the reserve-fund. We note again with satisfaction that the details of the working accounts are remarkably good. The yield of gas per ton of coal was excellent, and the unaccounted-for gas is a relatively small amount. All concerned with the Company may be congratulated on the satisfactory condition of affairs, which does them much credit, and which will be duly capitalized upon to-morrow week, when the half-yearly meeting of Shareholders will take place. Notwithstanding the reduction in price, the rental continues to increase in amount, and, happily, the London Company had a good half year for the sale of residuals.

The Phœnix Company also had a successful half year's working. The balance of revenue for the past six months amounted to £53,116; and, after payment of full dividends on all classes of ordinary and guaranteed stocks, there is left a sum of £1716 to be carried forward. The continually increasing business of this Company necessitated their making provision for future needs, and to provide for them the Directors have in hand considerable additions to their coal stores, and a further extension of their carbonizing apparatus. By these means we may anticipate that the coming winter will be safely tided over, and probably, if matters go on quietly, there will be sufficient power to provide gas in abundance for the whole of the Company's limits for some years to come. During the past half year, 68,860 tons of common coal and 3,000 tons of cannel were carbonized and used in the Company's works, and the average yield of gas was over 10,000 feet per ton. Of this the greater part was sold, the unaccounted-for gas being relatively small. We are happy to say that in the report of the Directors no complaint is made of the want of sale of residuals. Coke, in fact, produced £32,982, which leaves a fair relation to the cost of coal; and the other residuals fetched good prices; so that the Company may well be congratulated on the results of their half year's business.

The accounts and report of the Directors of the Alliance and Dublin Consumers Gas Company have been issued in anticipation of the meeting to-day. The balance of profit for the past half year amounted to £52,427, which leaves the Directors the power to pay 10 per cent. dividend, and carry forward the sum of £2297, which will make their unappropriated balance £25,022. It is against the payment of full dividends and these appropriations that some Irish journalists protest. They suggest that the Shareholders should content themselves with a 9 per cent. dividend, and that any excess of profit necessary to pay the 10 per cent. rate should go in reduction of the price of gas. These good-natured gentlemen appear to forget that for several years the Shareholders received very small dividends, and for two years none at all. The large reserve-fund, we may take it, is as much a protection to Consumers as to Shareholders. It is because the Company are in possession of such a good reserve that they are enabled to reduce the price of gas they did at the beginning of this year, and, at the same time, protect the interest of the Shareholders. Up to this time, at all events, no proposition has been made for the payment of back dividends, so on that score the citizens of Dublin have nothing to complain of. As a matter of course, the Company still continues to be managed by the Corporation, whose modes of attack vary. At the present moment the contest is that—the reserve is the same is too high, while men of experience think it too low. To the Corporation the matter cannot be of much moment, while to the Company it would be a matter of serious importance. In any case, the Directors are endeavouring to obviate all accusers of complicity by reopening the present feeling-mains with others of larger capacity. As our readers know, a Bill promoted by the Company received the Royal Assent in the past session, which, among other things, enables them to manufacture and supply apparatus for the consumption of gas for other than lighting purposes, such as cooking and heating, and also for gas-engines for the production of motive power. Great preparations are being made for entering upon this business as speedily as possible. There can be no doubt that the business once begun will be extremely profitable to the Company. The apparatus will not perhaps bear any very great profit, but what we look forward to is a large additional demand for gas in consequence of its use. It is, we believe, the universal experience, that the consumption of gas is greatly increased wherever such appliances are adopted, and we hope that other Companies who obtained similar powers last session will exert themselves to bring gas-stoves and other apparatus more into use as quickly as possible.

The little Brixton Water Works Company had a pleasant meeting on the 24th inst. The business of the Company continues to increase, and would increase much faster if the Company could reduce the price of gas; but the difficulty and expense of getting coal to their works acts as an effectual barrier to any reduction, as all events at present. There seems to be a prospect that presently a new railway will carry coals to within an easy distance of the works, when cheap carriage may allow of some diminution of price. The districts of the Company rapidly improves, and nothing but

[From the "Gas Times (Chelmsford Observer.)]

Gas Undertakings and the Electric Light.

We extract the following letter from the Manchester *Evening News*:

Sir,—I regret that I should have occasion to differ with many of the remarks contained in a leading article of the *Evening News*, treating of gas companies and the electric light. The tendency of such statements, if left unchallenged, is bad, and especially so in the present instance, for under a show of encouraging and assisting the progress of scientific discovery and improvement, the claims of justice and truth are entirely ignored. The writer expressed the belief that "gas undertakings are unlikely to be of much service a few years hence." How he gives the slightest consideration to the result which would ensue supposing his prognostication to be fulfilled? At the lowest computation there is expended on gas undertakings in the United Kingdom alone no less a sum than sixty millions pounds, representing an investment of at least one hundred and ten million pounds sterling; the shares or stock to that amount are held principally by the middle classes of the community, and are a measure of the thrift and self-denial of which we as a nation are justly proud. A large proportion of the investment is in the hands of, or in trust for, minors, widows, infants, and aged persons, whose whole or chief means of subsistence is derived from the interest they receive. The result of gas works becoming useless in a few years hence would be to plunge vast numbers of the most deserving of the population in penury and distress, and this surely, even if the interests of science demand it, would be a matter of deep consideration. But there might be some show of justification for even such a calamity as this, if it could be proved that gas directors and officials of gas companies as a whole are the grasping and unscrupulous knaves they are sometimes represented to be. Take the metropolis as an example, the gas companies of which the writer of the article holds up to scorn and contempt. "The metropolis," he says, "is placed in a miserable position as regards a supply of gas, and before long public indignation may rise to such a height as to render it necessary to take the illumination of London out of private hands." I deny the preposterous charge, and challenge the writer to make good his assertion. The gas supply of London is of the most ample and generous character. In this respect, as is well known, it is one of the wonders of the civilized world. The gas referees of the metropolis, Professor Tyndall, Dr. Pole, and Mr. Vernon Harcourt, who are appointed by the Board of Trade, are men in the foremost rank of science, and they certify week by week, through their examiners, that the illuminating power, purity, and pressure more than conform to the acts of Parliament by which they are regulated. The purity clauses in the London Gas Acts are the most stringent in existence; in no provincial or foreign town is anything like the same surveillance exercised. Does the writer of the article refer to the illumination of the streets? Then he is surely unaware that the public lighting is managed and controlled by the corporation and the vestries, and all that the companies are required and permitted to do is to furnish the necessary quantity of gas of a given illuminating power, whilst the size and number of lights in the streets are matters over which they have no voice, and are not allowed to interfere. In all vast industrial enterprises there will arise occasional causes of distrust and disagreement, but taking gas undertakings all round, whether in the hands of corporations or companies, they are not excelled in their management by any other industry in existence. Of Co London Gas Engineers (and they, after all, are the responsible purveyors of the gas of the metropolis) I can say from personal knowledge, and without fear of contradiction, that they are men who, for ability and integrity, are an honor to their profession. But what has all this to do with the electric light? Surely we can be shareholders and gas employees, and even gas directors, without being inimical to the progress of *science*. That the electric light will eventually supersede gaslight is, in the absence of the prophetic faculty, a mere matter of opinion. I am of opinion that it never will, either for general or domestic lighting, and have elsewhere given substantial reasons for my belief. The electric light has its uses, but they are in no way antagonistic to those of gas light. The writer of the article quotes the illuminating of Billingsgate Market as a successful application of electric lighting. He could not have selected a worse example, for after repeated trials the light there was condemned on every hand, both by dealers and customers, and was almost angrily hustled out of the place and the familiar gaslight reinstated. Again, the writer is quite beside the mark in his statement "that one of the largest gaslight and coke companies in London has obtained powers to illuminate the metropolis by electricity." The truth is, that of all the gas companies in Parliament during the year, not one of them has powers granted for supplying the electric light, although it would, in my opinion, have been altogether in the interest of science if they had. The Liverpool Corporation obtained powers to experiment upon and use the light under certain restrictions, but it is safe to predict they will never take advantage of the powers granted to them. Private enterprise alone can be trusted to undertake work of this kind, and we have private enterprise to thank entirely for the cheap and abundant blessing of gas light.

THOMAS NEWMARCH.

Pres. Manchester Ins. Inst. of Gas Engineers.

5, Norfolk street, Man., Aug. 18th, 1879.

The *Journal of Gas Lighting* comments as follows on the article to

In the Manchester *Evening News* of Monday, the 18th inst., an article appeared which displayed, if anything, rather more than the usual amount of ignorance of facts observable when writers in the general public press treat of special subjects—such as gas supply. For instance, the writer of the article referred to says: "One of the largest gaslight and coke companies in London has obtained powers to illuminate the metropolis by means of electricity," which is not a fact. He then goes on to remark: "Nothing much has been done as yet; but it is a significant sign of the times that such should be the case." A quotation follows from a London daily newspaper report of the speech of the Governor of The Gas Light and Coke Company at the half-yearly meeting of shareholders held on the previous Friday, when, referring to the improved system of street lighting carried out at the expense of the Company, he said: "It is now proved that if the public like to pay for it, we can give them a better light than the electric light will be, and at a very much reduced price." On this the writer remarks: "The views expressed by the Hon. Richard Howe Browne strongly suggest the idea that he is not entirely unacquainted with the adage, 'There's nothing like leather!' It would be difficult for the chairman of a gas company which, in bad times, pays 10½ per cent. to say anything through the medium of the electric light. And yet the efforts made and the powers acquired by the Company are calculated to excite doubts, if not of the sincerity of the belief expressed, at least as to the wisdom of the conclusions upon which it is based. It is absurd to suppose that the question can be shelved, or that scientific research should fail to discover means whereby electricity may be turned to further account in the interest of mankind. The world continues to move, whatever prejudice and self-interest may assert to the contrary."

It would be difficult to find more misstatements and misrepresentations in any column of type than appear in the article in question, and it must be viewed as a lamentable circumstance that the leading columns of a newspaper having the wide circulation of the Manchester *Evening News* should be open to writers displaying so much ignorance of the subject of which they treat.

Mr. Newbigging, however, in a letter which appeared in the *Evening News* the next day, ably replied to the article; and it would be well if gas engineers and others throughout the country, following his example, would make a point of writing and setting the true facts before the public, when remarks calculated to convey so erroneous an impression as the ones we have referred to are published in local newspapers.

[From the "English Mechanic."]

The Light and Energy of Electricity and Gas.

By J. T. Sprague.

Some very remarkable statements were made before the Committee of Parliament on Lighting by Electricity. These statements are embodied in the report, and having gone the rounds of the press without examination or comment, they will, no doubt, be adopted as settled facts. It is therefore very desirable that they should be examined, and that an understanding should be arrived at as to how far they are reliable, and in what sense they are true. We will therefore commence with the remarks of Sir William Thomson.

1746. We are anxious to obtain your opinion upon various points connected with electric lighting; perhaps you will let me go to the root of the matter, and ask you to tell us the energy which is used and exhibited in light in the production of the electric arc?—The energy which is actually used in the electric arc is about 1-horse power per 2,000-candle power. Of even more than 2,000-candle power, according to the dimensions and other circumstances of the electric arc.

1747. That is to say, 1-horse *power*, if fully employed, produces 2,000 candles or more?—Yes; 1-horse power actually in the electric arc; 1-horse power spent in stirring the luminiferous ether between the carbon points and on the surfaces of the carbon.

1748. Have you at all calculated the energy appearing as light in the case of the combustion of gas?—One-horse power of energy is the equivalent of gas produces about 12-candle power.

1749. And 1-horse power converted into electric light produces 2,000 candles?—Yes.

1750. As these are rather startling figures perhaps you will explain to the committee how you arrive at such results?—Sir William's *reply* is [illegible]

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Regenerative System for Gas Light.

1879

Mr. F. Siemens, of Dresden, Germany, like his brother, a prominent electrician and inventor, has published in the *Verhandl. z. Bef. d. Gewerb.*, a valuable application of his regenerative system for gas-light. Starting from the fact that the intensity of the light is increased by an increase in the temperature of combustion, he designed a number of different styles of lamps in which the air for the combustion of gas is heated by the waste gases, the supply of air being regulated by the currents produced by the difference of the temperature of the air, the gas and the products of combustion. The lamp consists of three iron tubes of suitable diameters, placed one within the other, the upper portion of the lamp being enclosed in a spherical globe. The entire space inclosed by the different tubes is filled with wire netting, constituting what Mr. Siemens calls regenerators, and which serve for absorbing the heat of the products of combustion and for giving it off to the gas and the air for burning the latter. The central tube is used for conveying the gas, which enters it from below. The air is admitted from below into the annular space between the central and second tube, while the hot products of combustion descend through the annular space between the second and the third tube. By this means the heat absorbed by the wire netting in the outer tube will be conducted and reflected to the two inner ones, and serve to heat air and gas and increase the intensity of the flame. The products of combustion rise upward within the space inclosed by the glass globe, and then descend along its sides, until they reach the annular space of the regenerator, without impeding the flow of air or gas. Mr. Siemens has constructed the lamp in such a manner that the regenerator, having a disc shape, serves as a reflector at the same time. While the construction of these lamps is not such as to make the system readily applicable to single burner lights, it is destined to enlarge or maintain within certain limits the ground which gas has been rapidly losing in its competition with the electric light for the illumination of large spaces.—*Iron Age.*

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

Journal of Gas Lighting, Nov 16 1879

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, OCTOBER 14, 1879.

Circular to Gas Companies.

WE were wrong last week, in speaking of the electric light as "a half-forgotten wonder;" for, before the ink was dry, an experiment was made with the Lontin system at the Aldersgate Street station of the Metropolitan Railway. This large cavernous building, it must be confessed, is very difficult to effectively illuminate. It could be brilliantly lighted by gas, if the Railway Company would go to the expense of a sufficient quantity, with suitable burners; but they have preferred not to make an experiment with the electric light. The lamps employed are eight in number, which are supplied with electricity by a Gramme machine, driven by a 25-horse power engine nominal, the distributor making 410 revolutions per minute, and the exciter half that number. As a matter of fact, the engine was only working on the Saturday evening, up to 14-horse power, which was sufficient to produce in each of the eight lamps a light said to be equal to 200 candles—more or less. With the Lontin system it is alleged that the carbons, of which we gave a description when the light was first introduced outside the Gaiety Theatre in the Strand, with a Serrin regulator, will burn at the rate of three inches per hour. The cost of the carbons, and the coal necessary to drive the machinery, is reckoned at less than threepence per hour. It is not to be expected, therefore, that gas can compete at this rate; but the figures we quote require substantiation. It may turn out that, after all, good gas light might at a little cost to wear is involved in the production of the electric light, furnish an illumination quite equal to that which is now said to flood the Aldersgate Street station. There is a talk that a large amount of undeveloped power lies dormant in the machinery, and this it has been proposed to utilize in lighting up the Metropolitan Meat Market. The machine now actuating the eight lights at the Aldersgate Street station is reported as capable of maintaining sixteen lights, which will have the same illuminating power as those at present in use—600 candles. About this we shall say nothing; but we turn with interest and curiosity to the experiments recently made by Professor Crookes, F.R.S., who is credited with having succeeded in obtaining, without the use of carbons, lights of small illuminating power, ex uno. Each one of these lights, it is said, will have the luminosity of three candles. Thirty of the lamps, it is thought, might be maintained with an expenditure of 1-horse power, at a cost of 1*d.* per hour, a penny per hour. Here, it must be confessed, we have the germ, at all events, of domestic illumination by means of electricity. Mr. Crookes is not the man to rest on his oars, but has a long and weary task before him ere he makes the electric light applicable to household service.

Further experiments in electric lighting have also been made by the Metropolitan Board of Works. We announced, some time ago, that a trial was to be made with the Jablochkoff system on Waterloo Bridge. Last Friday evening it duly came off. Ten lights were placed on circuit to illuminate the bridge—five on the western and four on the eastern side of the bridge, and one on the refuge at the Strand end. In addition to these, and in order to test the power of the machinery, five more lights were fitted up in the engine-shed at Charing Cross; thus making, with those already on the Embankment, six, five lights being maintained by a 20-horse power engine nominal. The five lights which were in the engine-room at Spring Gardens, and the entrance to the hall. Since the commencement of the experiment last December, up to the 9th inst., the length of cable laid down was 17 miles 361 yards. When the Board's offices in Spring Gardens are illuminated, the total length will be about 18¼ miles. Mons. Berly, the Ingineer to the Société Générale d'Electricité, intends shortly to experiment with electric candles of larger dimensions, giving lights equal to from 2000 to 6000 sperm candles, thus intimating to show that the Jablochkoff system can furnish a highly concentrated light if required.

But what of all this? Is the stronghold of gas lighting in the least interfered with when we have reports such as that presented at the half-yearly meeting of the London Gaslight Company, held last Wednesday? The report of the Directors, to which we referred a fortnight ago, contains facts which are all that could be desired. They show that gas is now so largely used for purposes other than illumination, that it is quite clear electricity cannot in any way affect the amount of its consumption. The question of the Company's amalgamation stands over for the present; but it cannot be long before a decision one way or the other will be arrived at. The London Company are solicited on two sides, and, if we understand matters rightly, are offered pretty much the same terms on both. It little affects the gas-consuming public in the Company's district whether or not they enter into a combination with the northern alliance, or whether it would be better to promote a complete southern alliance. To our mind, as we have repeatedly said, the London Company should be split into two parts, divided by the Thames. The Company's district this side of the river would be fully maintained as at present. On the opposite side, where, however, the Company are now doing a good business, a large district still remains to be, and will eventually be built over, and this, when accomplished, will add largely to the profits of the Company. The Governor, in his speech, a report of which will be found in another column, sends mention of the large increase in the consumption of gas during the past half year, it having been eighteen per cent. over that of the corresponding half of the previous year. This is a remarkable fact, and shows how little, after all, the electric light at present affects the use of gas. With results such as we have stated, the Company can afford to look upon the electric light with perfect equanimity. We report above two new experiments with the light, but they scarcely touch what we have all along called the stronghold of gas lighting. It must be confessed there is, in the discovery by Mr. Crookes, an approach, though only a very small one, towards domestic lighting; but the effect of this has to be verified by experience, and then we shall have to look seriously to the results of the new mode of illumination. It will not, however, affect us in the least degree. Supposing Mr. Crookes's discovery to be worked out to a success, so far as to supply a number of consumers of gas with those small lights, what would be gained? Obviously nothing at all. How many engines are to be employed, and where are they to be placed to supply light to the streets? A gas-pipe would furnish all that is required, and more than is offered by electricity, at much less cost, and engine power, with exciters and distributors, would be entirely dispensed with.

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, MAY 4.

Saint Leonard Local Board Bill—On the Order for Committee informed to-day that the respective petitioners against the Standing Orders are applicable to the Southampton Corporation Water Bill.

The Birmingham Corporation Water Bill, with amendments—Petitions against the Birmingham Corporation Water Bill referred to the Committee on the Bill.

Petitions against the Birmingham Corporation Water Bill presented.

Petition against allocation of Charges in Birmingham Corporation Water Bill presented from the Corporation of Wigan.

TUESDAY, MAY 5.

The Westgate and Birchington Water Bill was reported without amendment.

THURSDAY, MAY 7.

The Llandudno Improvement Bill was considered and agreed to.

Great Ormes Head Tramways Bill, as amended, was considered—Petitioner against the Bill withdrawn.

Petitions against the Cefn Mawr Estate; Scotfield Water, from London, Tilbury, and Southend Railway Company.

FRIDAY, MAY 8.

Manchester Corporation Water Bill,—reported specially from the Select Committee, with amendments.

Dudley and Stour Gas Bill,—Queen's consent signified, and Bill ordered to be reported from Select Committee, as amended.

Reported from the Select Committee, with amendments,

Glasgow Corporation Water Bill,—reported from the Select Committee, with amendments.

Dudley Sewage Bill,—reported without amendment.

Portsmouth Corporation Water Bill, Bromley Gas Bill,—read a second time, and committed.

Wenlock and Birmingham Water Bill,—read the third time, and passed.

HOUSE OF COMMONS.

MONDAY, MAY 4.

Colchester Water Bill.—The Examiner's report—"That the Standing Orders have not been complied with in the case of the petition for additional powers to the Colchester Water Bill," was referred to the Select Committee on Standing Orders.

Tay and Forth Navigation Bill.—The Examiners Report that the Standing Orders applicable to this Bill have been complied with.

The Torquay Bay Water Bill was read a second time, and committed.

London Sewage.—A petition from Plumstead, for leave to bring in a London Sewage Bill, was presented.

Resolutions to withdraw their petitions against the following Bills were communicated to the table by their petitioners:—Bill 7; Leicester Gas, from the Corporation of that town; Bill 8; Leicester Gas, from the Leicester and North-Western Railway Company; Bill 9; Preston Corporation, from the Midland Railway Company; and Wombwell Local Board, from the Midland Railway Company, Incorporated, and Wombwell Local Board, from the Wombwell Local Board; West Kent Main Sewerage, from the Dartford Rural Sanitary Authority.

TUESDAY, MAY 5.

Llandudno Improvement Bill,—read the third time and passed, with amendments.

Houghton-le-Spring District Gas Bill,—as amended, considered; to be read the third time.

Bills read a second time, and committed.—Blackpool Extension and Improvement, Leicester Corporation, Newcastle-upon-Tyne and Gateshead Gas.

Resolutions to withdraw their petitions against the following Bills were communicated to the table:—Bill 10; Leicester Gas, from the Leicester and North-Western Railway Company; Bill 11; Preston Corporation, from the Preston Improvement Commissioners; Bill 12; Wombwell Local Board, from the Wombwell Local Board.

Petitions against the following Bills were referred to a Select Committee:—Bill 13; Wombwell Local Board, from Elsecar, Wentworth, and Hoyland Gas Company.

Petition against Bill 14; Walton-le-Dale Local Board, from the Corporation of Preston, except as against clause 6.

Petitions against the following Bills were referred to the Examiner:—Bill 15; Taylor's Gas, Alliance and Dublin Consumers Gas, and Lots-worth Gas, from the Portsmouth Corporation Water Bill, Mr. H. Jenkins, and Mr. Hawksley to meet on Tuesday, May 12.

WEDNESDAY, MAY 6.

Resolutions to withdraw their petitions against the following Bills were presented:—West Kent Main Sewerage, from the Rural Sanitary Authority of Dartford; Local Board, from Elsecar, Wentworth, and Hoyland Gas Company.

Preston Gas Bill.—The Issue stated of the following petitioners against the Bill was disallowed:—Of Walton-le-Dale Local Board; Of Corporation of Preston, except as against clause 6.

THURSDAY, MAY 8.

Gas and Water Provisional Orders Confirmation Bill,—read a second time, and committed.

Resolutions to withdraw their petitions against the Nottingham Corporation Bill were presented from—By Thomas Allwood Mann, Of Thomas Lowe and others.

FRIDAY, MAY 9.

Colchester Water Bill.—The Standing Orders Committee reported "That in the case of the Colchester Water Bill, petitions for additional powers to the Bill, the Orders ought to be dispensed with, and that the petitioners be permitted to prosecute their additional powers, if the Committee on the Bill think fit."

Hoyland Gas Bill.—Bill read the third time, and passed.

Houghton-le-Spring District Gas Bill.—read the third time, and passed.

Wenlock and Wellington Water Bill.—as amended, considered; to be read the third time.

Tay and Forth Navigation Bill.—The Examiners reported that the Standing Orders had been complied with in the case of the petition for additional powers to the Bill.

Standing Orders Committee.—Sir Edward Colebrooke discharged from the Committee, and Mr. Arthur Peel appointed in his room.

Bills read a second time, and committed.—Aire and Calder Navigation, Dearne and Dove Canal, Warrington Corporation, Wearside District, Tay Association, Hereford Gas, Warrington Corporation, Wearside and Hebburn District Water.

Petition was presented from Henry Rose Dixon himself and the Rev. Edward Penrose Hethersall, Jun. Rector of Rumbold Light and Water Bill.

Mr. Newdegate presented a petition against the Bill, praying that the Bill may not be passed until the Report of the Select Committee on the Law of Property and Conveyance of the Ecclesiastical Commissioners, and a resolution for abolishing their public patronage have been considered.

A petition for and against the Bill was presented from the Rev. Thomas Carr and others.

Newcastle-upon-Tyne.

LONDON GASLIGHT COMPANY BILL.

On the motion of Mr. CHARLES FORSTER, the order that this Bill be committed was read and discharged, and the Bill withdrawn.

THE METROPOLITAN AS REGARDS ILLUMINATION BY ELECTRICITY.

(Continued from page 1.)

A Select Committee, consisting of Mr. Tollemache, Mr. Hardcastle, Sir Thomas Bateson, Mr. Adam, Mr. Alderman Sir Robert Carden, Mr. Ayrton, Mr. Hanbury, Mr. Mayhew, Lord Elcho, Mr. Arthur Peel, Mr. Torrens, Mr. Tollemache, Mr. Spencer Walpole, and Mr. Whitbread, was appointed by the CHAIRMAN.

Mr. Colonel Wilkins, Clerk, attended.

I am a Civil and Consulting Engineer, a Member of the Society of Telegraph Engineers, and of the Physical Society of London. I was the first to receive the Gramme machine in England. It was brought over in 1873 by Mr. Werdermann, the machine that was used in the shock brought in 1851 I designed the machine that was used in the shock brought in 1851 I designed the machine that was used in the shock brought in the Houses of Commons. The special difficulty in connection with that was getting the light to bring a signal light to show that the shock was sufficient to do the work. I designed the light that was used to Members outside the House. I designed the lamps which were used in the Committee of Works made in the Houses was very and the Prince Consort's Committee of Works made in the Houses was very and the Prince Consort's Committee of Works made in the Houses was very and the Prince Consort's

still more in favour of the electric luminary, no further addition to the working staff being necessary.

By Lord LINDSAY: It appears desirable, for a complete coast light and fog signal establishment, that the highest possible intensity of the light be available for covering the sea between the two-mile sound range and the geographical light range (which averages about 17 miles), whenever this is possible. From experiments made by Professor Faraday for the Trinity House in 1836, relative to the penetrative power of light through such obstructions as fog, mist, &c., and from the experiments since made by the French lighthouse authorities and the Trinity House with oil and electric lights, I conclude that, with the atmosphere so impaired for transmission of light, the oil luminary, at its maximum intensity, would be fairly visible at the fog signal sound range of 2 miles. The electric luminary, at double the Lizard intensity, would be visible at about 4 miles. Further, on more frequent occasions, when the oil luminary would be visible at about 8½ miles (half the geographical range), the electric light would be visible at its full range of 17 miles. Although the results to be obtained by increased intensity during impaired states of the atmosphere for the transmission of light appear feeble when compared with the power expended, yet so much can be accomplished by the electric light, in consequence of the enormous intensity available, combined with perfect focal compactness, that it will doubtless, in the cause of humanity, and in the progress of civilization and commerce, be considerably adopted.

Mr. *Thomas Stevenson*, F.R.S.E., F.G.S., M.Inst.C.E., the Engineer to the Board of Northern Lights, also gave evidence in respect to the application of electricity for lighthouse illumination. After describing the different forms of lenses in use, and the manner in which they are tested, he said the result was that as regarded power, the common plano-convex lens proved, as was expected, the most brilliant; the differential was somewhat less powerful, but the double lens was not only very much [illegible]r in power, but the distinguishing peculiarity of the electric flash [illegible]r lost as to assimilate it in a great degree to the oil lights. The [illegible]tive powers of the instruments, as shown by the liquid photometer, [illegible]llows:—The plano-convex lens, with ordinary lenticular divergence, [illegible]g equal to 1·00; the differential lens, with 2½° artificial divergence [illegible] and ordinary divergence in the vertical plane, being equal to [illegible] the double lens, with 6° of artificial divergence in the horizontal [illegible] the vertical plane, being equal to 0·75. These results seem to [illegible] the highly distinctive flash of the electric light, when acted on [illegible] apparatus, is due simply to the more complete parallelism of the [illegible] when it is assimilated, as regards divergence, to the oil light, the [illegible]educed very nearly to an equality.

[illegible]NCER-STANHOPE: Is the result that, in your opinion, the pene[illegible] an oil lamp is greater, in proportion to its light, than that of [illegible]ic lamp?

[illegible]: I am not prepared to say so, but I think it is quite possible.

[illegible] there is no doubt that by altering the divergence in azimuth [illegible] altitude, you reduce the electric light very much in power, and [illegible]ilate it to the appearance of an oil flame. [illegible] that is so, would it not contradict what the last witness led us to [illegible]pose—viz., that it was an advantage that the electric light was con[illegible]trated to a small point, instead of occupying that large focal width [illegible]h the oil or gas lamp occupies?—That is quite my opinion, that the more condensed it is, the better for the intensity; but if that intensity is reduced by altering its divergence in altitude and azimuth, it seems to melt away, and becomes very much like the oil light; and the subdivision of the light into several different lights, I suppose, would produce the same effect.

Mr. *William Henry Preece*, examined by the CHAIRMAN.

I am Electrician to the General Post Office, and have devoted much attention to the progress of electric lighting, as well as to other branches of electricity. In the Post Office the question of the application of the electric light is a serious one from two points of view—firstly, from an economical point of view; and, secondly, from a hygienic point of view. In the Post Office we pay about £7000 a year for gas, and any means that would enable us to economize that would be of great importance. Again, in our large telegraphic galleries we have at times as many as 1000 people; and during the night, which is now really our busiest time, owing to the enormous amount of work done for the press, we vitiate 5 million cubic feet of air every hour. Of those 5 millions, 1 million are vitiated by the operators, and the other 4 millions are vitiated by the gas; so that it is a matter of very great importance to us to remove, if we possibly can, those 4 million cubic feet of vitiated air. With that view, I have examined the systems of electric lighting both in Paris and in London, and seen, as far as I have been able, everything that is to be seen. There are three criteria that I have laid down which should be attained for the illumination of such rooms as the great telegraph-rooms of the Post Office. The first criterion is that any electric light shall possess a brilliancy of at least 1000 candles. The structure of our galleries is such that six such lights would enable us to light them up as efficiently as they are lighted now. The second criterion is that the light shall be absolutely steady; for, in carrying out the work of telegraphy, reading dots and dashes on very thin strips of paper, it is essential that the eyes shall not be wearied by unsteadiness. And the third criterion is that the light shall last all night without attention, and our nights sometimes in winter extend to at least 18 hours. I have not yet found any electric lamp that combines those three conditions. The difficulties do not consist in the production of the electric currents; for, so far as that is concerned, I think in the dynamo machines of the present day we have reached almost perfection. Siemens's machine reproduces in the form of electric current 90 per cent. of the mechanical energy thrown into it; and this is as near perfection as any machine has ever attained. Gramme's machine approaches it very closely; and, therefore, as far as the production of currents is concerned, there is nothing wanting. But, as regards lamps, while the Serrin lamp, for instance, gives brilliancy, it does not give durability. Those I have seen do not last more than about four hours. The Wallace-Farmer light lasts for a week, but it does not give steadiness. The Werdermann light is remarkably steady, perhaps the steadiest there is; but its brilliancy is very small. So that whilst there are lamps that meet separately each of the three points, there is no lamp that meets them all collectively. We are, therefore, pausing until we find that the lamps are sufficiently improved to overcome the practical difficulties we experience. I have both considered and made experiments upon the subdivision of the electric current for the production of various lights, and have examined the questions theoretically from a mathematical point of view, and also experimentally. I published a paper upon the subject in the January number of the *Philosophical Magazine*. In that paper I showed that when lamps are joined up in series, the intensity of light in each lamp diminishes with the square of the number inserted; and when they are joined up in a parallel arc, the intensity of the light diminishes as the cube of the number, showing, that when you attempt to subdivide the light beyond two or three, the intensity of the light diminishes in a marvellous ratio. In my view, the electric light is only economical when one machine is used to produce a single light. Any departure from that means waste economically speaking. I do not think that the electric light is at all applicable for street lighting; and for this reason, that if you have a long street with an electric light, you may have it in the middle; but we will say, for the sake of argument, that you have it at one end, and you have that light sufficiently powerful to light efficiently the extreme end. Then at the near end you must have an enormous waste of light; because, as the light diminishes with the square of the distance, the amount at the one end of the street, to give light at the other end, must be largely in excess of the requirements at the near end. From that point of view, I am at the present moment occupied in preparing, for the *Philosophical Magazine*, another paper on the subject, in which I bring out such an extraordinary result that I am not inclined to believe it is true; but the result is this—that you can light a street of 1000 feet with 40 lamps of 15 candles power better than if you use one single electric light of 6000-candle power, showing that the ordinary gas-lamps of 15-candle power are better adapted for street lighting than a single electric light. But supposing that you have symmetrical spaces like squares, the electric light comes out right. For such a place, for instance, as the Albert Hall, for spheres, for square spaces, one single centralized light is the same in effect as a largely distributed light; and practically, for economical purposes, it is better.

The CHAIRMAN: The point that I am specially anxious to examine you about is whether there is any danger to be apprehended in regard to the telegraphic wires of the Post Office from a general use of wires to convey the electric light.

Witness: Of course, it is a point to which we at the Post Office have paid a great deal of attention; and as soon as we found that so many corporations were applying to Parliament for power to lay down wires in streets, I at once proceeded to investigate the question, to see how far the presence of wires conveying currents for lighting would interfere with our working currents. In the first place, it was necessary to find what was the relative strength or power of those different currents used; and, by very careful measurements, I find that the strength of the currents used to produce the electric light is just 3000 times as great as the strength of those used to work our telegraphic apparatus. In fact, ours are very weak currents. I took advantage of the wires that are carried through the subway along the Embankment, and I obtained permission of the Metropolitan Board of Works to make some experiments. I took into the subway lengths of wires of the various kinds we use for telegraphic purposes—gutta-percha wire, and iron wire, and pieces of submarine cable. I lashed those different wires alongside the lighting wires, and watched their effects with telephones. A telephone is perhaps one of the most delicate instruments of research that we have for showing the presence of induced currents. In fact, the telephone has shown us an extent of induced currents in our wires that we never knew of before, and, by comparing the effect of working currents on telephones in our ordinary working circuits with the effect produced on the Embankment, I was able to estimate relatively the effect on our currents of the current for lighting. We placed those wires for a distance of 50 yards along the Embankment. Those wires on the Embankment run in pairs, the top wire carrying the currents in one direction, and the lower wire carrying the currents in the reverse direction. The telephone wire was a single wire laid alongside it. At first I thought that where we had two wires close to each other, and the currents in those two wires were coming in reverse directions, the effect of the one would be to neutralize that of the other; but we had a very powerful effect, indeed, as far as 6 feet from the lighting wire. The return wire was not in contact with the other. The wires were parallel. I was not quite satisfied with the result of the trial on the Embankment, and I tried a large number of experiments; but in every case I found that the effect was very large. In order to satisfy myself that the effect was as great as the experiments showed, I then had some special wires carried, worked by an ordinary Gramme machine, connected with a Serrin lamp, and there, at a distance of 10 feet from the lighting wire, the effects upon the telephone were considerably greater than those we get in our working circuits; giving indisputable evidence that the influence of lighting currents upon our working currents is very great indeed, so great that we should not be justified in consenting to our working wires being within 6 feet of any wires carrying lighting currents.

Then your opinion is that any wires conveying illuminating currents ought to be at least 6 feet from the wires carrying on the telegraphy of the country?—Most certainly, if they are going in the same direction. Of course, that does not imply that if they cross or go near one another for a short distance, under proper regulation, they might not be allowed; but if they go for a quarter of a mile, or half a mile, they certainly ought to be kept 6 feet off the telegraph wires.

Have you seen the evidence of Mr. Cooke, who said that if you used a return wire, and connected that with the wire which was carrying the electricity in the opposition direction, you could easily compensate, and prevent any induction?—That is so; a return wire would check induction, but a return wire to every telegraphic circuit in this country is rather a serious matter.

Not for the telegraphic circuit, for the electric light circuit?—My first experiments showed that that is not so.

There is a claim that in America they have overcome the difficulties of induction by burying the wires in paraffin, and then covering them with a tin case in which mineral oil is on the outside. Do you know whether any such system of isolation is likely to prevent induced currents?—I have not heard of those particular experiments, but I should doubt it very much. I have tried every possible and conceivable arrangement of wires to cure this induction, and at the present moment I have not succeeded. Many people assert, and I thought that if we had two iron pipes lying alongside each other, the iron of the pipes would form a screen, and would prevent the induction between wire and wire. It fortunately happened that in Aldersgate Street we had three lines of pipes running side by side, and I was able to throw out of work the wires in one pipe, and to experiment with those wires, comparing them with the working wires; but the iron seemed to have no influence whatever—the induction was just as strong without the iron as with the iron; the induction in the telephone circuit was, however, very much reduced, and practically cured, by the use of a return wire.

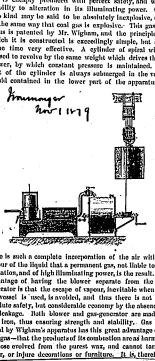
Lord LINDSAY: You said one of your conditions of a satisfactory lamp was that it should have a light equivalent to 1000 candles. Is not that a very small value to ask for an electric light?

Witness: It is, and it was specially placed low through the fact that the lamps that existed did not comply with the other conditions, and I had hopes that if we had the other conditions complied with, there would not be much difficulty in improving the brilliancy.

As to the question of steadiness, I think that there has been within the last two years a distinct advance in the steadiness of the light, has there not?—Decidedly; and there are very strong hopes that with the experiments that are now being made in the direction of incandescence, we may ultimately succeed in getting a lamp that shall be absolutely steady. For instance, at the Royal Institution, Professor Tyndall showed a piece of iridium wire raised to incandescence, which fulfilled all the conditions: it was over 1000 candles illuminating power, it was absolutely steady, and it would last for weeks; but iridium is extremely scarce, and the light very expensive, because all machines made to procure light by incan-

WIGHAM'S PATENT ATMOSPHERIC GAS-MACHINE.

THE merits of air gas for illuminating purposes are well known. Gas of this kind is, indeed, no novelty—it is nearly as old as the century in which we are living. We show, however, a diagram of a new apparatus by which carbonetted air is cheaply produced with perfect safety, and without liability to alteration in its illuminating power. Gas of this kind may be said to be absolutely inexplosive, except in the same way that coal gas is explosive. This gas apparatus is patented by Mr. Wigham, and the principle upon which it is constructed is exceedingly simple, but at the same time very effective. A cylinder of spirit wires is caused to revolve by the same weight which drives the air-blower, by which constant pressure is maintained. One part of the cylinder is always submerged in the volatile liquid contained in the lower part of the apparatus, and



there is such a complete incorporation of the air with the vapour of the liquid that a permanent gas, not liable to condensation, and of high illuminating power, is the result. The advantages of having the blower separate from the gas-generator is that the escape of vapour, inevitable when but one vessel is used, is avoided, and thus there is not only absolute safety, but considerable economy by the absence of this leakage. Both blower and gas-generator are made of cast iron, thus ensuring strength and stability. Gas produced by Wigham's apparatus has this great advantage over coal gas—that the production of its combustion area harmless as those evolved from the purest wax, and cannot tarnish silver, or injure decorations or furniture. It is, therefore, peculiarly suited for the illumination of private residences. J. Wimshurst & Co., of 19 Great George Street, Westminster, are the sole manufacturers of the Wigham apparatus.

such distinct, and having values to regulate the coal and cash for gas, for which purpose our engineers have furnished us with some excellent valves. Many attempts have been made to do away with or supersede the hydraulic main, and to employ clever and ingenious contrivances instead, either partially or wholly self-acting or otherwise—for either. Mainly as to have made meeting the seal from the dip pipes.

Many of these have failed from the advisability of forsaking old tools; but none so reliable, which, when properly working are old friend the hydraulic, which, when properly working are old friend the hydraulic, and it seems to me that [illegible] is, after all, the nearest line to one to given, when we do just reason for its retention. Its risk, expense, and trouble connected with the risk, expense, and trouble connected with the dip pipes. In hydraulic mains we have various plans for regulating the seal of dip pipes, and four of the best known of these are, I may mention among them Wilson's patent, with his contracted and movable tar chamber, its division between each dip pipe, and its most ingenious but very complicated self-acting "anti-dip reliever."

GAS CONDENSERS.

And now, passing on to the condensing apparatus, which in the early days of gas making, and even at present, was a very simple yet effective affair, the gas, passing through a series of perpendicular pipes, was cooled, and dropped the cooler matter on it reached the next stage; and I may say when this condenser is constructed so that the gas can be changed so as to leave the entrance and exit from either end, a great amount of cleaning is thereby saved, as the gas when at a certain temperature will keep the pipes clean. Now we have the condenser in many forms, horizontal or vertical. The vertical is not also a very efficient plan, in the wall condenser, which, in many instances, is carried all round the walls of the works, thus saving space, which in most works is not overplentiful. We have also the perpendicular pipe condenser, with the internal air pipe, which gives a large cooling surface to this class of gas. The box condenser, with its contents consisting a current of air through them, the gas to be cooled passing in both in the form of a screw, so that the figures formed by the gas and air currents are like with the current of gas through the sandwich of the cell, and in many cases a flow of liquor is kept up—generally water, these pipes, in some cases with the flow of gas, and in others against it. This seems to be a desideratum of condensation—either to let in the air or water with the gas, or the gas with some cases underground, with a view to carry the condensed liquors as far as possible with the flow of gas, and thereby to let in its purification, by taking from the gas further impurities. One gas engineer has applied the principle of the screw condenser to the ordinary condenser. It does its work most effectively. We have, however, four valves of a small size to the gas leaves the hydraulic main, especially from its liquor, or they will, and the flow of gas is perfect, giving and the tar and liquor at the risk of improved cleaning the gas, and thus be a fair field for the Jeffrey & Young process, in converting the crude liquor into rich vapor to be picked up, and excited the gas for light, which I should have been sent out of it. And while here we are leaving we have at the same time made progress.

WASHERS AND SCRUBBERS.

And now we have washers and scrubbers, such as there were in the early days of gas lighting. These two processes are very alike, and of the present day are combined and included in the best of works. The old form of washer, which can remember was a vessel with a mixed chamber and one, having its cover studded with rows of small inch, through which the gas passed, washing the water, and forcing it forward to the mixed chamber, [illegible] and passing through a succession of cells and flows. The scrubber was a washer, pure and simple, which I thought had long since had its day, but as it undoubtedly took precedence of the washer, I again revived, and being added to a "patent scrubber" of the early days, consisting of wooden frames filled with boards, bricks, coke, and wooden shelves were used, but only to a small extent. We now have many forms of apparatus for washing the gas—the gigantic lower scrubbers, filled with thousands of feet of coke, with the liquor constantly flowing over for distributing the liquor over the wide-extending material, [illegible] and displacing large surface for the easy passage of their means of gas. Other scrubbers, I might mention, Bills which are on which form we see, if we can get it to do it work [illegible] by dividing gas into minute streams, and [illegible] the particles of it may come in contact with the scrubbing material, thus washing it of its impurities, and in a certain form, will become a most unmodified liquor. Already we have taken strides in this direction, and have a patent scrubbing machine, guaranteed to work with a pressure of 1 inch, and consists of small discs, with arrangements of perforated iron plates, either washed by a shower of liquor or dipping on a shaft, and which will be so simply constructed that every gas engineer will be able to work out any increase of his present capacity.

GAS PURIFICATION.

Then we come to purifiers, when we get rid of the bulk of our impurities—subjoined liquors, and [illegible] and [illegible] with the gas, which, when [illegible] to small degree, [illegible] no doubt, by the necessity to the [illegible] the removal of the ammoniacal compounds, more especially to our lower manufacture, we have had to devote our attention to the [illegible] and improvements following in quick succession, and [illegible] have proved [illegible] to [illegible], and it is here, however, that we have [illegible] in the matter of purifiers we have another question. [illegible] purifiers by their [illegible] changes in their [illegible], so as to utilize the purifying material, also position and [illegible] may be effected. The first arrangement of purifiers we have in use is that by placing a quantity of lime in two with [illegible] the gas in such a manner as to [illegible] thoroughly, we have had a [illegible] enough, but gave us the idea for our first purifier, the first one ever, which is the most effectual one, however, for the removal of the carbonic acid and sulphuretted hydrogen, but [illegible] the ammoniacal compounds, and the moist gases required to [illegible] the [illegible] considerable, that now this form of purifier is of rare occurrence. Then we come to the dry lime process, which is now generally used, and the purifiers for same, and [illegible] for lifting and [illegible] which otherwise would be a work of no small difficulty, and valves with which we can control the gas and arrest its progress [illegible] and [illegible] alone we have many beautiful [illegible] valves, [illegible] purifier, as far as apparatus is concerned, we may [illegible] that we have [illegible] remember when purifiers were used without valves and covered continuously—the first, always first, and the last always last—consequently [illegible] the [illegible] was stopped when they were being cleaned and filled with fresh lime. When we look back and see the former means of changing the passage of the gas to and from the various purifiers, and [illegible] of from those vessels by means of the series of side valves attached to the pipes—a costly, intricate, and dangerous plan—and the now simple method by means of the hydraulic valve first, of the many forms of fixed valves now in use, we cannot help noticing progress great indeed.

[illegible] the years oxide of iron has become very generally adopted for the purification of gas, even more so in England than in this country, but that [illegible] to that of [illegible] for effectiveness, or I question if in many cases it is on the score of economy. In [illegible] we have various [illegible] where the color from spent lime is found so objectionable, as to [illegible] the manufacturer to adopt oxide of iron, as here the carbonic acid where the oxide is used, and this lime, when spent, has very little smell, if any. Another great advantage in the use of oxide is that it can be used over and over again, until the sulphur forms nearly 50 per cent. of the mass, and then it can be treated by the chemist, who extracts the sulphur for commercial use. Patents have been secured, and in some works adopted, whereby the oxide is revivified without removal from the purifiers. Where this is done a great saving is effected, otherwise the labor account incurred in working for extinction is considerable. We are promised yet another advance in the purification system, and that in the revivifying of the oxide, and I may say that a gentleman who has either seen the process or practically tried it, [illegible] for satisfactorily [illegible] the [illegible] is now in several works, giving promise of success, and I may say that [illegible] to-day from seeing [illegible] a gentleman who has either seen the process or practically tried it, [illegible] for satisfactorily [illegible] the [illegible] is now in several works, giving promise of success, and I not stop here, for it has been sold by chemists and eminent engineers, and [illegible] to [illegible] the [illegible] can be conducted in closed vessels, and already we have made, in the old of progress, but profit.

SUBSTANCES FOR REMOVING IMPURITIES.

We have the exhauster and governor, neither of which was in use in the early days. Both are now indispensable in every well-arranged work, and I feel that the latter should be found wanting, unless, as in some cases, the use of different governors for different [illegible] for satisfactorily [illegible] the [illegible] and very clever and serviceable forms of apparatus for controlling the pressure of gas, and [illegible] the [illegible] have drawn from the field of labor, yet the governor, in its various forms, has done much to [illegible] the [illegible] in reducing the pressure to an even standard, and equalize the same at other times, thereby enhancing the value of the gas to the consumer, and [illegible] more and more to the testimony and wisdom is now to consume gas at very [illegible] pressure can only be regarded as [illegible] large mains and services, accompanied with a like increase on internal fittings of all kinds.

GASHOLDERS.

And, gentlemen, when we come to the gasholder we can certainly make progress, for the gasholder is at other times of the present day, and those in the early days, when the holder was considered a [illegible] and [illegible] the [illegible] among buildings for fear of accident, we, and even the outsiders, [illegible] to the advance we have made. And again, looking at the enormous holders now in use, capable of storing not thousands, but millions—and one holder which is being constructed capable of containing over 3,000,000 feet—this, gentlemen, is a great stride indeed, and shows the confidence of the manufacturer, to which it appears they is no limit, either in point of [illegible] or size.

It has been asked, and made a subject for a prize paper, "Is the gasholder a necessity?" and what has been the [illegible] elicited for them?" An attempt was made on paper to show how this could be done by the building of such large holders as are noted, shows that we are far from the realization of such a [illegible].

MAINS AND SERVICE PIPES.

Should the day come when we are called upon to supply 10 candle gas instead of 16 candle, as we do at present, we shall [illegible] be required in our plant, with larger mains and services. The [illegible] should induce us, as I already [illegible] to [illegible] the use of small services and [illegible], and, if possible, to [illegible] the [illegible] of [illegible] pipes, and [illegible] the [illegible] of [illegible] pipes, knowing that, to secure a good supply and proper consumption, we have [illegible] to do this cannot be large, or the pressure with our many improved burners too light. I myself do not think that, as far as [illegible] is concerned, it is [illegible] to [illegible] in illuminating power will be necessary, or be desired, but [illegible] increase in general use we need to have [illegible] than gas, and from this fact we would gather that our [illegible] of [illegible] gas engineering is to devise and adopt any and means that will enrich our present gas from our present make, and [illegible] any that our consumers use the same as at present [illegible] for its proper combustion, so as to get [illegible] of a given quantity of gas, and [illegible] of light [illegible] [illegible] any improvements in the various appliances, so that the [illegible] be [illegible] and [illegible] and [illegible] light secured from the [illegible] And I would [illegible] that at present they have anything [illegible] [illegible] [illegible]

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TO CORRESPONDENTS.

W. L. A. J. D. C. G. S.—*Thanks for letters received. See below.*
B. B.—*Not before us. Can you send it?*
S. C. T.—*Pamphlet received, and shall have attention.*

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, NOVEMBER 18, 1879.

Circular to Gas Companies.

We may commence the "Circular" to-day by correcting a statement made last week, when referring to the extraordinary meeting of the United Gaslight Company, recently held. We stated that the Companies Clauses Act, 1863, only allows four per cent. interest to be paid on debentures, overlooking the fact that the Amendment Act of 1869 removes this restriction, and enacts that—"Part III. of the Companies Clauses Act, 1863, shall be read and have effect as if the following words, that is to say, 'not exceeding the rate mentioned in the Special Act, and if no rate is prescribed then not exceeding the rate of four pounds per centum per annum,' had not been inserted in section 22 of that Act; and any Special Act of a Company passed before the passing of this Act prescribing any rate, shall be read and have effect as if no rate had been prescribed therein." *The rate of interest, therefore, is at the discretion of the Directors, unless a rate be prescribed in the Special Act.*

The daily papers of last Saturday contained the usual "Notice of parliamentary notices of measures to be submitted in next session of Parliament." The Bills [illegible] *that put forward by the Corporation of the City of London.* The co-operation of the Metropolitan Board was invited, but that body, at their meeting last Friday, *declined to join in the enterprise*, and we now do not know what will become of this projected Bill, the object of which is to alter and amend certain clauses in the Acts of The Gaslight and Coke, The Commercial, and the South Metropolitan Gas Companies. The alterations proposed to be made mainly relate to the fullness and pressure that may be incurred for defects in illuminating power, purity, and pressure; but there is, at the same time, notice given of an intention, if possible, to alter the illuminating power, of course in an upward direction. We do not think we need say more on this matter, for since the Metropolitan Board, who are alone concerned with the Commercial and South Metropolitan Companies, decline to join in promoting the Bill, it will probably be dropped. The Corporation of the City of London are interested in The Gaslight and Coke Company only, and they have accordingly, on their own account, given notice of a Bill to alter and amend certain clauses in the Company's Acts relating to testing and testing stations, and to make further and more effectual provision as to testing the purity, pressure, and illuminating power of the gas supplied within the City, also as to the position and number of the testing-places. It is, of course, desired to alter the present mode of measuring deficiencies and penalties, and to impose new ones. The notice also proposes to give further powers to the Gas Referees.

It has been known for some time that the Phœnix Company have it in their minds to erect extensive works not exactly in rivalry of those at Beckton, but still on a large scale, nearly opposite that station, on the Kentish side of the river. They gave notice of a Bill to acquire for the further purpose eighty-six acres of land on which to erect manufacturing and storage works, and for the conversion of residual products. The Bill will further be to empower the Company to raise additional capital. The Company will necessarily go in for the Beckton trade, and, we presume, nothing else. It is further desired to manufacture and supply apparatus for the use of gas for other than illuminating purposes, and to supply ordinary gas-fittings. Other powers of amalgamation with all Companies within the Metropolitan district are also desired. This is significant, and makes us hope that before many years are over a general amalgamation may take place.

Seeing that there is, as our readers have already been informed, a scheme before the Board of Trade for the amalgamation of the Phœnix with the South Metropolitan Company, and in the event of its being confirmed, this measure will be proceeded with by the United Company.

Perhaps, under the circumstances, it was necessary for the South Metropolitan Company to give a "Circular" to the above. Accordingly, we find this Company announcing their intention of applying the same bonds as will be scheduled by the Phœnix Company, and for the same purposes. New capital will be asked for in the Bill, and this is to be raised by the creation of new stock, and by borrowing on mortgages or bonds. As a matter of course, the standard illuminating power of the gas to be supplied by the United Company will be brought up to that of the South Metropolitan Company; but it is only fair to say that the Phœnix Company, though legally bound to supply only twelve-candle gas, have for years past supplied gas equal, or nearly equal in power and purity to that furnished by the South Metropolitan Company.

We look for the happiest results from the combination of the Southern Companies which is foreshadowed in these notices, and in the scheme now before the Board of Trade. As consumers in the Phœnix district must in any case be considerably benefited, and have reason to be more than well satisfied, enjoy a long course of prosperity.

The London Gas Company give notice of a Bill very similar to that which they promoted but withdrew last session, to give them power to supply gas-fittings, gas-stoves, and other appliances for lighting, warming, ventilating, cooking, and purposes in lighting, and for other purposes. We hope the Company will succeed in obtaining the powers they desire, which cannot but be equally beneficial to them and to their consumers.

From the abstracts, in another column, of the Gas Acts passed last session to confer further powers upon Companies already incorporated, it will be seen that gas legislation, as we have already said, has taken an almost surprised turn. The peculiar features of the Alliance and Dublin Companies' Act is the power to supply in bulk different qualities of gas for any purpose. We can hardly guess what the Company intend to do. To supply gas of different qualities for special purposes would involve [illegible] establishment of plant, and we do not know that the Co-

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TO CORRESPONDENTS.

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THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, DECEMBER 7, 1869.

Circular to Gas Companies.

THE Corporation of the City of London are just now much exercised as to the question of the alleged abnormal consumption of gas, and require to know why the gas bills of the Corporation should be so much higher than they were for corresponding periods of previous years. It is a fact belief in the minds of some members of the Court of Common Council, that the Gas Companies have in their power to force gas through pipes and meters, and thereby exaggerate the registration. Mr. G. C. Haweis curiously enough, brought been for the past year under the consideration of the Corporation of Dublin. Our neighbours at Guildhall may pick up the question exactly where it was left in Dublin. They have two officers who can set them perfectly straight on the matter. For example, they have the very able Chief Gas Examiner, Mr. C. Heisch, F.C.S., the gentleman who was consulted by the Corporation of Dublin, and who is as practically versed in chemistry as in physics; and they also have Mr. Sylvern, perhaps the most experienced man in the Metropolis for the examination of meters. The first-named gentleman's difficulty is to get enough, rather than too much pressure; and that it is only when pressure is very excessive that there is any need to prevent it, and then it can always be controlled by means of the finger-tap or a governor—an instrument, which should be placed in every establishment where the consumption of gas is large. Thus, if consumers will only take a very small amount of trouble, and go to a little expense, they may easily save themselves from over-pressure. Besides, it surely ought by this time to be a well-known fact, that what we had occasion a few weeks back to call an overdriven meter, always registers slow, to the advantage of the consumer and the disadvantage of the Company.

We are not surprised that a delusion on the point we have just mentioned should prevail in the gas consumer's mind—that if extra pressure be put behind the instrument, the gas must necessarily go faster; but this does not apply to gasmeters, in which the alternations of water-level form such an important item in the measurement. For example, the difference in registration of a meter with a pressure of five-tenths of an inch or three inches is exceedingly small, but that different results to cause the meter to go slow—that is, to register against the Company, and to the advantage of the consumer. All this will be made perfectly clear to the Court of Common Council of the City of London by their officers, and in the long run the gas-consuming public will be gratified by the reports of these gentlemen.

A year ago, as we have said before, a question of precisely a similar character was brought under the notice of the Gas Committee of the Corporation of Dublin, and a report has been furnished by the experts and officers employed. The secret of the increased gas consumption is to be found, it is said, in increased pressure; but if that be the case, it is really the consumer's own fault, in not regulating it. The Corporation of Dublin have consulted a large number of gas authorities in all of the principal cities and boroughs of the Kingdom, and these gentlemen substantially agree as to the cause of the apparent abnormal increase in the consumption of gas. The simple explanation is that the days have been short and dark, and consequently more light has been required. The Dublin Corporation do not seem to be satisfied with the information they have received from the experts—they have so far consulted, and secondly they desire one further reference—that a person well skilled in the matter should be consulted, not simply for the satisfaction of the citizens of Dublin, but for guiding the Corporation in regard to their future dealings with the various companies, when the "skilled" person has made his report, we shall no doubt learn much as to the so-called vagaries of meter registration, and the causes of excessive consumption. When the Gas Committee of the Corporation of the City of London, last year on this subject, first came over the present session, we shall also, no doubt, find that the conclusions they have come to will substantially the same as those at which the Dublin Corporation have arrived—viz., that if the consumers would only take the trouble to regulate the flames by means of the finger-screw, and at the same time use proper regulating appliances, there would be no cry of increased gas bills.

We have now before us all the parliamentary notices of the Bills to be brought forward in the coming session. It will be seen, as we go along, that some are duplicate measures. But as the numbers now stand, there are only in all twenty-nine applications for authority to incorporate Companies without statutory powers. We never remember, in any session of late years, so small a number of notices for special Acts of Incorporation; nor, we observe, the paucity of the number of Bills made up by applications for Provisional Orders. It may be a very general impression is abroad that the next will be but a short session, and that it would be a waste of money to promote measures which would never be considered; but there are some who cannot wait. Incorporated Companies are often in urgent need of further powers and additional capital: this we have fifteen Companies in this category. We have previously noted the numerous proposals by three of the large Metropolitan Companies, and the most important remaining are the Liverpool United Gas Company, who, as we read the notice, do not in this case seek power to raise additional capital, but only go in for increased borrowing powers. The British Gaslight Company, London, have given notice of a Bill to raise more money for their Stratford-shire Potteries station. The Malvern Gas Company give notice of a very comprehensive measure, which is to grant them power to enlarge their works, extend their limits, supply gas in bulk, and manufacture and sell gas-stoves and lighting engines, &c. The Wandsworth and Putney Gas Company, give notice of a Bill to sanction further loans for amalgamation purposes, and to raise additional capital. That well-managed undertaking, the Reading Gas Company, now require to increase their borrowing powers. The Company give notice of a Bill to enable them to acquire land upon which to extend their works, and for that purpose to raise further money. Reading is one of the most progressive of inland capitals, but little depends on manufactures.

TUESDAY, DECEMBER 14, 1869.

Circular to Gas Companies.

ONE is a very general impression among tourists who never get beyond the leading boroughtowns, that Paris is a illantly lighted city, and so, it must be confessed, certain tions of it are. The Boulevards, the Rue de la Paix, and public places in general, are much more brilliantly illuminated than anything we have to show in London. The ce de la Concorde shames our Trafalgar Square, while the anse d'Enfumement, even with the electric light, pales ore disgraced to the Champs Elysées. And yet it is not mere gas is better in Paris than in London. As a ter of fact, it is much poorer; but then it is dressed to ge competition. The Municipality employ its wealth, ority, and consequently low prices; and the Municipality ing these powers, you may actually have a visible illumination of the public establishments open much later than we are.

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TO CORRESPONDENTS.

P. ST. JOHN PATENT GAS PURIFIER.—*Some of the earlier copies of last week's* JOURNAL *were printed before it was noticed that the numbers on page 836 had been inadvertently duplicated. The mistake would not cause any confusion, the lettering being the same in both pages, but it is to be regretted, and that Fig. 3 was the duplicate, and Fig. 4 the plan of the apparatus.*

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THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, DECEMBER 16, 1869.

Circular to Gas Companies.

THE Corporation of the City of London are just now much exercised as to the question of the alleged abnormal consumption of gas, and require to know why the gas bills of the Corporation should be so much higher than they were for corresponding periods of previous years. It is a fact belief in the minds of some members of the Court of Common Council, that the Gas Companies have in their power to force gas through pipes and meters, and thereby exaggerate the registration. Mr. G. C. Haweis curiously enough, brought been for the past year under the consideration of the Corporation of Dublin. Our neighbours at Guildhall may pick up the question exactly where it was left in Dublin. They have two officers who can set them perfectly straight on the matter. For example, they have the very able Chief Gas Examiner, Mr. C. Heisch, F.C.S., the gentleman who was consulted by the Corporation of Dublin, and who is as practically versed in chemistry as in physics; and they also have Mr. Sylvern, perhaps the most experienced man in the Metropolis for the examination of meters. The first-named gentleman's difficulty is to get enough, rather than too much pressure; and that it is only when pressure is very excessive that there is any need to prevent it, and then it can always be controlled by means of the finger-tap or a governor—an instrument, which should be placed in every establishment where the consumption of gas is large. Thus, if consumers will only take a very small amount of trouble, and go to a little expense,

HELD AT PHILADELPHIA, PA., OCTOBER 15, 1870.

[Continued from page 204.]

Mr. Nettleton—I am not aware that there are any other committees to report. I have a communication to the President of the Association which I think if proper to read. It is from the Philadelphia Gas Trust, and is as follows:

Gentlemen:—We cordially extend to the American Gas Light Association an invitation to visit all the gas works in Philadelphia under the control of the Board of Trustees.

Very respectfully,

THOS. ROBIN, Registrar.

Mr. Cartwright—I move that the invitation be accepted at the convenience of the members, and that the thanks of the Association be tendered to the Secretary of the Franklin Institute for the invitation.

Carried.

Mr. Helme—It might be proper to say at this point that the Secretary of the Franklin Institute, before we convened here to-day, requested that I should extend to the members of the American Gas Light Association an invitation to attend their monthly meeting, which takes place in this room this evening, at 8 o'clock.

Mr. C. A. White—I move that the invitation be accepted at the convenience of the members, and that the thanks of the Association be tendered to the Secretary of the Franklin Institute for the invitation.

Carried.

Mr. Helme—I think the members will find the meeting here to be very interesting. The general order of business is first gone through with, and then various subjects, of a scientific nature and otherwise, are brought up, discussed, explained, and illustrated. I would state that at this time a year ago we were all interested and excited upon the subject of the electric light. We did not know exactly where we stood. Up to that time large gas meters had not been experimented with to any great extent. We all knowthat some experiments have been made in this direction upon the outskirts of the Atlantic, and some of the large burners that were used themselves found their way to this country, and I desire to say, for the information of the Association that there is a large Wigham burner which is operated on Westminster Bridge in competition with the electric light, and which was decided to be preferable to the electric light. It is put up at Cherry street, in this city, and will be burned this evening and next week for the gratification of such members of the Association as wish to let it. It is a 28-jet burner. That gives us the very highest light of 12 cubic feet per hour, and a power of 420 candles, camel gas. It is a thing to see, and in our tests we have only been able to pass about 25 ft., and it seems to give a candle power of about 250 or 275 candles. It is to be burned to-morrow evening and every succeeding evening until 12 o'clock, at the point I have named, and if any one wishes to go and see how a of these burners operates, he will have an opportunity to do so.

The President—Doubtless every member of the Association will accept that invitation. It is very desirable to learn all we can about the new

Mr. Helme—It merely serves to give us an idea of what may be accomplished in that direction. It is a large light, and certainly very much preferable to the electric light.

Mr. Neal—I move that we proceed to the election of officers.

REPORT OF COMMITTEE ON NOMINATION OF OFFICERS.

Mr. Wood—On behalf of the Committee on the Nomination of Officers, I beg leave to submit the following report:

The Committee recommend for President of the Association, W. H. Price, of Ohio.

For Vice-Presidents, Geo. A. Hickenbower, Ohio; John P. Harbison, Connecticut; Geo. A. Mellhenny, D. C.

For Secretary and Treasurer, Wm. H. White, New York.

For Finance Committee, John S. Chambers, N. J.; Theobald Forstall, N. J.; S. Slater, R. I.

For Executive Committee, Henry Cartwright, Pa.; F. C. Sherman, Conn.; C. Wood, N. Y.; Geo. S. Hookey, Ga.; James M. Starr, Ind.; P. T. Ill.

Respectfully submitted,

A. C. WOOD,
GEO. DUNBIT,
P. T. BURNS,
THEOBALD FORSTALL,
W. A. STEARNS,
Committee.

Mr. C. A. White—I move that the Secretary be authorized to cast the ballot of the Association for the gentlemen named by the Committee as officers for the ensuing year.

There being no objection, the Secretary was then proceeded to cast the ballot for the Association for the gentlemen named as officers for the ensuing year.

Major Prosser was appointed teller.

Mr. Wood—I trust that it is understood by the Association that General Boone and Mr. Nettleton both peremptorily decline re-election.

Major Prosser—Mr. President, the teller appointed to receive and count the votes of the Association for officers for the ensuing year, begs leave to report that he has examined the ballots, and has found the gentlemen whose names were presented by the Nominating Committee to be unanimously elected.

The President—I have been in very great doubt whether I ought to thank you for this election. I certainly do thank you, gentlemen of the Association, most heartily and sincerely for this evidence of your good will and esteem; but I feel very greatly inclined to go again into the ranks. I have reached an age when I have got beyond the petty ambition to occupy a conspicuous position. I would rather have had the opportunity to be at liberty to make motions and talk a little, than to be tied up as I am in this place. It may be, however, for the good of the Association that I am tied up in this way. I might talk too much, and make too many motions. Since, however, you have chosen me to occupy this position, I will endeavor to perform its duties to the best of my ability, and I desire once more to return my thanks for this expression of your preference. [Applause.]

PAPERS.

The President—The next thing in the order of business is the reading of papers.

Mr. C. A. White—As there are but a few minutes before the hour fixed for adjournment, I think it would be proper to take up the reading of papers at this time. If a paper is read now, and we take a recess until 2 o'clock, many things which might present themselves to our minds as the paper was being read, will have been forgotten during the intermission. It therefore seems to me to be proper to defer the reading of the papers until we assemble this afternoon. I think we had now better adjourn until 2 o'clock, unless there is something which requires our special attention.

Capt. White—Before that motion is put, I desire to say that I think the Association has overlooked one very important matter. The President and Secretary of this Association, who have served so so faithfully and acceptably for the past four or five years, now, of their own free will, retire from office. It seems to me, sir, that we should express our manners if we allow those gentlemen to step down from the positions which they have filled from year to year to our home and abode, without expressing to them our sincere and hearty thanks for the manner in which they have administered the duties, oftentimes onerous, of their several offices. I therefore move you, sir, that the thanks of this Association be tendered to the retiring officers—to our honored President, Gen. Charles Boome, and to our able and efficient Secretary, Mr. Charles Nettleton. [Applause.]

The President—I am sure that every member of the Association will respond most heartily to the motion that has just been made, and I am very glad that Capt. White has had the thoughtfulness to bring it to our attention. We certainly ought not to adjourn without expressing our high appreciation of the services rendered by the gentlemen who retire from office to-day. I am sure we will all of us gladly bear testimony to the high esteem with which we regard the honored gentleman who has filled the office of President, as well as to the efficient, zealous, and satisfactory manner in which the duties of Secretary and Treasurer have been discharged by the gentleman who now voluntarily retires from the office. I think that to him, perhaps, more than to any other man, is due in a large measure the success which has followed the organization of this Association. We have sometimes discussed our Secretary pretty freely—not in the way of criticism, but in the way of commanding upon the amount of compensation to which he was entitled for his services. A question has from time to time been raised in regard to the amount of his labors, but for my own part I do not think that the Association has ever really appreciated the amount of labor performed by our Secretary, and the obligations we are under to him for the very excellent position which we, as an association, occupy to-day. And while we all recognize and appreciate to the fullest extent the distinguished services which our President has rendered, I think we must all admit that to Mr. Nettleton, more than to any other man, is due the success which has attended our labors thus far. [Applause.] I am glad, gentlemen, that this expression of my sentiments meets with your approval. For my own part, I have never felt that the services of the Secretary have been very highly paid for; but in that I have had the misfortune to differ with

Proceedings of the Seventh Annual Meeting of the American Gas Light Association.

HELD AT PHILADELPHIA, PA., OCTOBER 16, 1879.

[Continued from page 276.]

SECOND DAY—AFTERNOON SESSION.

Mr. Wood (Syracuse)—I have had a little experience in the use of gas stoves, but I do not believe that the gas stove interests can be handled by individuals, but must be handled by gas companies. We arranged for the use of gas stoves, and give them to our consumers at cost price in our own men. We took particular pains, in the first place, to let the people in Syracuse know we had gas stoves by calling their attention to the fact. I invited a party of gentlemen to my office, and I brought a caterer there and had them a good, square meal. The scheme operated very successfully. We gave them a meal in courses—giving them broiled sand, broiled oysters, broiled steak, roast quarter of lamb, etc. We made gravy, and heated paper and washed the dishes four times. We set the table that number of times. As for the economy of them, I agree fully with the figures that Mr. Goodwin has given. I never tried any experiment to know what the cost would be in using coal and giving such a supper. The cost was $1.50 with gas at $2.50 per thousand. The fish and the meats were cooked extraordinarily well, and everybody was pleased with them. Among the party present that night I took particular pains that there should be the editor of our daily paper, as well as a Sunday morning paper. They gave us a very fine notice indeed and had notice in each paper. Contemporaneously with that I prepared an advertisement on the subject and put it in all the papers at once. I also printed it on the back of our gas bills, and sent them to our consumers, so that the people of Syracuse knew that we had gas stoves to sell.

I do not think there has been anything brought into our community that has attracted so much attention. The people are ready for it. I could not go into the street, and meet friends on business or socially, or even go to church on Sunday, without being asked about that gas stove; and even the minister, after hearing him preach a sermon, asked me about it. There is no trouble in introducing the stove to your consumers, and no trouble in selling the stoves if you bring them properly before the attention of the people. I have placed three stoves in the best houses in Syracuse, where they have large ranges of the most approved patterns, and the occupants of such houses have told me that they considered them the best article of furniture that was in use in the house, and the most convenient. Many of those people are using them through the winter.

As to the cost of running these stoves, I have not heard the first complaint from any one. We have prevented several bills, but no complaint has been brought to my attention in a single instance. I do not quite agree with Mr. Hinsley about the profits that gas companies are going to make by putting up these stoves. I think it costs just as much for his plant, and for every item which goes to make up the cost of making gas for cooking purposes as for lighting purposes. I think we include all the elements of cost in the manufacture of gas in making it for cooking purposes the same as we do in making it for lighting purposes. I do not know that I have anything more to say upon this subject. There is no trouble in introducing these stoves in my judgment, if you only let people know that you have got them. If you can once introduce them, of course it will make a very great increase in your consumption of gas. The first stoves we got some time in May or June.

The Secretary—How much has your consumption increased?

Mr. Wood—We cannot tell. Since the oil excitement has come on, some of our consumers have left us and bought oil stoves, and have been burning oil. But they have been coming back; the oil don't suit them very well. The consumption of gas in these stoves for that reason has been somewhat intermittent, and I am not able to tell what our consumption has been during the whole season.

Mr. Neal—I am informed by the Committee on Arrangements that the use of this hall has been given *free* to the *Association*. I would therefore offer a resolution that the Secretary be directed to express our appreciation of the kindness and generosity of the officers of the Franklin Institute in giving us the use of this hall *free of charge*, and that a vote of thanks be tendered to the officers of *the Institute for their courtesy*.

Carried.

Mr. Neal—I would like to state, on behalf of the Executive Committee, that since the recess of the Association I have received some application for membership. As I understand it, the business will be finished and the Association will adjourn at 7 o'clock to-day. It is therefore too late for the Executive Committee to take the proper action upon these requests for admission. I am sorry that they were not sent in before. I trust these applications will not fail to the ground, but that they will be presented at our next meeting. I merely state this in order that the gentlemen whose names have been proposed will understand it.

Major Dresser—On behalf of the Association, I wish to offer the following resolution:

Resolved, That this Association tender to the local committees its thanks for the most admirable manner in which every arrangement for the comfort of the members and the success of this meeting has been made by them.

Carried.

Mr. Starr—I understand that the results of the interesting experiments made by Mr. Goodwin are to be published in a separate pamphlet. I think it would now be a good time for the members to come forward and give their orders for these pamphlets, which are to be given to the people of the community in which they live. I would ask Major Dresser to set me down for 100. I want to distribute them among our people, and if this information is put in tubular form it will save a great deal of trouble.

Major Dresser—It will save a great deal of expense in the printing of these pamphlets if the members will indicate the number they want.

Mr. Starr—If we go in proportion to the size of the town, I suppose Chicago will want 100,000.

Major Dresser—I am not able to state just what the cost will be, but it will be trifling; and, of course, the greater the number of copies ordered, the less the cost.

Mr. Starr—I suppose the statements of Mr. Goodwin will be published in the GAS LIGHT JOURNAL, and Major Dresser will then know about what the cost will be, and he can make a statement in the columns of the JOURNAL so as to what it will be; and members can then send their orders to him by mail for the number of copies they desire.

Major Dresser—I think that will be the proper course to pursue.

Mr. Mellhenny—I desire to offer a resolution that the thanks of the Association be tendered to our worthy President for the very faithful and efficient manner in which he has performed the arduous duties of his office during this session. All in favor, please say "aye."

Carried.

Mr. Price—It is very well known that our friend Mr. Allen is here, and would like to make some remarks in regard to his particular system of making water gas, I suppose, or, at any rate, upon the subject of water gas. It is now somewhat late, and I suppose the members of the Association are a little weary; but I will put the question whether they will wait and listen to Mr. Allen or not.

Mr. Allen—I do not intend to occupy the attention of the Association more than 15 minutes.

The President—I think the gentlemen had better wait and listen to what Mr. Allen has to say.

Mr. Allen—Mr. President and gentlemen of the Association: The manufacture of gas is a science of no mean order, and it seems to me that the scientific principles upon which it is based should be discussed more fully than I have yet heard them.

I have heard a great deal said, and have seen a great deal written, with regard to the formation of naphthalin, which has been called the curse of gas making for many years. I believe I have never heard the question asked, Can a good illuminating gas be made without the formation of a particle of naphthaline? I have heard the subject discussed in regard to the removal of ammonia. I believe, under the process that has been in operation for 75 years, there has never been a gas works that has made gas without making ammonia. The question has not been asked, to my knowledge, "Can gas be made without the production of ammonia? So with sulphuretted hydrogen and impurities that are formed under the process ordinarily used.

Now there are certain chemical results produced in the manufacture of gas which depend entirely upon the temperatures used. There are two forces that a gas manufacturer employs—expansion and contraction, heat and cold. Without heat there is no light. The impurities in gas are nearly all made at low temperatures. Good gas—perfectly formed chemical gas—is made at a high temperature. Coal tar and oil are distilled, commencing from 212° and running up to 1000°. In the ordinary process you make about 12 gallons of tar per ton of coal.

Now, when your heats are down, ammonia is formed by one equivalent of nitrogen and three of hydrogen uniting over red heats. If you pursue a different course and have your heats are never lowered to red heats, you will have no ammonia.

Naphthaline is formed by a sudden change of temperatures. It is a crystallization of the elements subjected to heat. If by a given process you volatilize all the chemical proportions of the elements of gas, you will have no naphthaline. It is well known that in the production of illuminating gas there are about 100 simple gases that are combined together and form a compound which there are 40 hydrocarbons. You have in the ordinary coal gas

the force of men employed by the Providence Gas Co., who have charge of the gas-cocks and burners.

Alderman Smith moved the passage of the resolution, and asked for a call of the Board; but as screen prepared to act upon so im was withdrawn. It was th dent of Lights and the pres printed. Subsequently th copies of the documents fo rescinded the portion of th

ALARMING CONFLAGRATION

On Saturday, Dec. 6, a the Consumers' Mutual ensuing two of the fro which were filled with be ness, and three workmen without injury except th burned while starting a sulted from the leaking building now used by th The generators are on th and are fed from the ba consisting of an iron fur placed along the wall, a ing at No. 1 feeder, in t running over one of the floor, where it came in contact with the fire. Mr. Armstrong noticed the fire while a second floor, gave the alarm, and ran to and near No. 1 feeder, a expending by the heat right hand and arm ve attached their hose wh n load report. The g explosion lifted the g the iron girders of th roof wall inward. A ...pieces of slate knocke

The firemen were n leading into a second the breach in the roo nick, however, the fi engines and No. 3 fir ing the fire before ...smothered with wat by water. The floc ...doors and window ...said that "it took ...This is the first acci this case the benefi ...two small feeders, f

There was suffici the reporter visit work.—*Baltimore*

ACCIDENT AT

For property vastly to our notice, and which took place ...announced itself ...have received fro explosion occurre the archer street ...eldest there can ...leading from the ...lead, and owing ...concerned, the in ...tion. It appears ...means entered ...and ignited ...

...RES, BALTIMORE, MD.

...fire at the works of ...feeder street, Canton, ...the generators, and ...ensuing, night fore... ...time, but all escaped ...hand and arm were ...ape. The accident re... ...gas generators in the ...ture of gas from oil. ...side of the building, ...there is a "feeder," ...d. These feeders are ...The oil began leak... ...generating room, by ...the wall to the first ...fire. Mr. Armstrong ...second floor, gave the ...an order to do so, to go ...the fire, the pipes, ...el. In doing so his ...His firemen had just ...ing the oil and making ...gas, and the force of the ...the support afforded by ...wall outward, and the ...slate roof overhead, and ...

...falling by way of a porch ...sunk went up, widening ...

By order of Chief Hen... ...the men of Nos. 2 and 3 ...ing succeeded in subdu... ...smothered with wat... ...by water. The floc... ...doors and window... ...said that "it took ...

...with air will explode, ...seven or eight years. In ...two small feeders, f... ...and book fire, exploding ...

...imply the mains and when ...were preparing to start ...

ENGLAND.—The necessity ...frequently prevented itself ...the present. The accident ...seems it is to keep tar or ...lish particulars which we ...On Thursday, Nov. 13, an ...pany, December, by which ...ers up. The cause of the ...ght of gas from a fitting in ...mains has only recently been ...ill, considerable sinking ...ind, being drawn nearly over ...on this point, and by some ...nal commencement the pavement ...ake had been taken over the ...et was tremendous, but for ...anoeuvring, and the mains ...ept. Several received a ...lost or became broken. The ...*and Water Engineering.*

[From the St. Louis *Gas-Light Journal*.]

The City of St. Louis vs. The St. Louis Gas Co.

Text of the Supreme Court Opinion in Full.

On the 23d ult., the Supreme Court of Missouri overruled a motion for a rehearing of this case on behalf of the city and affirmed the former decision. The St. Louis Gas Company will probably take possession of their property at once. What will be the final arrangement as to the affairs, etc., of the company is not yet fully known. The continuation of the decision in full, is this important case, is unavoidably crowded over till the next issue.—Ed.

Electric Light in Liverpool.

The Library Committee of the Liverpool Town Council seem to be very well satisfied with the result of their experiment in lighting up the Picture Reading Room by Electricity. It is admitted, however, that the effect is not all that could be desired. The lights will flicker, sputter, and hiss, and at the present moment there does not appear to be any effectual way of curing these eccentricities. We may mention here, in connection with Liverpool, that the electric light has been introduced on board ship, for the illumination of the saloons of large sea-going steamers. The *Mendora*, which from Glasgow to Liverpool with the light in operation, and it is entered in a donkey-engine will drive a Gramme machine, and we can see no obstacle they can only find a properly-constructed lamp that will give a steady light, and make no splutterings. Although we years ago pointed out that gas in the electric light a successful rival there, and have no wish to detract from its reported success.—*Journal of Gas-Lighting.*

Edison's Light in New York.

THE REPRESENTATIVES OF THE GAS COMPANIES DO NOT FEAR ELECTRIC LIGHT COMPETITION.

Chief Engineer C. V. Smith of the Manhattan Gas Light Company said yesterday:—"So far as I know, there is nothing in the recent developments regarding the electric light to cause the holders of gas stocks to lie awake nights. I am not speaking of the promises and alleged prospects of the electric light, but of what has actually been accomplished. * * * There is plenty of talk, promise, and prediction; but we have yet to see any one furnish a light as good and as cheap as gas. There has been no fright among the large holders of gas stocks—not even a flutter. There may have been some fright among a few small holders, but I am sure that if the fact of the recent sale of gas stocks had been known, there would have been a stampede of electric light competition. The more intelligent holders of stock keep pace with all the news as to the electric light, so far as they can, and are not in the least alarmed. So far as I know, the holders generally at the time, be any cause for it to fear. These investigations were not trivial nor superficial, but were as thorough as they could then be made. We expect to supply a large part of the people of New York with gas for a long time to come; and if anybody has any gas stock to sell at a sacrifice, there are plenty to buy it who think it a safe investment."

Charles Hoey, Secretary and Treasurer of the New York Mutual Gas Light Company said: "We have no confidence in the electric light yet. There is not enough of it used to amount to any competition with gas, and no facts are furnished on which to base a comparison of the cost of the two lights. It is nothing new to hear of plans of furnishing cheap light. Every month some inventor discovers a new method of burning gas more cheaply, gets a patent, and that is the last of it. You turn our gas in the gas office, although you have an electric light frequently on the outside of the building. Now, we are not going to get frightened until you have the electric light inside, and find that it is cheaper or better than gas. All the places where gas light is used. At present we are not alarmed about the prospective competition of electricity."

O. F. Zollikoffer, Secretary of the Metropolitan Gas Light Company said: "So far from becoming alarmed at the recent promises of the electric light, we are confidently expecting a gradual increase in the consumption of gas. The price of gas has been nothing to the composition of the different gas companies with each other that we are satisfied of its ability to compete with fuel for cooking and heating purposes. All the gas companies now make a reduction in price where large quantities of gas are used. There is a sliding scale of prices, so that when one consumes 100,000 cubic feet a month, the price is reduced one half, or to seventy-five cents per 1,000 feet. This, of course, tends to encourage the consumption of gas. We have been at much pains to inform our customers how they can use gas economically for cooking. The electric light man does not even think of that yet. We have a room with about twenty-five different patterns of gas stoves for cooking and heating purposes, where we show them in practical operation. It will be a good many years before the electric light can do anything like that. The use of gas for cooking purposes has probably been more developed in England than here, but our American manufacturers have produced some great improvements in gas stoves. We have a big gas stove in which you can roast two turkeys, bake six loaves of bread, and boil four pots all at once for seven cents an hour. I guess the electric light won't do that for some time. Our directors ordered a thorough investigation of the electric light last autumn. They employed chemists and practical men, and examined all the patents, and they could find no cause for alarm in the progress then made. There has been nothing since done that warrants a change of opinion, nor do I see anything in the course of the stock market to show any loss of confidence in gas stocks. Possibly the electric light may be practical for large spaces, for signal lights, &c., but for the purposes now requiring gas, you may say we are not think there is any immediate prospect of its being used. Our stockholders are not frightened. We expect to sell more gas instead of less."

At the Municipal Gas Light Company's office, the Secretary, P. Allen, said: "We can't tell what the electric light may come to, because the projectors of it do not make known sufficient facts on which to base the price of their light and cost. At present, taking all the scientific figures I can get, I do not see how they can make their light cheaper than ours. Certainly the price of gas has not been reduced on account of the electric light. We have heard many promises from Edison, but do not know what he can do yet. When we know that, we shall be able to say how it will affect the price and consumption of gas. But there are many practical details yet to be worked out. Even the electricians are divided in opinion about what he has done. When the experts disagree, how can we be expected to come to any conclusion? Possibly the electric light may succeed next year, and possibly its success may be fifty years off; at present we are not alarmed. When Edison shows us a cheaper and better light that can be used as generally as gas, it will be time enough to get frightened. The electric light is very pretty, but that is a long way from practical use in the lighting of dwellings, &c."

Representatives of several companies were asked whether there was any prospect of a consolidation, whether there was any talk of it, and they said but none were found who would say that they had heard of such a project.—*New York Sun*, Dec. 27.

Competition and its Results.

As a matter of interest at the present time, in connection with the proposed consolidation of the Brooklyn companies, we give the following, which appeared in the Brooklyn Eagle, in January, 1870.

It is good evidence, and shows exactly the usual promises made to get a good hold.

The consolidation, if carried out, only gives about a million and a quarter to the heirs, assigns, successors, etc., of the Mutual company then born.—Ed.

BROOKLYN, January 15, 1870.

To the Honorable, the Common Council of the City of Brooklyn:

Gentlemen—I have the honor to inform your Honorable Body that the undersigned represents a company composed of the citizens of the city of Brooklyn, which has been organized under the general laws of the State of New York, passed February 16th, 1849, and intended for the purpose of manufacturing illuminating gas in the city of Brooklyn, said company to be known and designated as the Mutual Gas Light Company of the city of Brooklyn, state of New York, and its premises thereof, I respectfully make application to your Honorable Body for permission to open the streets or avenues of said city for the purpose of laying gas mains and conduits in order to enable our company to accomplish the objects of its organization. Should your Honorable Body grant us this privilege we will furnish gas to the people of the city of Brooklyn of an illuminating power equal to twenty (20) candle light, at a reduction on their bills of at least twenty (20) per cent less than the present proposed reduced rates of our city gas companies.

We will furnish and set the meters, lay the service pipe, and connect them with the pipes in the buildings free of all cost to the consumers. We also claim that our fellow citizens should have the right and benefit of practical competition as the only means of obtaining better and cheaper gas. We also respectfully represent that the removal of upward of three thousand (3000) gas meters from the houses of gas consumers in this city within the four months last past indicates a degree of necessity for cheaper and better light by the people that cannot be wisely disregarded by your Honorable Body, and to that end we will give such security and assurances as your Honorable Body may suggest as a guarantee of our good faith, as well as our ability to maintain a company that will successfully compete with the present opposition for the privilege of supplying a cheap and superior quality of gas to the people of Brooklyn.

The Mutual Gas Light Company of the City of Brooklyn, by

[Signed] WARD B. MEEKER,
President.

[OFFICIAL NOTICE.]

The Third Quarterly Meeting of the Central New York Gas Engineers' Association will be held in parlor "A," Bresler's Hotel, Rochester, New York, on Thursday, November 25th, 1875, at 11 o'clock, A.M.

The importance of these meetings cannot be too highly estimated, and the results emanating from the papers read, and the discussions upon them by the members, has already proved a profitable source of information to the companies who have been represented.

These meetings are especially beneficial to the smaller companies—they necessarily are compelled to use every means to reduce the cost of manufacture, as they have the benefit of the experience and manner of working of all other companies.

The expenses attendant upon the meetings are very light, and cannot be set up as a bar to the admission of any company.

It is earnestly hoped that every company, not already represented in the Association, will forward the name of some representative, preferably the superintendent, to the Secretary, at an early date; and that their representative be present at the opening of the Convention.

A paper will be presented by Mr. A. D. Perry, of Rochester, on the proper and legitimate means to be used in the extension of our business. Other papers will be read, and matters of importance to every gas company will come before the meeting.

The headquarters of the Association will be at the ... [illegible] ... special rates have been obtained for the benefit of ... [illegible]

... Secretary.

Gas Stocks.

NEW YORK, Friday Evening, April 23, 1875.

The market is dull, prices remaining the same as last week, with the exception of Manhattan, New York City, which has declined from 165 to 160 bid; Brooklyn from 140 to 138, and Metropolitan from 91 to 89. Mutual has advanced from 97 to 99 bid.

Sensible Action of a Foreign Gas Company.—The London *Gas Circular* and *Review* of April 10th, 1875, contains the following plan, adopted by one of the English gas companies, looking to the increased use of gas for domestic purposes, a plan which would return to every gas company in the country benefit in cost should they adopt something similar to it, and educate the people to the admirable advantages which gas possesses for this and many other purposes:

"At Coventry the gas company has taken up the matter of cooking by gas, and has set to work with a will under the guidance of Mr. Hinton, who has formerly in the city and they have ordered this week a number of gas cookers of a large number of shapes being exhibited, and as an inducement, to commence to adopt the principle, they have reduced the price of gas for cooking to 2s. 6d. per thousand feet. The gas company throughout the country are showing a manner of enterprise that few have done the last few years."

Silica's Electric Light.—An important specification, relating to the electric light, has been published. It is dated March 30, Ethan Silica, of England, in America, and has been registered in the London Patent Office on the 17th ult. The specification is a long one, and is illustrated by a number of drawings which accompany it, as given in the description of the famous patentee's Park. The features of the invention are the regulation of the current and thermo-electric regulation of the intensity of the current.

Provision is made for preventing the cut or strife of the rays or other media, through which the electric current passes, from melting, and so destroying the apparatus, the electric current being automatically cut off when the fused silica rods, temperatures are reached, and increased in non-conductivity a melting contact, such as a fusible metal plug, which is fused by the heat of the rays, regulates, cutting in resistance or connection, the passage of the electric current through the incandescent rods. The specification also describes the application of a simple automatic thermal regulator. Under this invention the supply of the electric current will be precisely regulated to the degree of intensity of illumination required for the purpose of any article.

Natural Gas at Rochester, N.Y.—Mr. Bateson, of Rochester, one of drilling contract gas well near that of the Traveler Company. Until Every lessee also thinks of leasing his property for the purpose of boring for gas, and the result is to encourage the prospect of a new source of revenue to build market Rochester if the citizens will take $10,000 worth of stock.

Lighting the Parks of New York.—Councilor Kelly, Commissioners Watrous and Lane met on the 20th inst., and opened bids for the several contracts of the Park Department. The bids for lighting the various city parks were as follows: Manhattan Co., $14,000; Harlem Company, $13,000; Metropolitan Gas Company, $13,000; Harlem Company, $11,340; New York Mutual, $11,000.

The three Gas-light Company of Boston is to provide a total of gaslights upon 122 lampposts the common, the

Mining Journal.

NEW YORK, Friday Evening, April 23, 1870.

There has been a ... [illegible] ... ings in the ... [illegible] ... ver, a falling

ABERDEEN CORPORATION GAS SUPPLY.

A statement in our "Trade Notes Items" last week, on Wednesday, the 29th ult., the Gas Committee presented to the Town Council of Aberdeen an abstract of the accounts, for the year ending Sept. 30, in connection with the gas-works. From these it appears that the quantity of gas manufactured was 1,782,236 ft., made up as follows:—

Expenditure to Sept. 30, 1878	£156,313 16 6d	
Ditto during the year	6,000 0 0	
	£162,313 16 6	
Less dispreciation and contingent fund . .	4,775 16 6	
	£157,538 0 0	
Less amount of sinking-fund applied in paying off borrowed money	7,900 0 0	
	£149,638 0 0	

Of this amount, £111,352 13s. 11d. is represented by the gas annuities; £20,000 being borrowed on mortgage, and the balance, £18,285 15s. 1d., carried to account. The profit and loss account, which is as follows, shows a balance of £2,902 19s. 2d. carried to net revenue account to meet annuities, interest, &c.:—

Dr.—*Profit and Loss Account for the Year from Oct. 1, 1878, to Sept. 30, 1879.*

To Manufacture of Gas—		
Purifying materials	£19,661 12 2	
Salary of superintendent	131 5 3	
Salaries of engineers and foremen . . .	315 0 0	
Stokers and gasmen	1,172 4 7	
Maintenance of works and plant, including repewal of meters, apparatus, utensils, and tools	806 2 3	
Materials	£1813 16 6	
Wages	352 7	
	1,166 17 7	
Distribution of Gas—		
Wages of Meter Inspectors	£352,337 7 0	
Rentals, repairing, and collecting Meters .	£203 15 0	
Materials	£216 2 1	
Wages	276 12 2	
	492 14 3	
Repairs, maintenance, and renewal of mains and services, and laying, testing, and interchanging Meters	423 1 11	
Materials	£315 0 9	
Wages	290 3 8	
	605 4 5	
Rents, rates, and taxes—		
Gas-works, counting-house, and house .	£1,004 0 7	
Meters, showrooms, and house	247 11 5	
	1,251 12 0	
Management—		
Salaries	£1,743 11 8	
Collecting, carrying, printing, and advertising	1,743 11 8	
Bookkeeping	115 12 4	
	181 17 10	
Discount on gas and bad debts	297 10 2	
Bad debts	919 10 6	
	£431 1 10	
	£3,212 10	
Amount transferred to depreciation, including £500 on new plant	3,644 11 8	
Interest on gas annuities	5,570 11 7	
Interest on loans—		
£7,229 10 1		
Less £4,326 16 1		
	2,902 19 0	
Balance carried to net revenue account to meet annuities, interest, &c.	£18,285 15 2	
	£49,863 15 2	

Cr.—*Profit and Loss Account.*

By Gas and meter rents	£49,863 15 2	
Rental products—		
Coke	£19,004 12 6	
Tar and ammoniacal liquor	£787 13 10	
	£791 15 10	
Transfer fees	4,221 12 8	
	4,013 8	
	£49,863 15 2	

PRICE OF GAS AT ST. JOHN, N. B.—Mr. Robert Hale and Mr. John

[illegible] are concluded their visit (on behalf of the St. John Gas Light Company) to the different gas works in the United States and the Upper Provinces, to see if any improvements could be made here in the manufacture of gas. They visited Portland, Me., Baltimore, Montreal, Toronto and Kingston. Out, but found no improvement that could be utilized here. In several places gas is manufactured from oil instead of coal as is done here, and can be furnished at a lower rate but that mode could not be carried out here as cheaply on account of the high duty.

COAL GAS *vs.* WATER GAS.

The standing Committee of the Society of Gas Lighting on this vicinity has lately been at work upon a pamphlet setting forth of an interesting pamphlet by Eugene Th. Peel, C.E., engineer of the Newark Gas Light Company, on "The Waste of Energy in the Production of Water Gas." In it Mr. Vanderpool, whose reputation is certainly second to no man in the profession, appears as the advocate of the coal gas process. So pronounced, indeed, is his position that one can almost suspect a *double entendre* in the words, as if he laughed that investors and engineers wasted their energy if they undertook the production of Water Gas.

He commences by giving an account of the old attempts at this manufacture. Then, taking an average analysis of anthracite, he calculates the amount of air which would have to be used to generate the steam required for the production of 1,000 cubic feet of a mixture of hydrogen and carbonic oxide. Next, he considers the amount of heat required to heat the carbon and keep it at a temperature which will dissociate water. He then allows a certain waste, due to the heat carried off by the gas, which, he says, leaves the generator at a temperature of 2,192° F., a statement which we do not at all assent to. It is declared, as the reader may have observed, from the idea that the water is dissociated, but it is a case of decomposition, or of dissociation, and we may suppose its temperature is not far lower. He finds that, theoretically, 28.31 lbs. of anthracite are required for the production of a thousand feet. We give the above as an illustration of the careful manner in which Mr. Vanderpool has worked up the subject. We condense his remarks, giving the final comparison he makes between coal and water gas.

The cost of 1,742 cubic feet of Scotch water gas is:—

1. Anthracite, 75 lbs. = 15.1 cents; 2. Naphtha, 5 gal. = 25 cents; 3. Coke, for vaporizing, etc., 4 cents; 4. Labor, 8 cents; 5. Lime, 1.5 cents; 6. Waste, 2 cents; total, 55.6 cents. Cost per thousand cubic feet, 48.6 cents.

The cost of 11,200 cubic feet of 16-candle coal gas is:—

1. Coal, $5.50; 2. Labor, $1.12; 3. Purifiers, 56 cents; 4. Wash, 5 cents; total, $7.23. Less residuals:—1. Coke, $2.52; 2. Tar, 25 cents; 3. Ammoniacal Liquor, 10 cents; total residual, $2.87. Net cost of above amount of coal gas, $4.01. Cost per thousand cubic feet, 35.8 cents.

Our criticism on the above would be that the residuals of the coal gas are entirely too high. He allows a sale of 31½ bushels to the ton, which is almost beyond theory, although Mr. Vanderpool supports it as a result which ought to be reached. Also, the case seems drawn against the water gas process. It would be presumptive to go further in criticism than this without going over the whole question as carefully as he has done, and the above review gives only a slight idea of the treatment the subject receives at his hands. The ratio of practice to theory of waste of heat and many other items enter into the calculation and make it a good example of the class of papers that should be read before our gas societies. It would be interesting to know whether the Society by publishing this interesting and able paper would wish itself to be considered as an advocate of coal gas and a condemner of water gas—the one defect of the treatment of the subject, to our mind.

The following is the list of members of the Society:—

Honorary Members—C. F. Chandler, M.D., Ph.D., LL.D.; Prof. Henry Morton, Ph.D.; Wm. King, C.E. (of Liverpool.) *Members*—James H. Armitage, C.E.; Frederick S. Benson, C.E.; Wm. Coombe; Geo W. Drenner, C.E.; George W. Edge, C.E.; William Farmer; Chas. C. Morton; Albert M. Smith; C. Vanderpool; Smith, C.E.; Joseph Russell Thomas; Eugene Vanderpool, C.E. *Non-Resident Members*—Oliver E. Cushing, C.E.; Theobald Forstall; Charles D. Lamson; Francis C. Sherman; S. G. Silsbee; Frederick A. Sabbaton.

METROPOLIS (GASHOLDERS).

Provisions Amending the Enactments to Amend the Penalty Clauses of the Chartered Gas Companies Acts, 1857 and 1859.—At the meeting of the Special Purposes and Sanitary Committee, summoned by the Board to consider the necessary notices of the Indemnities to apply to Parliament, either independently or in conjunction with the Corporation, for an amendment of the penalty clauses of the Gas Light and Coke Company Acts? His worke from which the gas is manufactured according to the make at its works; but in consequence of the manipulations which had taken place with regard to the purification of the gas, and the materials employed, the standard at which the Company were manufacturing. The alteration proposed was, in the case of Parliamentary authority being obtained, a certain stated fine should be inflicted, was known to the progress of the Bill, and that the Company would be prepared to go to Parliament in the next session, rather than submit to the probability of a dissolution; and the motion, especially considering it was carried by 17 votes to 12. The Corporation have, however, given notice of a Bill to effect the proposed alterations.

The following is the Whitmore's report on the Illuminating power, pressure, and quality of the gas as required by The Gaslight and Coke Company in the parish of Marylebone during October:—

Averages.	Illuminating Power in Sperm candles.		Mean Pressure.		Mean Quantity of Gas per Hour consumed by each Burner.	Gas Consumed per Cent.
	Minimum allowed by Act.	Highest.	Lowest.	Highest.	Lowest.	
Common gas . . .	12·41	17·12	12·10	2·06	2·00	Nothing.
Coked gas . . .	12·41	13·70	12·10	2·06	2·00	Nothing.

Mean of daily readings of barometer . . . . . 29·95

Mean of daily readings of thermometer . . . . . 52·75

* Each observation consisted in the readings of the photometer, at intervals of one minute.

This mean illuminating power of the common gas during the month of October was equal to 16·61 sperm candles; it was equal to 16·61 candles in 1877 October, and to 16·64 candles in 1876 October. The mean light of the coked gas was equal to 13·61 candles; it ranged between 13·70 and 13·52 candles. There was thus a fall below the legal standard. The consumption of gas per burner found in 100 cubic feet of both gases was very low, and of common gas little more than 2 cubic feet per hour. The pressures of the gas, and on occasion was unfavourable hydrogens detected by the ordinary tests.

The Gas Supply of Halstead.—In our issue of the 2nd inst., among the notices of Bills to be proceeded in next session of Parliament was one by the Proprietor of the Halstead Gas-Works, who intends applying to Parliament for Powers for a Provisional Order in respect to his undertaking. In reference to this proposal, a public meeting was recently held for the purpose of considering the question, which has been in the parish for a long time, and it was agreed to entrust the Local Board to obtain such professional assistance as they may require in the preparation of the necessary application. The opinion of the ratepayers present was adverse to any loss in the future; and the result was shown at a meeting of the Board held last Tuesday, when, after a long discussion, it was brought forward a resolution in favour of an increase in the price of gas from 4s. 6d. to 5s. per 1000 cubic feet. The result of the vote, by a majority of seven in the Board were, there was no option left but to increase the price in order to meet the expenses of the Bill, and the resolution was carried, subject to the assignment of the works. If other than the Board are sold off they could pay a lighting rate, but this could not be done until they had increased the price of gas to the maximum allowed by Act of Parliament. It was only after fully considering the position of the Board that he had resolved to promote legislation, and he did so with the consent of several shares. He trusted that shortly they would be able to announce a profit on the undertaking. The Bill would be introduced early next session. Consequent of the question he addressed could after the report of the Local Government Board Inspector had been received. The Chairman and several other members of the Board spoke in favour of the proposal, and the vote was, at the close to pay off the debt caused by the loss in working, and that it was absolutely necessary to adopt some means of clearing off the liabilities. After a long and angry discussion, it was decided by a majority of seven to one to proceed, to the Bill next Session.

The *Queenstown Gas Act* dissolves and reincorporates the Queenstown Gas Company, Limited, which was started in 1856 with a nominal capital of £10,000, of which £9000 has been paid up. The Company, however, meantime, have expended on works, money to the amount of £30,000 out of profits. By this Act the capital of the Company is fixed at £30,000, which is to

GAS LEGISLATION FOR 1879.

Or the six Companies who applied to Parliament during last session to be incorporated with statutory powers, five succeeded in obtaining the object of their wishes. The sixth failed by what may be called a mere slip, which is now the subject of legal investigation. The Acts passed were as under:—

The *Hamilton-le-Spring Gas Act* incorporates a Company for the supply of gas to Houghton-le-Spring, Newbottle, and East Rainton. The amount of capital authorized is £20,000, and power is given to borrow £6666, the rate of interest on which is not to exceed five per cent. In this case the Standing Orders were so far suspended that neither sliding scale nor sanction clauses are enacted; so the dividend payable will be regulated by the General Act, and is limited to ten per cent. Gas of fourteen-candle illuminating power is to be supplied, but nothing is said about purity. The pressure at which the gas is to be furnished is that which is now usually prescribed —viz., six-tenths of an inch from midnight to sunset, and eight-tenths from sunset to midnight. The maximum price for gas in Houghton-le-Spring is fixed at 4s. per thousand feet, and 5s. in Newbottle and East Rainton. On the whole, the Company have succeeded well in Parliament. They want for a 5s. maximum in Houghton-le-Spring and 4s. 6d. beyond, so that the terms granted cannot be considered illiberal.

The *Knutsford Light and Water Act* dissolves and reincorporates the Knutsford Gas and Water Company, and, so far as gas supply is concerned, authorizes them, with a present capital for that purpose of £11,000, which is to be converted into stock, to raise an additional £20,000 in £10 shares, with power to borrow £7500 on the original, and £5000 on the additional capital. The dividends on the new capital are limited to seven or six per cent., according as it is mixed as ordinary or preference. Auction clauses and sliding scale are inserted; but the latter has been somewhat modified from what it was originally (see Vol. CXXXIII., p. 839), and the initial price is now fixed, regardless of total annual consumption, at 4s. 6d. per thousand feet. The gas furnished is to have an illuminating power of fourteen candles, tested by Sugg's No. 1 "London" Argand burner. A testing-place is within twelve months to be established upon or within two hundred yards of the works. The pressure at which the gas is to be supplied is that which is now usually prescribed—viz., six and eight tenths of an inch, within the usual hours.

The *Worcester Gas Act* dissolves and reincorporates the Worcester Gaslight Company, hitherto carried on as a Limited Liability Company. The undertaking was started in 1836, with a capital of £2000 in £5 shares; but additions have been made from time to time, so that the original capital had reached to the sum of £24,000. By this Act, however, the amount of the original capital is reduced to £20,000, and power is given to raise an additional £16,000. It is prescribed that £12,000 of the original capital shall be converted into stock, and the remaining £8000 shall also be divided into 800 shares of £10 each. These old shares will, of course, be entitled, subject to the sliding scale, to ten per cent., but the dividends on the £16,000 new capital will be limited to seven per cent. if issued as ordinary, and six per cent. if as preference shares, subject to the sliding scale. These shares are, as a matter of course, to be offered by public auction or tender. Power is given to borrow £5000 on the original, and to the usual extent on the additional capital. Gas of fourteen-candle illuminating power is to be supplied, tested by Sugg's "London" Argand, No. 1. Subject to the sliding scale, the standard price which may be charged for gas is fixed at 3s. per thousand. The Company may manufacture, purchase, sell, or let on hire all kinds of apparatus for the utilization of gas for other than illuminating purposes, the charge for which is to be settled by agreement. The Act further authorizes the construction of a siding and a junction with the railway. Beyond this the Act makes all necessary provision for the transfer of the undertaking of the Limited Company to the Incorporated Company, with all rights and liabilities. The limit of the Act includes the town of Worcester and several surrounding townships and parishes. In one part of the district the Company come in collision with the Lancaster Gas Company, but it seems that any differences can easily be arranged.

[ITEM FOUND IN BOOK]
VEVEY

Menlo Park Scrapbook, Cat. 1023

No. 15. "Gas"

This scrapbook contains clippings about gas; most are from The Journal of Gas Lighting, Water Supply, and Sanitary Improvement and the American Gas Light Journal. The book covers the years 1879-1881, but most of the material is for 1880. This book appears to be a continuation of No. 14. There are 137 numbered pages.

Blank pages not filmed: 107-137.

Gas

15

1023.

Beam No. 1

NEWARK BOOK BINDERY & BLANK BOOK MANUFACTORY,
JOB & MERCANTILE PRINTERS.
WILLIAMS & PLUM,
777 Broad St., Newark, N. J.,
STATIONERS and BOOKSELLERS,
MERCANTILE PRINTERS,
BOOK BINDERS,
FIRST CLASS BLANK BOOK MANUFACTURERS,
LITHOGRAPHIC CHECKS, BONDS, NOTES, &c.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

COURT OF COMMON COUNCIL.

At the Meeting of the Court last Thursday—the Lord Mayor (Sir J. W. Truscott) presiding—the Gas and Water Committee presented the following report in respect to the proposed application to Parliament, during the present Session, for an annulment of the penalty clauses of the Gas Light and Coke Company's Act of 1876:—

"Your attention was called, in 1879, to the subject of the penalties to which, under the existing laws, certain of the Metropolitan Gas Companies are liable in the event of their failing to supply gas of the prescribed illuminating power, purity, and pressure, and we were subsequently instructed by resolutions from the Court of Common Council, dated Jan. 22, 1880, forwarding a letter from the Gas Referees on the subject, and directing us to consider what steps it was the present duty of the Corporation to take in the matter, and to report thereon to the Court, and asking the Corporation to favour the Board with their observations thereon.

A copy of the letter of the Gas Referees was also forwarded, and in this was a detailed statement of the difficulties which exist in the ascertainment of the illuminating power of gas manufactured at different places, and of ascertaining from whence the gas supplied to any house and the desirability of placing the testing-places in or near the localities where the gas is consumed, and not at the manufacturing stations, and under the Acts of 1845 and 1876, the provisions of those Acts seemed to be complicated, and as far as we can see, not to give the consuming powers, except of the, for the first half-year, very small penalty for defect of illuminating power. The Gas Referees further state that the alternative principle of fixing the testing-places at or near the manufacturing stations would meet the difficulties, but that the Gas Referees have no power to alter the testing-places, except on the application of, in every case for removal from the districts to which the gas is supplied, and as evidence is less scrutiny for the independence of testing. The Gas Referees also called attention to the difficulties which exist in the ascertainment of the purity of the gas supplied, and they ask the Board of Trade to consider the subject, and, on the grounds above stated, with a view to the amendment of the law in regard to these penalties.

Your Committee have considered the matter, and are of opinion that the present law relating to the penalties to be recommended may be limited to two—namely, (a) Whether the present penalty provisions could not be made for the testings for pressure; (b) Whether the testings for illuminating power, purity, and pressure should not be made of the quality of gas at some of the manufacturing stations, or within the districts where the gas is consumed.

In accordance with the request of the Board of Trade, we directed a reply to be sent to them, giving the views of your Committee with respect to the two points mentioned by the Gas Referees.

First, as regards the question of pressure. After careful consideration of the matter, your Committee are of opinion that the present penalties should be kept by means of self-registering pressure-gauges at the testing-places, and that the penalty should be increased. In addition, that observations of the pressure should be made at indefinite periods at certain of the street-lamps in various parts of the districts, in a manner to be determined by the Gas Referees, and that the penalty for a first default in such a case should be imposed from any examiner or other person in the Gas Referees' service, and that the pressure in any specified locality, he should take a test of the pressure at the nearest testing-place twenty-four within 24 hours of such complaint being lodged in writing at his office.

Secondly, as regards the position of the testing-places for illuminating power and purity, and having in view the difficulty of ascertaining from what manufacturing station the gas is supplied in a particular district, it is most desirable that tests should be made of the gas at the point where it is consumed, and your Committee are of opinion that experience has proved that testing near the manufacturing stations is unsatisfactory. Answers in the Committee to be desirable as a general principle that the testing-places should be placed in or near the districts where the gas is consumed; and they are also of opinion that the testings which would be thereby made would be more than counterbalance any possible objection which might be taken to the system.

In order to carry out this principle, it would be necessary to make an alteration in the law as regards penalties for deficiency of illuminating power and purity, and clause 30 of the Act of 1876 would require amendment. The penalty for a first default might be reduced to the present penalties in the aforesaid clause, in which a penalty for a first default for not a half a candle of illuminating power is fixed at 40s., and fixing a penalty for a first default for not a half a candle of illuminating power, taking into consideration as to whether such gas is manufactured, or its quantity. Your Committee would also recommend the amending of certain other clauses in the interests of testers which have been found to be inconvenient in practice. If these suggestions were carried out, the Committee believe that the Gas Referees would have no difficulty in so fixing the locality of the several testing-places as to enable them to carry on an actual testing of the quality of the gas delivered to each part of every locality.

We have since received a communication from the Gas Referees that, in accordance with the request of the Board of Trade, they have on occasion by your Committee, they propose to substitute three testing-places for the gas manufactured by The Gaslight and Coke Company within the City. After that communication had been received, a meeting was held at which your Committee, the Gas Referees, and the Solicitor to the Board of Trade were present, and at which the Gas Referees stated that the testing-places that corresponded with the three subscribers, through which all the gas manufactured by The Gaslight and Coke Company within the City was to be tested separately—namely, (1) Holgate Dept. Street, (2) Montague street, (3) Bridge Street, Blackfriars.

We have since received a further communication from the Board of Trade, stating:—"It will not be possible to effect the necessary alteration in the law during the present session, as The Gaslight and Coke Company's Bill, in which clauses giving effect to the proposals of the Gas Referees, and a special Bill dealing with the subject could not be brought in without the consent of the Standing Orders. In these circumstances the Board of Trade would suggest that the Corporation should not take any steps in regard to the application to Parliament for giving the necessary notices in the coming autumn of a Bill to be entitled 'The Gas Examiners Act' enables, and I am to add that, should the Corporation decide to take such steps, the Board of Trade will be prepared to support the Bill, and the Board of Trade will be prepared to give all assistance and information in their power."

We likewise received a communication from the Metropolitan Board of Works, requesting that the Court would memorialize your Committee upon the subject of an alteration in the existing law as to testing-places, and the recovery of penalties incurred by Gas Companies.

Under these circumstances, we beg to recommend that your Committee should be authorized to confer with the Metropolitan Board of Works as to giving the necessary notices, either separately or jointly with the Board, of the intention to apply to Parliament, during the present session of Parliament, in accordance with the suggestions of the Board of Trade; and further, that we should be also empowered to confer with the Gas Referees, the Solicitor to the Corporation, and the Solicitor to the Board of Trade, with respect to such Bill."

Deputy RIDDAY said the Committee had already given notice of a Bill, and he hoped the Court would sanction what had been done.

It was, however, agreed to defer the consideration of the question.

METROPOLITAN BOARD OF WORKS.

At the Meeting of the Board last Friday—Sir J. M. Hogg, M.P., in the chair—a Special Purposes and Sanitary Committee submitted the following report:—

Your Committee have to report, with reference to the letter from the Board of Trade, relative to the question of the difficulties which exist in the ascertainment of the law respecting the places for testing gas, and the recovery of penalties incurred, that they have had the matter under consideration, and are of opinion that it is desirable to apply to Parliament, during the present session, for such authority for the Committee to confer with the City Corporation on the subject, both with reference to the Board's Bill and to the Corporation's Bill, as your Committee may think fit. Your Committee recommended that the Board do resolve that the Committee are of opinion that, under existing circumstances, the most practicable course to be adopted is to apply to Parliament for the repeal of the 30th clause, that the preliminary notices on behalf of the Board and the Corporation be given separately, the Committee reserving for future consideration the advisability, and terms of the Board's co-operation with the Corporation in their application.

At the meeting of the Metropolitan Board of Works, held on Friday, the 30th ult., Mr. Richardson, the report was brought up, and the recommendation was agreed to.

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METROPOLIS WATER SUPPLY.

COURT OF COMMON COUNCIL.

At the Meeting of the Court last Thursday—the Lord Mayor in the chair,

The BRASSBRIDGER reported that notice had been given of a Bill to be introduced into Parliament, with power to purchase the Water Companies of the Metropolis; and he suggested that the question should be referred to the Commissioners of Sewers and the Gas and Water Committee.

This was agreed to.

The report of the Gas and Water Committee, upon the several references relative to the supply of water to the Metropolis, recommended that proceedings be discharged, and further that the Committee should be authorized to watch any proceedings that might be taken by the Government with respect to the Water Supply of the Metropolis.

Mr. Deputy DIMSDALE, in moving the adoption of the report, stated that the Committee having been authorized to communicate with the Government in regard to the measures which the Home Secretary had promised to introduce, a question of the London Water Supply, communication had taken place, and the Committee had been advised by Mr. Cross that any interference on the part of the Corporation would only lead to complicate matters. Under these circumstances the Committee proposed to content themselves with watching any proceedings that the Government might take on the subject. They were assured that in any arrangements that might be made the interests of the Corporation would not be overlooked.

This was also agreed to.

Lieut.-Col. Bolton, in his report to the Local Government Board, on the water supplied by the Metropolitan Water Companies, during last month, says:—"The state of the water in the Thames at Hampton, Molesey, and Sunbury (where the intakes of the West Middlesex, Grand Junction, Southwark and Vauxhall, and Lambeth Companies are placed), and in the Lea (where the Companies are situated) was indifferent from the last to the first month, when it became grayed, and afterwards continued good during the remainder of the month. Road state of the river at West Molesey during the month was 9 ft. 1 in., and the lowest 1 ft. 1 in. above the summer level, the rainfall at this place being 2·21 inch. The water in the River Lea was generally good during the month. [These remarks refer to the condition of the water previous to filtration.] The state of the intakes was generally in a much better condition during the month of October than it was in the previous month, and the filtration was efficient. The supply furnished by the various of the Metropolitan Water Companies was clear, bright, and properly filtered."

THE AMALGAMATION OF THE SOUTH METROPOLITAN AND PHŒNIX GAS COMPANIES.

THE SCHEME SUBMITTED TO THE BOARD OF TRADE.

The first thirteen clauses of the scheme submitted to the Board of Trade for the amalgamation of the South Metropolitan Gas Company with the Phœnix Gaslight and Coke Company, under the powers and provisions of the South Metropolitan Gaslight and Coke Company's Act, 1876, and the Acts incorporated therewith, are (excepting the change of name and date, and one or two minor alterations noted below) the same as and proposed and accepted in the case of the recently completed amalgamation of the Chelsea and Kensington Water Companies Gas Companies. These clauses were set out in full as recently as the *Journal* for May 3 this year (Vol. XXXIII., pp. 722-3), and need not be repeated at length. The variations only being mentioned.

1. Commencement of operation of scheme.—Jan. 1, 1880.
2. Amalgamated Company to be called South Metropolitan Gas Company.
3. Works and properties of the two Companies vested in the United Company.
4. Debts payable to the United Company.
5. Debts, &c., of the two Companies to be debts of the United Company.
6. Contracts, agreements, &c., to be those of the United Company.
7. Actions or parliamentary proceedings by or against, and proceedings in Parliament mentioned, so as to cover the notices issued by both Companies for Bills to be promoted next session.
8. Books to be evidence.
9. Accounts of the two Companies to be made out separately up to Dec. 31, 1879.

Dissolution of the reserve-fund.

11. Registers of amalgamating Companies to subsist until replaced.
12. Resolutions, &c., continued.
13. General saving of rights and claims.

Constitution and Regulation of United Company.

14. Provisions of existing Acts continued.—The Acts relating to, or affecting the South Metropolitan Gas Company, and the Phœnix Gas Company at the date of the commencement of this scheme, shall, except so far as the same are varied by, or inconsistent with this scheme, remain in full force; and all rights and powers of every kind, or any of them, conferred on and vested in either of the two Companies in relation to the undertaking of such Company, may be enjoyed and exercised by the United Company: Provided that in the event of the provisions of any Act of the Phœnix Company, or any Act incorporating any Act of the South Metropolitan Company, the appointment of the Auditors of the last-named Company shall (except otherwise specially provided by this scheme) prevail and be observed by the United Company.

15. Half-yearly Meetings.—The half-yearly general meetings of the United Company shall be held as soon after the 31st of December and the 30th of June in each year as the Directors may deem expedient, but not later than the 28th day of February and October respectively.

16. Directors of the United Company.—Upon the execution of this scheme, the Directors of the Phœnix Company shall cease from their own number five members to unite with five seven Directors of the South Metropolitan Company, and become Directors of the United Company; and thereupon the Directors of the United Company shall be twelve. Provided that on the retirement of the present Secretary and Engineer of the South Metropolitan Company, he may be appointed a Director, and thereupon the number of Directors may be increased to thirteen until the next necessary occasion, when they shall again be twelve in number.

17. Remuneration to the Directors.—The fees payable to the Directors continuing in office shall, subject to the provisions of the South Metropolitan Company's Special Act, 1862, and so long as there are 12 Directors, not exceed £500 per annum; but if that number be increased by the Board, the fees may be increased in the proportion.

18. Allowance to Directors for retirement.—[Provides for the payment of an allowance to Directors retiring from office, and for the continuance of the allowance to the widows of deceased Directors.] The amount of such retiring allowance shall be charged upon the general revenue of the United Company, and shall be carried to a suspense account, and be liquidated by equal annual instalments during the next seven years.

19. As to retirement of Secretary and Engineer of the South Metro-

The Potential Energy of Coal Illuminating Gas.

The potential energy of coal gas is taken as the average of the results obtained by seven different observers. In the "Treatise on Gas Manufacture," par 21, Pelouze, 1870 edition, Vol. I., pp. 156-7, is given the analysis of the gas of the Paris Gas Company, and its calculated calorific power. The analysis made by M. Rudelle is—

	By Volume.	By Weight.
Nitrogen	3·70	4·70
Oxygen	0·60	1·05
Carbonic oxide	7·10	8·80
Olefiant gas	6·60	12·90
Saturated hydrocarbons	6·30	10·50
Marsh gas	52·10	47·35
Olefiant gas	19·60	14·70
	100·00	100·00

Specific gravity, 0·600.

The calorific power of this gas is—

P = 0·608 × 34,462 + 0·256 × 2123 + 0·124 × 13,063 + 0·111 × 11,857 = 11,251;

and, making certain reductions, = 10,253 calories; or,

10,253 calories × 3·968 = 40,687 heat units; or,

1 cubic foot is equal to 627 heat units.

M. Morin makes 1 cubic foot equal to 695 heat units; Dr. Letheby, 620 and 705; Mr. J. J. Evans, 630; Mr. Goddard, 692.

We are now prepared to show the waste of energy.

Waste of Energy in the Production of Water Gas, based upon the Consumption of 100 lbs. of Anthracite Coal per 1000 Cubic Feet of Gas Generated.

Assuming that 100 lbs. of anthracite coal are required to produce 1000 cubic feet of water gas,

The theoretical energy of 100 lbs. of anthracite coal is
100 × 13,000 = ... 1,300,000
The theoretical energy of 1000 cubic feet of water gas is
1000 × 300 = ... 300,000
Waste of energy 1,000,000
Percentage of energy utilized. . . 300,000 ÷ 1,300,000 = 23·08
Percentage of energy wasted . . . 1,000,000 ÷ 1,300,000 = 76·92

We have data that show, under the most careful working, that 1000 cubic feet of water gas have been produced from 75 lbs. of anthracite coal, and we will assume this as the best work obtainable in practice, and base it as a basis of comparison, so as to give the water gas process every favor in energy.

Waste of Energy based upon the Consumption of 75 lbs. of Anthracite Coal per 1000 Cubic Feet of Water Gas Generated.

The waste of energy would then be as follows:—

The energy of 75 lbs. of anthracite coal is . 975,000 heat units.
The energy of 1000 cubic feet of water gas is . 300,000 "
The waste of energy is . . . . . 675,000 heat units,
or the
Percentage of energy utilized is . . 300,000 ÷ 975,000 = 30·80
Percentage of energy wasted is . . . 675,000 ÷ 975,000 = 69·20

100·00

We will now compare with this the energy theoretically and practically developed per cubic foot of 16-candle gas, making the water gas being a non-luminous gas. As in the case of the manufacture of water gas, we have taken the results obtained from the best practice for a comparison, so in the manufacture of gas from bituminous coal we have taken as a standard some of the best results actually worked, namely, the composition of our best coking coals:—

	By Weight.
Carbon	82·93
Hydrogen	6·00
Nitrogen	1·00
Sulphur	1·00
Oxygen	7·07
Ash	2·00
	100·00

and a coal of the above composition has a potential energy of about 14,000 heat units.

One ton of such a coal properly carbonized will produce—

12,000 cubic feet of 16-candle gas, weighing . . 672·00 lbs.
Weight of tar . . . . . 182·00 "
Ammonia liquor . . . . . 112·00 "
Impurities, CO_2 . . . . . 7·00 "
CO . . . . . 7·00 "
Ammonia . . . . . 0·00 "
. . . . . 980·00 lbs.
Add 2000 lbs. of coke . . . . . 2000·00 lbs.
Showing a loss of . . . . . 1020·00 "
. . . . . 2980·00 lbs.
Making total weight . . . . . 2980·00 lbs.

Energy Required for the Distillation of 1 Ton of Bituminous Coal.

To produce this gas there would be required, theoretically, taking the heat to be raised for each coal as 32, the gas at 95, and assuming the coal and tar the same as water, and the coke as 0·207 Fahr., and that the tar and gas leave the retort at a temperature of 950°,

2240 × (2200 − 32) + 672 × (950 − 95) + 980 × (950 − 32) = 4,860,480 + 574,560 + 898,960 = 6,334,000 heat units.

As required 1,680,000 heat units to raise 2240 lbs. of coke, or 28 per cent. of the total energy of 12,000,000 heat units, contained with the following energy of 1 ton, 2240 × 14,000 = ... 31,360,000 heat units.

Less, 28 of gas, with an energy of 6,334 = 7,240,000 "
24,120,000 "
40 = 12,000 of coke = 8,040,000
16,080,000 "

Waste of energy . . . . . 24,080,000 "

6,000,000 + 31,360,000 = 37·7 per cent., which is represented by the air not be credited with any waste by leakage, &c., although they do not part that the ammoniacal residuals are valuable, and, in an ultimate scale upon a commercial basis, would reduce the percentages of waste in the production of coal gas with a good setting of the retorts, and by the use of the gas-furnace, 1 ton of coal can be carbonized on the test of 30 per cent., or 932 lbs. of the coke produced. It is said that in some of the compliance with the terms of the lease, but the limit has not been reached by 15 per cent. of the coke produced.

The present extended use of the gas-furnace in France and Germany, and the excellent results obtained therefrom, seem to indicate that less than 30 per cent. of the coke produced would be required to be used for fuel, low cost of coke, personal percentages of coke, and the cost of working this system of generating our heat. Although in the conversion of the will feel little a gas there is a waste of energy of more than 30 per cent., still this waste is more than compensated for by the efficacy of the gas.

The application of the gas-furnace to an ordinary French boiler at the iron-works of M. Muller, at Ivry, showed that before the application the boiler and apparatus evaporated 6 lbs. of water per lb. of coal, which is very good work, and when converted to gas-fuel to 6·66 to 9·28 lbs. per lb. of coal—an average of 8·97 lbs.—showing a saving of 32 per cent. in favor of gas-fuel, or an economy of 32 per cent. in the consumption of coal. A full description of this boiler will be found in C. E. Clark's "Text-Book on Boilers and Engines."

In the practical carbonization of bituminous coal we have therefore—

Waste of Energy in the Carbonization of Bituminous Coal for the Production of Illuminating Gas.

1 ton of coal, with a potential energy of . . . 31,360,000 heat units.
12,240 cub. ft. of gas, with an energy,
7,000 = 7,392,000
992 lbs. of tar, with an energy of 21,840 = 2,167,680
1050 − 2·3 × 10,950 = . . . 13,040,720 "
23,380,720 "
Being waste of energy . . . . . 8,156,280 heat units,
and we have
Percentage of energy utilized . . 23,380,720 ÷ 31,360,000 = 74·9
Percentage of energy wasted . . 8,156,280 ÷ 31,360,000 = 26·1

Comparative Energy, in the Shape of Gas, Derived from the Pound of Coal by the Two Methods.

So that we have 1 lb. of coal in the shape of water gas giving, in its changed condition, a potential energy of

10,253 ÷ 2·2 = 4,660 heat units,

Whereas 1 lb. of coal in the shape of coal gas, tar, and coke, the gas having also an illuminating power as given, by a standard candle, a potential energy of

23,380,720 ÷ 2240 = 10,450 heat units;

or 1 lb. of coal, in the changed condition of coal gas, tar, and coke, gave the same illuminating power as given, by the use of coal in the water gas.

The question of the relative waste of energy of the two methods of gas-making, and the relative cost of transporting the coal and coke, is self-evident that 1 lb. of coal in the shape of coal gas gave twice as far as 1 lb. of coal in the shape of water gas. This is a most important consideration, and, moreover, is only one of the many considerations commercial value of the coal gas method, we have a good illuminating power, and, therefore, an increased income.

To make the above calculations of practical value, it is necessary to look at the illuminating powers of energy in the two methods from a commercial point of view.

We will take the following data as a basis, assuming that in the near future the price of coal, coke, and gas will reach a point where there is a fair profit to those producing them. There are now in the city of Boston, Mass., 100,000 gas-burners, consuming 5 cubic feet per hour, for 700 days per year, will advance to 7 daily, or 5 dols. per ton; but we will take the price of anthracite that would be required to produce the same heating estimates in this vicinity—viz., 6·50 dols. per ton. We will also fairly represent the price of coke at 5 dols. per ton, although the cost at 10 cents per bushel. The tar we could use as a fuel, and the price fixed somewhat low, at 2 dols. per bbl. We will take the price of gas at 1·50 dols. per 1000 for 25 cents. We will take the price of sulphite at 4 cents per cubic foot. We will take the cost of sulphite at 2 cents per cubic foot. We will also consider that in the manufacture of water gas, and the emoluments from the sulphite per cubic foot are the same. The volume of the two gases in question is the quantity of sulphite used. This must be accounted for by the difference in the quantity of sulphite used, on the average, for the same illuminating volume. So that under constant pressure and temperature, and to different kinds of gases, water, and there is still room for the globe full of other volume of sulphite to be used. This is the reason why we have stated that the globe will be charged with a certain number of three bodies under nearly the same conditions as if each were the only one present in the space. We will take the increased volume of the gas to be 25 per cent., or 1·25 volumes per cubic foot, and the commercial gas being specific gravity 0·45 and 1·25 × 0·45 = 0·56 specific gravity per cubic foot, the difference between the two gases in question will be 0·56 − 0·45 = 0·11 specific gravity per cubic foot, and the commercial gas being specific gravity 0·56

possible for the genuine coolness of the climate. New purifiers, scrubbers, condensers, meters, &c., had been sent out, and it is believed that the works and their generally are very efficient. The necessary repairs to the large gasholder were found more extensive than was at first supposed, and the tank has been entirely rebuilt. The gasholder has been enlarged against increase. The holder has been materially strengthened and improved, and the Manager reports that "it is now in a state of thorough repair, and will last many years without renewal."

Additional notice was held during the year to the extent of 322 miles.

It will be seen from the accounts that advance exchange has again proved a serious loss to the Company, and to the Country. There is now an improvement in the rate, which it is hoped may continue.

The services of the Resident Committee are appreciated by the Directors; as also the unremitting energy and ability evinced by the Secretary, Mr. Hewison, in the management of the affairs.

The Directors now recommend alone, a balance (after carrying the sum of £7,000 to reserve-fund) of £17,382 2s. 3d., out of which the Directors recommend a distribution of 5 per cent., free of income-tax, payable on the 6th of December, leaving with the present payment of 2 per cent. on the 6th of June last a total dividend of 7 per cent. for the year.

The Directors retiring by rotation are James Sydney Shepherd, and William Wells, Esqrs., and the retiring Auditors are Messrs. Lawrence Hammond, and Thomas Newton Baker, Esqrs., all of whom, being eligible, offer themselves for re-election.

Dr.	Balance-Sheet, June 30, 1879.		Cr.	
80,000 shares of £5 each	£400,000	0 0	Amount of Shares on Call	£320,000
20,000 " " £10 each	200,000	0 0	Calls, 1878	
10,000 " " £10 (paid)	10,000	0 0	Calls during the past 12 months	15,087
	£610,000	0 0		
Loans on debentures . . .	10,750	0 0	Net profit to the 30th of June last	£17,382
Reserve-fund	10,081	0 0	Balance brought forward	1
Dividends unclaimed . .	697	0 0	Services laid and mains to June	1,000
Amount due by the Company	4,110	11 6	Amount due to the Company	2,859
Balance from general revenue account	2,189	3 9	Value of stocks, viz.—	2,253
			Coals	2,599
			Purifying material . .	213
			Oils	130
			Fittings and meters . .	1,307
			Tools	3,532
			Horses, carriages, &c. .	1,035
			Stock of sundry goods .	1,276
			Repair stores	1,253
			Office furniture, &c. . .	201
			Sundry debtors	19,597
			Cash in London	1,000
			Cash in hand	2,000
	£264,364	6 1		£264,364

Profit and Loss, or Working Account, for the Thirty-Second trading Year to June 30, 1879.

Dr.			Cr.		
Manufacture & distribution—			Gas-rental	£248,978	2 10
Coals, carbonization, and purification, and	£91,021	15 3	Meter-rents on plant . .	15,000	0 0
Salaries to Chief & Assistants . .	2,332	6 10	Transfer fees	23	11 6
Directors and Auditors	1,000	0 0			
Rates & general expenses . . .	612	17 11			
Law charges	2,253	10 0			
Repair of gasholder	6,000	0 0			
Sales account	1,015	7 1			
Wear and tear and repairs . .	3,311	7 5			
Rent and taxes	1,351	1 6			
Bad debts and discounts . . .	1,000	0 0			
Balance	17,382	12 2			
	£264,264	10 1		£264,264	10 1

General Revenue Account.

Dr.			Cr.		
Dividend of 5 per cent. for the last 6 months of the year . . .	£8,000	0 0	Balance on June 30, 1878 . . .	£16,982	4 8
Twelve months' trading to June 30, 1879, received at the Company's Offices . . .	419,060	0 0	Gross net profit and loss account	17,382	12 2
Interest on debentures . . .	10,750	0 0			
Interest on loan account . . .	2,253	10 1			
Income-tax	1,000	0 0			
Reserve-fund	7,000	0 0			
Balance	17,382	2 3			
	£34,434	12 4		£34,434	12 2

The CHAIRMAN, in moving the adoption of the report, said it was not to him that he did not think there was much necessity for him to add to it. The progress of the Company had been so good, considering the great depression of trade which had prevailed in Europe, but the Directors hoped that they had now come to the end of the depression, and that matters were taking place. The revenue of the Company generally for the several new large progress were in every department. Since the last meeting they had been deprived from two extraordinary periods of last year, but less profits very much less than last year, and considering the receipts from which they arose, this was satisfactory. In the long-continued darkness of trade. However, there had been an increase in private lighting. Shops and streets had been well lighted by the Company, and there had been a great number of new customers, showing that they had very good light. During the first quarter of this year gas supplied [illegible] increase of about 60 lights, and during the last quarter no less than 90 more had been supplied here and during the last quarter no less than 90 more. The native customers [illegible] Company did all customers were satisfied they had no reason for lighting up, but the Company's gas liberally when customers. The Company had endeavoured to prepare for coming years and good the appliances were ready and as great exertions. Have been prepared for them, and figures [illegible] consumption of gas would [illegible] with regard to the prospects for carrying on the undertaking, and would be completed [illegible] with the existing [illegible] which is compulsory [illegible] The Company had had [illegible] number of lights. The Directors [illegible] entailed a heavy sacrifice [illegible] The Directors [illegible] new contract for 21 years from [illegible] 1879; and, although it was a very low rate of 2d rupees per [illegible] thought it should be [illegible] leave no room for competition. They had not [illegible] their position, and lighting in Colombo [illegible] [illegible] They had not [illegible] [illegible] but it did not prove a success. An agent of one of the companies [illegible] delay its last to obtain the [illegible] [illegible] [illegible]

WATER GAS:

ITS HISTORY AND MANUFACTURE.

By [illegible]

President of the [illegible] Institute of Engineers.

June 15, 1880. No. IV.

Since the publication of my last article on this subject in THE SANITARY ENGINEER of Nov. 1st, p. 399, I have seen for the first time a piece of testimony in support of the views there expressed which was very gratifying because altogether unconscious and spontaneous.

It appears that some of the gentlemen interested in the water gas manufacture considered my views as to the poisonous nature of carbonic oxide partially as expressed in the *Gas Light Journal* of March 2d and 16th, 1875,[1] as involving the conclusion that water gas was so practically dangerous (on account of the large proportion of carbonic oxide contained in it) that it should not be admitted into general use, even if it possessed such advantages of efficiency and economy as would otherwise entitle it to acceptance.

I am quite ready to admit that when the subject first came to my notice my impression was very much of that nature, but further consideration modified this view, and in the articles referred to I stated precisely the same opinion as is expressed in THE SANITARY ENGINEER of Nov. 1st, namely, that while carbonic oxide was unquestionably a virulent poison, and therefore an objectionable constituent in any gas, yet that the danger of accident being "at most a remote and occasional risk" it would be a question of economy and efficiency simply, whether water gas did or did not become "the gas of the future."

Further, however, to appreciate the force of my statements and seeming inconsistency, it must be remembered that because I had confined one of their too enthusiastic advocates who had unhesitated that carbonic oxide was not poisonous, but was rather a desirable anæsthetic, it would be necessary to outweigh my authority with that of another, these gentlemen addressed themselves to Prof. Adolph Wurtz, of Paris, member of the Academy, etc., and his reply, dated June 12, 1878, and referring to my articles of March 2d and 16th, is now before me. In this Prof. Wurtz, by way of correcting what he supposes to be my views, says: "There is no doubt whatever less danger in all gases containing carbonic oxide, but coal-gas is not exempt from this, as twelve per cent. of its volume may be carbonic oxide; but I think that this danger which exists only have serious consequences in most exceptional cases, or by a sort of fatality, has been very much exaggerated and need really not be considered, if one remembers that we use gas without hesitation for lighting our dwellings, in spite of the real danger of explosion and fire which exists, no matter what kind of gas is used."

Here I find fully confirmed my statement that carbonic oxide is a dangerous poison and that gases are more or less dangerous as they contain more or less of it, and that it is the only dangerous element of coal gas. That twelve per cent. of coal gas may be carbonic oxide, we may readily admit, even in face of the analytical results, which show that in fact it generally ranges from five to seven per cent.

That those poisoned by gas are "fated" so to perish, and therefore could not be saved by the absence of the fatality of accident with coal gas Prof. Wurtz is undoubtedly right and it only remains for experience to prove that a similar immunity will attend the use of a gas containing 20 to 30 per cent. of carbonic oxide.

It thus seems to me that my real views, as actually expressed in this and other journals, have been fully sustained even by one who was called upon to refute me or what he supposed to be my conclusions.

The question then, as I wrote nearly two years ago, is essentially one of economy of production and efficiency in use, the extra risk arising from the larger percentage of carbonic oxide being possibly compensated, or, where it is fully recognized, by extra care in putting in fixtures and in the use of the gas.

Let us see then what can be said on these subjects.

In the first place, as regards economy, I have now before me figures furnished officially by the Municipal Company showing the actual amounts expended for material and labor during the year 1878 and the actual quantity of gas available produced from the same (*i. e.*, amount sold exclusive of leakage and condensation).

These figures are as follows:

Anthracite Coal.....	$24,231.90
Gasoline.....	2,026.35
Coke.....	23,021.35
Crude Water.....	1,000.00
Residuum.....	2,631.51
Wages.....	413.91
	72,124.52
Gas sold during year.....	$52,901.80
Cost per 1000 cubic feet.....	$52,901.80 / 72,124.52 = 73.35 cts.

This, be it remembered, expresses only the cost of manufacture without any allowances for interest on capital, repairs, etc., or the "cost of distribution," which is the same with any kind of gas and, as all gas makers know, is a very large fraction of the total outlay involved in carrying on their business.

These figures, however, show that under the conditions of cheap naphtha, prevailing during last year as well as in 1878, the cost of making gas at the Municipal works was perhaps ten cents per thousand less than the average cost of making a coal gas of equal illuminating power by the old methods now generally followed.

Passing next to the question of efficiency. I have during the last year made a number of photometric measurements of the gas supplied by the Municipal Company in comparison with that sent out by the Manhattan Company which I selected because it was known to be a pure *coal gas* and thus convenient as a standard of comparison.

Greatly to my astonishment, I found that when *burned in the same burner* (*i. e.*, that known as the Sugg. G, argand of 33 holes) the amount of light yielded was essentially the same for either gas. In other words, if the coal gas which (burning in the old standard burner of 15 holes) gave only a light of about 17 candles, was burned in the new 33-hole burner, it gave about 20 to 21 candles; the consumption in all cases being the same, namely, 5 cubic feet an hour.

In other words, the difference in illuminating power, about which so much has been said, is due to the burner not to the gas. The water gas could not be burned in the old standard 15-hole burner (this burner would not feed 5 cubic feet an hour at ordinary pressures), hence the 33-hole burner was adopted as the "standard burner" for the water gas, and with it a light of from 20 to 22 candles was obtained, but it was not noticed that with this same burner pure coal gas would yield an equal light.

In other words, this improvement in burners went to the credit of the water gas.

To obtain the better light it is therefore only necessary to change the burner.

I find, moreover, that the regulated batwing burners give an equally good result.

[To be continued.]

DEWSBURY CORPORATION GAS SUPPLY.

We have received from Mr. Charles Armitage, the Engineer and Manager of the Dewsbury Corporation Gas-Works, the following details of their working during the half year ending Dec. 31, 1875:—

Gas made as per station-meter	61,505,100 cubic feet.	63,705,400 cubic feet.
Gas used for retort-purposes	2,200,300 "	
Gas sold for public lighting	302,300 "	
Gas used on works		56,850,000 "
Unaccounted for		6,713,000 cubic feet.

Equal to 10·5 per cent.

Capital employed—
£317,731 5s. 6d. or £23 9s. 6d. per ton of coal carbonized, or £3 13s. 6d. per 1000 cubic feet of gas sold.

Coal carbonized—

Cannel	4,522 tons or 10·56 per cent.	
Cannel	422 " or 9·61 "	
Total	4,950 tons.	

Illuminating power required by Act	14 candles.
Illuminating power supplied	14 "
Gas manufactured per ton of coal	10,351 cubic feet.
Gas manufactured per ton of coal	10,351 "
Gas made per retort-charge, per ton of coal	6,017 "
Coke made (including 12 cwt. per ton of coal)	5,111 tons.
Coke sold	3,716 "
Coke sold, per cent. on make	72·70 per cent.
Coke used in heating retorts	1,395 tons.
Ditto, per cent. on make	27·30 per cent.
Coke used for other than Gas Works	1,395 tons.
Ditto, per cent. on make	27·30 per cent.
Average price of coke sold	9s. 6d. per ton.
Tar made per ton of coal	11·77 gallons.
Average price of tar per gallon	1½d.
Liquor made per ton of coal	33·97 gallons.
Average price of liquor per 1000 gallons	10s. 7d.
Coke, tar, and liquor realized per cent. on cost of coal	8s. 7½. per ton; 30 per cent.

			Cost per 1000 Cubic Feet Sold.		
Manufacture—	£. s. d.	£. s. d.	s. d.	s. d.	s. d.
Coal	707 13 4	—	0 11 03	—	—
Purifying material and labour	122 12 4	—	0 0 11	—	—
Retort wages, Engineers, and Stokers	292 14 5	—	0 0 11	—	—
Yard wages	102 0 3	—	0 0 3	—	—
Repairs and renewals of property	212 2 2	—	0 0 8	—	—
Repairs and maintenance of works	121 3 3	—	0 0 10	—	—
Miscellaneous outgoings	76 10 5	1,618 7 11½	0 0 3	1 4 2·06	—
Distribution—					
Salaries of Meter Inspectors	103 4 9	—	0 0 8	—	—
Wages of Meter Inspectors	63 0 0	—	0 0 5	—	—
Repairs and renewals of mains and services	100 3 2	332 17 2	0 0 8	0 1 3·8	—
Public lamps, and lamp-lighters	133 8 6	—	0 0 11	—	—
Rates and taxes	233 9 5	457 18 11½	0 0 18	0 1 7·7	—
Management—					
Managers and Clerks salaries	125 0 0	225 0 6	0 0 10	0 0 10·3	—
Stationery and printing	100 0 6		0 0 8	0 0 8	—
Law charges, &c.—	39 11 7	139 0 1	0 0 13	0 0 13·0	—
Law charges	1 7 1	—	0 0 0	—	—
Bad debts	135 7 6	—	0 0 11	—	—
Discounts	186 15 4	323 11 9	0 0 15	0 1 6·3	—
Total working expenses	—	2,511 9 11	—	2 0 0	—
Less residuals—					
Coke	352 1 5	—	—	—	—
Tar	102 16 6	—	—	—	—
Liquor	252 11 10	—	—	—	—
Rents of property, meter-rents, and sundries	110 7 0	3,214 17 4½	—	1 7·88	—
Net cost of manufacture and distribution	—	3,080 12 4½	—	0 10·12	—
Interest on mortgages	—	2,000 0 0	—	0 6·57	—
Amount required for sinking-fund	—	1,000 0 0	—	0 3·28	—
Balance of profit	—	103 17 4½	—	0 0·33	—
Total rental, including public lamps	—	6,184 10 0	—	1 0·30	—

[ANSWER BY MRS. HEMELLE, "RICHES' HOOKER."]

HARTFORD, CONN., *Dec. 26, 1875.*

To the Editor of THE SANITARY ENGINEER :

Should you kindly permit me to address your correspondent directly through the medium of your valuable paper, I should say—

Dear Madam.—My experience as mother, wife and housekeeper for thirty years and more has convinced me that healthful homes are to be looked for only through the intelligent watchfulness of the "women" who make the homes and who are the responsible guardians of their moral and physical purity; therefore I am glad to embrace every opportunity for conference with thoughtful women all over the country, that we may, through our common experiences of difficulty and mistake, help those who shall come after us to a greater measure of health, comfort and happiness than would otherwise be possible. Should my views correspond with your own I should be pleased to know it, and should it be otherwise, a plain statement of difference, with reasons therefor, would be most acceptable.

How to warm and ventilate a house, in this changeable climate of ours, seems to me a fundamental question, and one which may be made to include all others; therefore I begin with that; and have to say that, while I am not of those who talk much of "the good old times," in contrast with present days of "modern improvements," there are a few things which have gone out of use that should, it seems to me, be restored as fast as possible. The first is, open fire-places, with hearths of stone or tile, and large flues (flues should be twelve inches square, or in that proportion, whatever the shape of the flue) in nearly every room in the house, but especially in the chambers, and the smaller the chamber the more desirable the open fire-place. After much study of the many modern methods of ventilation my impression is that, both for private houses and and public buildings, heating school houses, there is no method of securing a gentle, *uncontrived* circulation of air through apartments quite equal to a smouldering fire on the hearth of an old-fashioned fire-place, with a heavy layer of wood ashes always accumulating under, and seldom removed from beneath the low brass andirons that lend an added glow to the domestic picture. "Oh, but the expense !—wood is as costly as gold in our cities," etc., etc. Yes, if used exclusively as a means of warmth, but if used in connection with furnace or stove heat for purposes of ventilation and cheerfulness, the expense would not be great, even at the present time, and when a steady demand should be felt, a competitive wood market would soon bring down the price to meet purses of very moderate dimensions. Considering present facilities of transportation in our country, and the immense forests waiting the use of the woodman to let in light and cultivation, also the need of new business avenues—considering also that the older countries of Europe will furnish wood to their large cities, having found it as legitimate a business to grow trees for fuel, as vegetables for food, we ought not to be deterred from at least considering the benefits to be derived from a restoration of the old fire-places, with its blessed chimney corner for the old, its cheerful paraphernalia of brass andirons, shovel and tongs, and dear old bellows also—anything for babies from time immemorial, and gentle inspirer of all quiet home thoughts.

As to actual cost I hardly dare attempt an estimate; but give me one old newspaper, eight or ten bits of pine shedding stuff, split fine for a fagot of brush-wood such as

Gas Lamp Makers in New York, 1876 1880

The nine-day's wonder of the Edison Lamp seems to have had its day, and now very little is heard of it, except an occasional short paragraph, either of promise or fun, in the daily papers, from which it would appear that the "perfect lamp" requires some further modification to make it just what is needed to supplant gas. In the meanwhile, there are some whispers in the street to the effect that some of the gas companies, at least, are not entirely satisfied with the present low price of gas. Two of the companies have declared dividends; but probably not from *earnings* during the past six months, but more likely from surplus on hand before the extreme reduction in price, or from funds derived from some other source. Certainly, no company with a stock capitals such as the New York companies have can be expected to earn and pay any dividend while selling gas at 75 cents to $1.50 per thousand. As to the policy of paying a dividend when it was not earned—we question the advisability of it. If it was a good thing to have a moderate surplus when good prices prevailed, it certainly seems to be a better thing to have it during a fight. There are one or two things that are quite encouraging in the situation to-day. The New York Mutual Company have called meetings of its stockholders for the purpose of ascertaining a reduction in the capital stock of that company from five to three million dollars; and as it is understood that a very large majority of the stockholders are in favor of the reduction, it will probably be done, although, at this moment, we are not aware that all the details are arranged. This is a noble example, and we wish that the lead taken in this matter may be followed by many other companies who would seem to have a capital out of proportion to the business they are doing. A moderate capital is an absolute necessity in order to sell gas cheaply and make a fair profit, and cheap and good gas is what the consumer demands, while a fair profit on investment is what the stockholder is justly entitled to.

The Municipal Company, on the other hand, have called a meeting for the purpose of increasing their capital stock from two to three millions. This is said to be necessary *for* purposes of extension. Subsequently to the issue of the call for the above meeting, an explosion or accident occurred at the works of the Knickerbocker Company, Second avenue and Ninety-third street, and connections were made with the mains of the Municipal Company for the purpose of getting a supply for at least a portion of the Knickerbocker's consumers.

The damage done by the explosion at the Knickerbocker's works is variously stated, all definite information being withheld by the company. The fact or their getting a partial supply, at least, outside, however, is undoubted; and another thing which transpired a few days later would seem to indicate that the damage was considerable—and that is that the Knickerbocker company is reported to have sold out entirely to the Municipal Company. If this is so it is another step in the right direction, for it practically consolidates two of the existing companies. The terms of the purchase are not made public; but it is a clever move on the part of the Municipal Company whether they continue the war of prices or not. The property and franchises are valuable, and it is not to be supposed that more was paid for them than they are worth. It simplifies the problem of ultimate consolidation immensely as there is one less company to negotiate. It is to be sincerely hoped that further amalgamation will follow, and that the business will be placed in the hands of one organization, with less capital than is already represented by the stock of the various companies; and that, satisfied with dividends of ten per cent., the price of gas will yield that, and keep all the works and plant in thorough order. This once done, opposition will cease and mutual benefit accrue to all.

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profit has been made by the Company. One authority puts it at nineteen per cent., and another at ten per cent., or a little under. The one thing wanted by the Company is an Act to incorporate them with statutory powers, and for this purpose they have announced their intention of applying to Parliament next year. This will, it seems, satisfy the Local Board. Let us hope that it will.

In another column will be found the full text of the valedictory address of Mr. R. Mitchell, of Coatbridge, the ex-President of the West of Scotland Gas Managers Association, delivered at the meeting of the Association on the 29th ult. He considers, as we said last week, that the electric "scare" has been beneficial to the interests of the gas industry, inasmuch as it has caused managers and others to look farther afield for new means of cheapening and improving the production of coal gas. We quite agree with Mr. Mitchell in his view that improvements are required in the retort-house and the means used for firing the retort-settings. It is the opinion of many gas managers that great improvements in this direction may be effected by the use of the Siemens or Oechelhäuser regenerator furnaces. The employment of these systems by Gas Companies would, of course, leave them with a large stock of coke in hand. They would then, as Mr. Mitchell said, have to go in "for small profits "and quick returns;" but this is scarcely satisfactory. We want to realize the full value of residuals, and not be required to make forced sales. Of course, the ex-President, like ourselves, is in favour of mechanical stoking. He is cautious not to express an opinion on any of the systems now under trial. Which of them is destined to come into most extensive use remains to be seen. It is not our province to express decided opinions when competing schemes are brought under our notice, and we shall not do so on this occasion—the rival inventors must fight for the merits of their own schemes. We content ourselves with thanking Mr. Mitchell for his interesting and instructive address, and are sorry we shall not hear more from him in his late capacity as President of the West of Scotland Association of Gas Managers.

The vaunted superiority of the electric light for lighthouse illumination—a superiority, however, not admitted by many of those well able to judge of its merits in this respect—is not always borne out in actual experience; as witness the following, which appeared in the daily papers at the close of last week:—*The crew of the schooner Conovium, of Aberystwith, bound from London for Dublin, with cement, landed at Penzance on Wednesday morning, their vessel having struck on the Stag Rock, near the Lizard, on Tuesday night, and foundered. The captain attributed the disaster to the glare of the electric light at the Lizard, which made him believe that he was at a greater distance from the land than he actually was.*

We would direct our readers attention to Mr. R. H. Patterson's article on the effects of temperature of gas and the air supply at the point of ignition upon the illuminating power of the gas, which appears in the present issue of the JOURNAL. On the 13th of January last we gave an account, translated from the *Journal für Gasbeleuchtung*, of a series of interesting experiments by Herr F. Siemens, on what he termed "Regenerative Gas Lighting"—that is to say, he described several ingeniously constructed appliances, by means of which the heat developed by the combustion of gas was made to warm the air and gas before they were allowed to combine at the point of ignition, the result being a decided increase in the illuminating power. Herr F. Siemens was led to make these experiments by the known success, in the furnaces which bear his name, of the principle of previous heating, by the waste heat of combustion, of the gaseous fuel and air for the production of intense heat; and as light is only a particular manifestation of intense heat, the inference might clearly be drawn that the agency which will increase the one would, if properly directed, also increase the other. The idea is not now, but practical difficulties have hitherto prevented its general embodiment in convenient and simple form; but it is just one of those principles, depending for success on certain characters in the materials and workmanship of the apparatus involved, which may have to wait many years after their first discovery until the time is ripe for their ultimate success. Mr. R. H. Patterson seeks to exemplify the bases upon which the utility of any process for previously heating fuel and air for combustion depend, with a view to the probability of further experiments in this direction, which, if properly directed and intelligently carried out, can scarcely fail to lead to useful results. It is scarcely necessary to refer to the increasing attention which is now being bestowed on gas-burners designed to give intense light, to show that no time could be more appropriate than the present for any researches which will tend to increase our knowledge of a field of utility for gas, which has so far been particularly fruitful, even with the very limited amount of labour which has been devoted to it; and we shall look for great progress in this particular matter during the next year. The success which has attended the efforts that have been made so recently to produce gas-lamps capable of illuminating large areas, and the amount of favour which, considering their novelty, they have received, permits us to indulge in the hope that other successful developments of the same idea will speedily follow. The most that can be advanced against the now "lighthouse" style of burners is that they necessarily consume a large quantity of gas. What is wanted now is a burner which, by intensifying the light yielded by the combustion of as much gas as an ordinary burner usually consumes, and which may perhaps be done by concentrating the heat carried off by the products of combustion, shall take an intermediate place between the humble bat's-wing and the concentric "lighthouse" Argand; and we trust that such a burner may be an accomplished fact in the near future. It is a subject to which many of our readers, as we are assured, might devote some research, with credit to themselves and advantage to the cause of gas illumination; and we trust that Dr. Siemens will not in this matter remain without rivals in this country.

On the subject of the benefit arising from the Gas Companies amalgamations carried out in the Metropolis during the last few years, there is a note in a small work recently published by Mr. J. Quick, jun., M.Inst.C.E. With the book itself—"The Water Supply of the Metropolis, and the Proposed Transfer of the London Water Companies to a Public Authority"—we are not concerned in this column (a notice of it appearing elsewhere); but, when referring to the benefit likely to accrue from centralization of management, the author, after acknowledging that the JOURNAL has constantly pointed out the advantages which would have accrued from amalgamation of interests, though "the [Water] Companies "have turned a deaf ear to the suggestion," writes as follows in regard to the Gas Companies:—"According to information, for which we are indebted to Mr. J. O. Phillips, "Secretary of The Gaslight and Coke Company, the amalgamation of seven out of nine of the Gas Companies formerly supplying the north side of the Thames, has already "*resulted in a saving of £40,000 per annum, and it is estimated* by the same authority that this economy could be "doubled if the whole of the existing Companies, north and "south of the Thames, were united."

Water and Sanitary Notes.

It is highly satisfactory to see that the health of London continues to improve, and that nothing is wanted on the part of the Water Companies to make the improvement permanent. The two last reports received from Drs. Frankland and Tidy show a material improvement in the condition of the Thames supplies, and point to a day when even better results may be realized. We shall be bound to hear a good deal about the Metropolitan Water Supply, for the Council of that busy body, the Society of Arts, have resolved to hold a conference, to commence on the 24th inst. It will continue three or four days, if not longer, and, considering that Metropolitan water affairs only are to be discussed, we think the time laid out is ample. But then we remember that the chief speakers at the Society of Arts are verbose to a degree. Let Mr. Edwin Chadwick, C.B., for example, once get on his legs, and nobody knows when he will resume his seat. In fact, most of the speakers at the Society of Arts seem impressed with but one idea—that they must indulge in a certain amount of talk before they are deemed worthy of notice. What will the conference end in? We have a strong suspicion that when it is over, Metropolitan water affairs will remain in the same condition as now. When the several speakers have aired their oratory, and a few votes have been taken, we shall find ourselves in the position indicated when the sergeant-major says, "As you were."

A gentleman occupying a high position in one of the London Water Companies lately told us, in respect to the alleged increase in the profits of the Companies through the operation of the quinquennial revaluations, that if the matter were thoroughly looked into it would be found that the increased rates demanded of the Companies by the Vestries would almost, if not quite balance the advances they actually made on existing water-rates. "A Water "Shareholder," writing to *The Times* last week, to some extent bears out this statement, and contends that the Com-

The Engineer Feb 20 1880

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GAS ENGINES.

Gas engines have lately been brought so prominently before the public at the different exhibitions of gas appliances, held by gas companies in various parts of the country, and more recently by the large display of engines of this class at the Royal Agricultural Show at Kilburn, that a few words about their history, and short description of those at present in the market, may prove of interest to our readers.

It is not our intention to go deeply into the principles of gas engines, but to give a short *résumé* of what has been done to develope these engines from the earliest up to the present time. That the prejudice that originally existed against this class of engines is being rapidly overcome is evident by the variety of purposes to which these engines are now being applied. This prejudice was no doubt originated by the failures of the early engines, before the combustion and combination of gases had been thoroughly investigated. The feeling was also greatly increased by the jealousy of small steam engine makers, who saw in these new engines formidable rivals to their own productions, and naturally cried down the new comers.

The first patent for what may really be called a gas engine was taken out in the year 1791 by one John Barber. It is described in his specification as "a patent for using inflammable air for the purpose of procuring motion." Coal, wood, or oil, or any other combustible matter was placed in a retort, and the smoke or vapour collected and cooled in a reservoir. It was thence conveyed by an air pump to a compressor or regulating bellows which supplied an exploder. Common air was then injected in due proportion, and the explosion was then affected by means of a light. Here then is roughly the principle of some of the most modern gas engines.

In the year 1794, Thomas Mead obtained a patent for an apparatus by means of which, when air, gas, or other elastic fluid came in contact with ignited combustible matter, or felt the power of heat in a confined space, it became decomposed and expanded by the heat, and by the evolution and expansion of its component parts acted on a piston and exerted power. His specification also shows how he obtained a vacuum under his piston which the atmosphere pressed on and forced it back. This is in part the principle on which the Otto and Langen atmospheric engine acted, which is described further on in this paper.

The principle of the hydrocarbon engine, manufactured by Geo. Brayton, of America, and by Messrs. Thompson, Sterne, and Co., of Glasgow, was partly anticipated by Robert Street, who in 1794 obtained a patent for an apparatus from which he proposed to obtain motive power by means of a few drops of spirit of tar or turpentine being poured upon the heated bottom of a cylinder, and thus being converted into vapour. Air was then sucked into the cylinder, and an explosive mixture formed, which when ignited forced up the piston, and thus by suitable mechanism gave motion to machinery.

The first mention we find of automatically governed engines is in a patent granted in the year 1833 to Lemuel Wright. The specification mentions that governors were applied to the engine to regulate the quantities of gas or air supplied to the cylinders. Various patents were granted between this time and 1860, which appear to have been more or less improvements of the afore-mentioned patents, but none came into practical use. In 1860 we find a communication from J. Lenoir was granted a patent for an invention consisting of the application and use of an inflammable gas mixed with a proper proportion of atmospheric air, and ignited inside a cylinder by means of electricity. The explosion thereby produced, acting on a piston, produced motion, which was transmitted to a driving shaft. The supply of gas was regulated by a suitable governor. In the same year Pierre Hugon obtained a patent for an engine somewhat similar in principle to the above. These, we believe, were the first two gas engines which came into anything like practical and general use. Later on—in 1860—Pierre Hugon obtained a provisional protection for improvements in his former specification. This applied to an improved method of lighting his charge, and for which purpose he used red-hot platinum wires. These engines were made double-acting, and great difficulty was experienced in keeping the cylinders cool. They were found to be uneconomical in practice, and never came into very extended use. A few of them may, however, still be found at work in various parts of the country.

The first patent taken out in connection with the well-known atmospheric gas engine of Messrs. Otto and Langen, of Deutz, near Cologne—afterwards manufactured in this country by Messrs. Crossley Brothers, of Manchester, the present makers of the "Otto" engine—was in the year 1863, and was improved in 1866, in which form the engine was subsequently made in this country. In this engine an explosive mixture of air and gas drives up a light piston attached to a rack in gear with a spur wheel on the fly-wheel shaft. This wheel is not connected with the shaft, but, by means of a ratchet wheel, or friction clutch mechanism, allows the piston to fly up free of the fly-wheel shaft when the explosion takes place; and on a partial vacuum being formed under the piston by means of the condensation of the products of the explosion, the piston descends by the pressure of the atmosphere. The friction clutch is then thrown into gear, and imparts motion to the fly-wheel shaft. This engine was found to be extremely economical in practice, only 21 cubic feet of gas per indicated horse-power per hour being consumed. Upwards of 4000 engines were made on this principle here and on the Continent, and a large number are at present doing good work in this country.

In January, 1874, a communication from Frederic Gilles, of Cologne, was granted a patent for improvements in motors worked by gas, as follows:—An elongated cylinder open at one end is provided with two pistons, a loose one, and a "working" one, connected in the usual way to a crank on the main shaft, which is provided with a fly-wheel. Assuming the working piston to be at the extremity of its inward stroke, on turning the fly-wheel it is drawn towards the outer end of its stroke, followed by the loose piston, until the latter is stopped by a crosshead on the rod attached to it. The working piston continuing its movement causes a partial vacuum behind it, in the space between it and the loose piston. The charge of mixed gas and air is then admitted into this space and is exploded. The force of the explosion causes the working piston to move onwards to the end of its stroke, and at the same time forces the loose piston to move quickly in the opposite direction. A vacuum is formed between them, which draws up the working piston, while the loose piston is held fast at the top of the cylinder by suitable mechanism. When the working piston nears the top of its inward stroke, the loose piston is released, and falling rapidly expels the products of combustion at the exhaust valve, and the action is then repeated. As will be seen from the above description, the engine is made with the cylinder vertical. The licensees for this country were Messrs. L. Simon and Son, of Nottingham, who made several of these engines.

The engine bears a remarkably close resemblance to, and, in fact, may almost be said to have been anticipated by a patent taken out in May, 1864, by Francis Wenham, for "an engine worked by explosive mixtures." The specification describes an engine whose action appears to have been precisely similar to the above. We are not aware, however, that an engine made according to his specification was ever brought out.

In May, 1876, Messrs. Otto and Langen, of Deutz, took out a patent for a gas engine, which, after several modifications and improvements, resulted in the production of the now well-known "Otto" silent gas engine, which has since come into such extended use in this country and on the Continent. Indeed, there are few large towns in England where many of these engines may not be found at work. The principle on which this engine works opened an entirely new field to scientists and engineers, and it may be looked on as the forerunner of an entirely new class of gas engines. This was the first engine in which a gradual expansion of the charge of gas and air was utilised, thus insuring great economy in working. By introducing a diluent of atmospheric air, or other neutral gas in sufficient quantity, with a small charge of coal gas, the highly explosive nature of a purer mixture of oxygen and hydrogen, or air and coal-gas, is reduced within an easily manageable compass. The charge is compressed in the cylinder, and then on a light being admitted, is exploded, or to speak more correctly, "burned," and this ignition expanding the neutral remainder of the charge, a well sustained and but gradually diminishing pressure is brought to bear on the piston throughout the length of the stroke, and a total absence of shock to the working parts is thus insured. We have seen diagrams taken from these engines at work, and they show a beautifully regular expansive curve, falling gradually from 160 lb. at the commencement of the stroke, to about 40 lb. on the opening of the exhaust valve. A chief advantage that this engine possesses over others in the market is that it performs in one cylinder what others are compelled to do in two, namely, the compression and ignition of the charge, the cylinder being used alternately as a pump and a motor. The fly-wheel consequently makes two complete revolutions for one charge of gas when the engine is doing full work. On starting the engine, the first out stroke of the piston sucks in the charge of gas and air, which is compressed by the first inward stroke of piston; the charge is then fired, and the piston consequently forced outwards again, and the second return stroke, performed by the momentum of the fly-wheel, expels the products of combustion at the exhaust valve, and the operation, as above described, is repeated. The engine is horizontal and single-acting, the charge being admitted behind the piston. The amount of gas used is in proportion to the work taken out of the engine, and is regulated by an extremely sensitive governor. The consumption of gas by the "Otto" when doing full work is about 22 cubic feet per indicated horse-power per hour.

Messrs. Louis Simon and Son, of Nottingham, took out a patent in 1877 for "Improvements in Atmospheric Gas Engines." Atmospheric air is compressed by a pump and stored in a reservoir, from which it is withdrawn and utilised in fixed quantities by suitable valves under control of the moving mechanism after the engine is first started. With the specification is a drawing of a vertical engine with the pump alongside the cylinder. In this arrangement the bed-plate is a hollow casting, and is used as a reservoir for the compressed air. In February, 1878, Messrs. Simon took out a patent for an engine with inverted vertical cylinder and pump, motion being imparted to the crank shaft by means of an oscillating beam and connecting-rod. The invention consists in the introduction of steam into the cylinders of gas engines. Steam is expanded by the heat of the cylinder, and by the heat developed by the combustion of a mixture of gas and air, and thus adds power, and economises gas. The engine is somewhat the same in principle as the "Otto" inasmuch as the charge of gas and air is compressed, and ignited under compression, but differs from it in that this engine ignites its charge once for every revolution, and by means of the pump, forces the combustible mixture into the cylinder during a part of the stroke. Eventually the beam was dispensed with, and the engine is now made in the form fully illustrated and described in No. 1203* vol. xlvii., of this journal. It has a novel institution in the shape of a boiler placed on top of the explosion cylinder in which the waste gases are used to raise water to boiling point, and thus, as already pointed out, slightly aid in driving the engine.

It is stated that a pressure of 40 lb. per square inch is attained in the boiler after the engine has worked a short time. The engine is made single-acting, and is virtually a combination of a gas and steam engine, as it has two elements acting together to produce motion, viz., combustion and expansion of a mixture of gas and air and steam, generated by the heat of the exhausted gases. The diagrams taken from the engine are good. In an improved design of this engine, patented in 1878, it is shown as an ordinary vertical engine with the cylinders below. A hand force-pump is added for facilitating starting. This engine is now also made horizontal, and was recently exhibited at an exhibition of gas appliances held in Nottingham.

An engine recently shown at an exhibition of gas appliances, held at Bradford, and manufactured by Messrs. S. Clayton and Co., of Bradford, was patented by them in 1878. This engine bears a striking resemblance to the "Otto." It is a horizontal engine, but uses a separate pump underneath the cylinder for drawing in a regulated supply of air, gas, or vapour, and forcing the same into the cylinder through a port regulated or controlled by a valve. The gas supply is regulated by a governor, and the charge of air may be either compressed or used at atmospheric pressure. The engine can be made either single or double-acting, and differs from the two foregoing engines in that the charge may be fired every stroke, or each alternate one as desired. It also has no slide valve, but instead, uses one of a conical rotary construction, somewhat like an ordinary cock. Having no data, we cannot speak as to the consumption of gas by this engine.

Richard Hellewell, of Blackburn, in 1878, improved on a patent taken out by him in 1877, for a vertical engine with two pistons in one cylinder. When the charge is ignited the loose piston is driven upwards by the force of the explosion, and is held at the top of the cylinder by suitable mechanism. A vacuum is formed, and the other piston, to which is attached the connecting rod, is drawn upwards by means of the vacuum. The loose piston is released when the fast one has reached the top of its stroke and then follows it down the cylinder, and the operation as above described is repeated.

* January 7th, 1879.

The Engineer Feb 20 1880

Engineering, June 6, 1890

To the Editor of ENGINEERING.

SIR,—During the discussion before your reference, on the 9th, 16th, and 23rd ult., on Mr. Dugald Clerk's paper, it was admitted that the "Otto" system economizes coal not contradicted by others, that gas engines in general, and particularly the "Otto" system, consume from 20 to 25 cubic feet per horse and per hour, power, as stated by Mr. Denny Lane, in his Cantor lecture (fifth inst.), quoting the manufacturers' numbers, or at the extreme rate of 28 to 32 for the smallest engines and from 17 to 20 cubic feet for large engines.

I have not figures to compare me, considering that one cubic metre (nearly 35.32 cubic feet) is the consumption of the engines of "Otto" system according to Le Compagnie Parisienne de Gaz at Paris' manufacturers of those engines in France, Mr. Arnergraud in his notable work "Polidectics—Industrial Gas and Heat Engines," at page 31, Appendix, page 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42.

The discrepancy between those calculations is too important to be accounted for by the different calorific intensity of gas in London or Paris, although some allowance must be made. If we assume that the calorific intensity of gas in London and Paris is 700 and 670 "calories" per cubic metre, respectively, the first corresponding to 19.83 "calories" per foot, and the second at a consumption of 1,000 "calories" per cubic metre, that is the calorific intensity of gas in Paris according to several French scientific works, and that the engine, of which the consumption of gas is supposed to be 31 cubic feet per hour and per horse power (as an average between the figures given by Mr. C. H. Cheesbrow and Mr. Denny Lane), is a perfect engine, which is not the case, as it is full well put, a scientific mistake (read to that of Paris, viz., 670 "calories" per cubic foot), the consumption of that engine would be augmented by about 21 per cent., viz., from 31 to 37.52 cubic feet. We shall require more explanation on the subject in order to account for the above difference; it is my opinion that either the "Otto" engine is not perfect, or that the quality of the gas supplied is lowered by the indicator and not by the friction indicator as Mr. Denny Lane says to be a general practice with the manufacturers. However, supposing that the power intended by the indicator (as the figure of 22 cubic feet per hour and per indicated horse power given by Mr. Bidder, Wilton locks are to believed), the power wasted away by friction would be approximately 15 per cent., as the ratio of the two figures 22 cubic feet and 19.25 cubic feet is such. Now let us suppose that the power has been estimated indicated horse power and that the waste on account of friction, &c., is only 25 per cent.; it is obvious that in order to obtain on the axle or shaft of the engine an effective power equal to the indicated one, the consumption of gas would be raised from 22.75 cubic feet per horse and power to 29.

With I take the liberty of addressing to you these few lines for insertion in the columns of your valuable paper, may only hope that either persons more competent than myself, and having the opportunity to make practical experiments, may accurately determine the consumption of "Otto" engines, I am, Sir, your faithful obedient

servant, FRANCISCO DE LA VIBORA.

Madrid, January 29, 1890.

The Economics of Coal Gas.

Electric lighting cannot, so far, be regarded as a success in itself, but, by putting the gas companies on their mettle, it bids fair to prove the means of developing the full powers of their commodity, both as a source of illumination and in many other ways. Until quite lately, from causes which had their origin, in some part, and at a very early period, in the ignorance of managements, gas has always been consumed in a most unscientific fashion; the excessive pressure, for example, at which it has been used not only wasting it, but needlessly reducing its illuminating power to an excessive degree, and the new burners and methods which the necessities of competition with electricity have recently brought into existence and notice are yet far from having got into general use. What can be done in gas lighting, and economically, too, when it is burnt on scientific principles, may be learnt from the displays at street refuges and other points of the metropolis, and what has been effected in the street may be profitably imitated in the dwelling. The waste or bye-products of the gas manufacture are now so valuable that they are understood to pay the whole cost of production of the gas; it is evident that the application of the latter to heating and cooking purposes, and as a source of motive power, is only in its infancy; and probably the profits from these subsidiary uses and from by-products would return a handsome dividend to shareholders, even if as a source of illumination gas should ultimately be wholly superseded by electricity.

Coal Trades Journal

June 16 1890

YESTERDAY afternoon, on the application of Mr. Baxter, Stock and Right Brokers, of 20, Cornhill, prices for insertion in the closing prices yesterday of some of the principal gas companies:—

Gas Companies.			Water Companies.		
Brentford . . .	141	—46	Chelsea	192	—201
Bristol, 7 per dec.	21	—23	East London . .	155	—160
Brighton and Hove . .	51	—53	Grand Junction . .	112	—120
British	94	—95	Kent	135	—140
Commercial . . .	21	—23	Lambeth	167	—172
Continental Union .	105	—108	Do., 7 per cent. .	170	—176
Do., 7 per cent. Pref. .	203	—210	New River . . .	155	—160
Crystal Palace District.	128	—130	Southwark & Vauxhall.	161	—167
Hampton	170	—175	Do., 7 per cent. .	170	—176
Gaslight and Coke . .	172	—176	West Middlesex . .	155	—160
Imperial Continental .	179	—181	Southwark & Vauxhall.	161	—167
London	180	—185	Do., 7 per cent. .	170	—176
Phœnix	95	—98	West Middlesex . .	170	—174

LONDONDERRY GAS COMPANY, LIMITED.—The Directors of this Company, in the report presented to the thirty-third half-yearly meeting of Shareholders on the 6th inst., state that the profit for the year 1889 is £2,707 net profit of £617 18s. 4½d., while the balance brought forward from 1888 was £90 0s. 11d. A dividend at the same rate as for the half year was £90 0s. 11d. A dividend at the same rate as for the half year was £90 0s. 11d. A dividend at the same rate as for the half year

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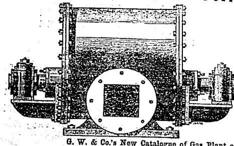

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PHŒNIX ENGINEERING WORKS:
-LAND STREET, SOUTHWARK, S.E.

became part of my duty to superintend its erection, and to see to its working after the contractors had completed.

The site selected as being convenient for the machinery was the Corporation Depôt, situated 400 yards from one end of the Promenade, and 250 yards inland. Here was put up a substantial timber building, 60 feet by 25 feet, and inside, on the ground, was laid a framing, which formed the foundations for the machinery, the interspaces between the timbers being filled in flush with concrete, and then boarded over to prevent dust rising. Upon this were fixed, as they arrived, two portable 16-horse power engines and boilers, and at the opposite end were the electric machines, of which there were seven, all being driven from a counter-shaft placed between them and the engines. From each of the six machines a distinct wire is led to its own lamp, and one common return wire, so to speak, answers for the whole. You will, no doubt, wonder what the odd machine was for. Well, at first, the whole of the six machines had to perform the duty of producing their own electricity, but that duty is now taken from them by specially devoting a dynamo-electric machine to that purpose solely, and this was found to be better for the lights.

The first difficulty we had to contend with was the laying of the wires inside the 2-in. and 3-in. cast-iron pipes, it having been decided to place them underground, hidden from view. This proved no easy matter, inasmuch as the wire was in 500-yard lengths, and it was desirable to have as few joints as possible. It therefore cost as much to put the wires through as it did to make the trenches, so careful had we to be in order not to damage the insulation, and to keep off the water. The weather happened unfortunately to be unfavourable for us, as, a day or two after commencing, a series of high winds set in, with their usual effect at Blackpool of forcing the water over the Promenade, to the amusement of visitors, but to the detriment of our work; for, at every tide, it filled the trenches and pipes with sea water. However, as there was no time to stop, we persevered, and completed the 1500 yards in the week allowed us, and were ready for the preliminary trial to take place on Saturday, the 13th; but, alas! all our efforts were unavailing, for the insulation of the wires had yielded to the water, and it was quite spoiled for the purpose, so there remained no alternative but to withdraw them. This we commenced on the Friday evening, and drew out the whole and laid them on the arms of the lamp-posts. By the Saturday night we had temporarily connected the wires, and had two of the most commanding lights at work with good effect. By the following Monday morning we had collected together the most suitable poles in the town, and immediately set to work and placed them up telegraph fashion, and secured the wires thereto with iron staples, there being no time to get insulators fixed. During the time the wires were being completed, experiments and trials were going on in the engine-room, and by Thursday, Sept. 18, all was finally ready, and the lights were lit at dusk with remarkable steadiness, considering the drawbacks we had to encounter for want of time.

I may tell you that it was with no small degree of pleasure I beheld, from an elevated position, the lights shedding down their bright white beams on the upturned faces of at least 70,000 persons who had come to Blackpool to witness the grand spectacle—to see the poor gas once for all annihilated. Well, I must say the gas cut a sorry figure when burning in the lamps when the electric lights were lit, of which a good many of you present were eye-witnesses; but it became very useful as the nights grew darker, and one of the new illuminants was suddenly extinguished, for it would have been unsafe to the public to have left all in darkness, which might have occurred at any moment. As we got more accustomed to its eccentricities and freaks of going out every now and then, we gained confidence, because we found out how to apply the remedy. In nine cases out of ten the cause was the rack holding the carbons getting fast, and a man was usually on the look-out to shake it with the line to the lamp. So frequently did this happen that ultimately the passing public and youths saved us the trouble by merely pulling the line as they went by. Sometimes, however, more serious mishaps would occur, owing to the exposed position of the lights, and to the strong gales of wind and rain. The delicate working parts were affected by corrosion and damp, and in such cases there was no alternative but to take the lamp in for readjustment; so [illegible] One would naturally say, why not take out the spare lamp and substitute it for the other? [illegible] bad light, it until explained. The reason is this, that owing to all the circuits being of different lengths, and having different resistances, each lamp had to be accurately adjusted, and tried in the test-room, with the current flowing all through the wire. Thus, supposing No. 1 lamp went out, and could not be got to work again; it is 1400 yards away, and it would be necessary to send two men to lower it, couple the two wires together, bring the lamp back, and set to work adjusting the spare lamp to the circuit, which would require, say, half an hour; then to send it back and hoist it up, the whole occupying 1½ hours, during which the light would be out, and would need another attendant, who would afterwards have nothing to do, and some nights would never be wanted, although he must be always at hand.

The mode of working [illegible]

THREE MONTHS EXPERIENCE OF ELECTRIC LIGHTING AT BLACKPOOL.

[illegible]

'politan Board last May, but to the latter I have added the apparatus which I find necessary to work their plant permanently, and this enhances the capital. Each item that is added is marked with an asterisk (*). It must be noted that the apparatus at Westgate was only temporarily fixed:—

Capital Account.

Blackpool. Six Lights = 36,000 Candles available.				Westgate. Six Lights = 1182 Candles available.				Thames Embankment. Twenty Lights = 4000 Candles available.			
Two 16-horse power engines and boiler, with reserved power	£598	0	0	One 10-horse power engine and boiler	£300	0	0	One 20-horse power engine and boiler, with reserved power	£495	0	0
Counter-shaft	52	0	0					Counter-shaft	20	0	0*
Coating	13	0	0								
Seven machines (Siemens's)	800	0	0	Two Gramme machines	220	0	0	Two Gramme machines	360	0	0
Seven Siemens's lamps and six lanterns	143	0	0	Six Jablochkoff lamps, complete	60	0	0	Twenty Jablochkoff lamps, complete	200	0	0*
Terminals	12	0	0	Terminals, &c.	2	0	0	Terminals, &c.	5	0	0
Belting	60	0	0	Belting	4	0	0	Belting	35	0	0
8800 yards of cable	556	0	0	1200 yards of cable	110	0	0	3900 yards of cable	390	0	0
Posts and poles	40	0	0	Six lamp-posts	12	0	0	Twenty lamp-posts	40	0	0*
Engine-house	200	0	0	Engine-house	200	0	0	Engine-house	300	0	0*
Foundations	60	0	0	Foundations	10	0	0	Foundations	50	0	0*
Gas and water fittings	9	0	0	Gas and water fittings	9	0	0	Gas and water fittings	9	0	0*
Strophometer	10	0	0	Strophometer	10	0	0	Strophometer	10	0	0*
Velocimeter	2	0	0	Velocimeter	2	0	0	Velocimeter	2	0	0*
Tools	10	0	0	Tools	10	0	0	Tools	10	0	0*
Galvanometer battery and leclanche	5	0	0	Galvanometer battery and leclanche	5	0	0	Galvanometer battery and leclanche	5	0	0*
Ropes, tackle, stays, &c.	30	0	0								
Labour erecting, and sundry bills	200	0	0	Labour erecting, and sundry bills	46	0	0	Labour erecting, and sundry bills	69	0	0*
Total	£2800	0	0	Total	£1100	0	0	Total	£2000	0	0

Below I will compare the working expenses we are now at, and those of the others for one night of 5½ hours:—

Blackpool. 36,000 Candle Power.				Westgate. 1182 Candle Power—Four Hours Lighted.				Thames Embankment. 4000 Candle Power.			
One engineman	£0	5	0	One engineman	£0	5	0	One engineman	£0	6	8
One assistant	0	3	4					One assistant	0	6	8
								Two assistants	0	10	0
Attendant and supervision	0	7	0	Attendant and supervision	0	7	0				
Oil, tallow, turps., &c.	0	1	6	Oil, tallow, turps., &c.	0	0	5	Oil, tallow, turps., &c.	0	1	7
Water for boiler and general use	0	0	6	Water for boiler and general use	0	0	2	Water for boiler and general use	0	0	2*
Gas	0	0	6	Gas	0	0	6*	Gas	0	0	6*
Carbon, with waste, 10 feet at 9d.	0	7	6	21 candles at 8d., 16s. 3d.; dropped to 2d.	0	4	0	20 candles, each lasting 1½ hours = 80 candles, at 2d. each	0	13	4*
Fuel, coke, and coal, 13 cwt. per night	0	6	6	Fuel, coke, and coal	0	6	0	Fuel, coke, and coal	0	4	9
Interest at 5 per cent.	0	11	8	Interest at 5 per cent.	0	4	7*	Interest at 5 per cent.	0	8	4*
Repairs and maintenance, 10 per cent.	1	3	4	Repairs and maintenance, 10 per cent.	0	9	2*	Repairs and maintenance, 10 per cent.	0	16	8*
Total	£3	6	10	Total	£1	16	10	Total	£3	8	8

Now, it is a very difficult matter to put the proper interest to these tables, inasmuch as the longer the lights are burned, the less is the cost per hour; but as I must compute it in some way, so as to arrive at the actual cost, I shall take our own as we intend to use it, or I will give it the benefit of being lighted every night during which our gas-lamps are alight—viz., 240 nights—and allow them to burn from 5 to 5½ hours. Any other deductions you wish can be made accordingly. In the preceding table you will note that we have two engines and boilers, and during the last week we kept the plant going with only one running; therefore, we shall compare favourably with the others in having reserve power, which is far better for working steadily and safely, and I may say it would be very necessary to have other parts of the plant in duplicate if we were working under penalties for not keeping up the illuminating power, and were fined heavily for occasionally leaving part of the town in darkness.

Before closing my paper, I will say a word or two on some of the effects which our lights have produced in different states of the atmosphere, and conclude with a few remarks on electric lighting generally as an illuminant for our cities. The four lights as now placed light up the Promenade at Blackpool very well for a length of 1500 yards, but not evenly, there being a flood of light directly under them, and not so much midway between them, though amply sufficient for any requirement. If there had been six lights on this length, the effect would have been uniform throughout. As comparing the diffusibility of the light under various conditions, the best result I have noticed particularly has been on some nights when I have been able to read the time very readily by my watch at a distance inland of about 1½ miles. This effect, I am of opinion, was caused by the reflection of some passing rain-clouds, which I noticed hanging about in large masses pretty low in the atmosphere. The same thing has been of particular benefit to some of the fishermen, who have had to go out on the sands about two miles away, at night time, to take fish, and they have many a time been able to see distinctly. The opposite effects are produced in a dense fog. I have only been able to see the lights at a distance of 100 yards, and I could see at the same distance one of the large 100-candle gas-lamps we have fixed in another part of the town, owing to the difference in the colour of the light.

The strong concentrated light of an electric lamp is very bad for the eyesight, and I would not recommend any one having a weakness in that direction to look at them. I myself, as well as the men employed, have had painful experiences of the result, although at the time we were unconscious we were being affected. While experimenting with the lamps it is not noticeable, but after leaving the room the effect is severely felt, and if badly affected there will be no sleep for you that night, but you will have to sit up and keep the eyes wide open, and shaded from light, as it is impossible to shut them, so painful are they. This result has been produced, though in a less degree, in the case of a great many who have visited the room to see the mysterious apparatus at work.

The grand idea of the divisibility and distribution of electricity in the same manner as gas or water—viz., having large leading wires or mains running through the principal streets, with small branches to each consumer—has not for a moment been entertained by any of the electricians, though this is the plan the anxious public are waiting for; the reason being that you cannot have a storeage for your supply, as with gas, where you create a large reserve, and, charging all your pipes under pressure, leave those who require it to simply turn on an outlet for the supply, and, by the grand old law of gravitation, they get all they want from the stock, while a fresh supply would be making and storing for next day in the gasholders. Not so with electricity. As it is generated, so it must be consumed; for electricity must move in a circle, otherwise it cannot be created, and as it moves it disappears. The same electricity does not move round again; it never passes the starting-point, but as it comes it dies, and makes room for more. Now, as it is impossible to store electricity in any appreciable quantities, we see that the object must be to utilize its power as it is being generated; therefore the greatest difficulty is in the distribution as produced. This will be found a great disadvantage, assuming that a town is to be supplied, for it would mean that the apparatus would have to be constantly going in order to supply light when any consumer might at his option desire to avail himself of it during the day or night. It would be like working a gas-works without holders for storeage, with the same disastrous results financially speaking—namely, increased capital, and wear and tear of retorts, plant, and now and then all darkness for a short time in the town, if a sudden draught took place on the mains, owing to a large establishment lighting up without notice. This feature in electric lighting has not as yet shown itself, it being now at the will of the manufacturer of the light when the lamps shall be lighted and put out; but let the consumer have that power left to him, which he will claim as his right if he has to pay the bill, and another difficulty is once more placed in the way of electric lighting for towns.

I am, of course, presuming that there is no difficulty in generating electricity, for it is mere mechanical power that is required. Nothing is used in its manufacture, and, consequently, there is no end to its source. This leads me to the electric lighting systems of the present day, which are nearly all alike in their working, as regards divided lights. The plan adopted is to put from half a dozen up to, say, 20 lights on one circuit—that is to say, one machine has 20 lights put on its wire from leaving the machine to coming back. The distance may be no object, so long as your wire has conducting power sufficient; but here again you are met with a difficulty, otherwise you would increase the number of lamps indefinitely; that is to say, the limits of the power of the machine is soon reached, and the more breaks or resistances you put on the circuit, so each of the lights is less in proportion, for the law of the flow of electricity is inversely as the resistance. Thus, let us suppose the current is represented by 100; now add to the outside circuit a resistance of one lamp equal to the internal resistance of the machine, which is about the best result of the Siemens machines, and you have doubled the resistance to the current; therefore, the total current is reduced to 50, of which the outside circuit has 25 available; that is to say, double the resistance, and the current is halved; treble the resistance, and the current is one-third, and so on. Therefore, you will see how quickly the lights are reduced in power, and how soon the maximum is reached, so that you could not have small lights so economical as large ones. The same is the case with lamps burning by incandescence; you all know that it is only the resistance to the current-flow that converts electricity into heat.

I really cannot see the cause for gas directors becoming alarmed lest they should be driven out of the field for lighting our houses, for I am afraid that electricity, with its delicate working parts and complicated automatic cut-off arrangements—all which are claimed to be simple in action, but which I am certain would soon get out of order if left to take care of themselves in any ordinary house—I am afraid, I say, that the cut-off arrangements now in operation would be apt occasionally, under ordinary usage, to cut off all the supply on the circuits, instead of that to a single house. For public squares, large halls, and for lighting the main thoroughfares of large towns, where more light is wanted than is now thought necessary by most local authorities, there, I say, gas and electricity will come into competition; but I am of opinion that our main thoroughfares are well illuminated during business hours by the shop lights, almost without the gas in the street-lamps; so that to employ electricity on a large scale would be a waste of money, just as much as lamps of 200-candle power being placed every 60 yards or so apart. After business hours there is, comparatively speaking, not anybody out of doors, and gas-lamps are ample for the purpose of giving light. The scope which electricity has is necessarily very limited, there not being so very many large spaces that will need to be lighted up so brightly as to justify recourse being had to it in preference to gas. There is a larger field open for it in the transmission of motive power, in which electricians may reap more remunerative employment for their labours if they will accomplish their grand idea of utilizing the tides, and the Falls of Niagara, in supplanting the present method of supplying motive power for the great industries of the world.

Discussion.

Mr. Newbigging said that his previously expressed opinion regarding electricity as a source of lighting had not undergone any change. Lighting by means of electricity was simply an expensive luxury so far. It was not a new light, as some people imagined. The electric light was about as old as gas lighting; but whereas the one had been found thoroughly practicable, and had been made subservient to our daily wants—had, in short, become an absolute necessity—the other still remained in embryo, having scarcely advanced a step towards meeting our requirements in that respect. He spoke, of course, more particularly as to the application of the light, because, without question, the means for its production had been much improved of late years. There could be no doubt that most of the

tity of gas consumed, and the Secretary having proved the number of the meter,

Mr. *Detheridge*, the Official Meter Examiner, was called, and stated that he had carefully examined the meter which had been supplied to the defendant, and found that its actual registering was 1·93 per cent. in favour of the consumer. He thoroughly tested the index dial as far as practicable, and found nothing the matter with it.

Mr. DENNIS cross-examined with the object of showing that the index might have registered a much larger consumption than actually occurred, but witness said it was impossible under the circumstances, as the meter was in perfect order.

Mr. LUSHINGTON gave judgment for the full amount claimed, with costs. Payment in 14 days.

LAMBETH POLICE COURT—SATURDAY, JUNE 12.

(*Before Mr.* ELLISON.)

OPPONENTS OF THE CONSTANT SUPPLY SYSTEM.

Matilda Flight, of Bond Court House, Walbrook, was summoned at the instance of the Lambeth Water-Works Company for neglecting to comply with the regulations under the Company's Acts to provide stand-pipes or covered cisterns with proper fittings, in the place of butts, to houses of which she was owner, in Hope Street, Villa Street, Walworth.

Luther Clements, of Seymour House, Peckham Rye, was also summoned for a similar offence with regard to houses of which he was owner in Gurney Street, New Kent Road.

Mr. BESLEY appeared to prosecute, and stated that the Company had for some time been using every exertion to carry out the constant supply system, as required by the Board of Trade, and £3000 or £4000 had been expended in this most important work. Mrs. Flight was summoned with regard to some 51 houses in which she had failed to carry out the regulations. The Company had been most considerate in the matter, and did not cut off the supply of water, which they had power to do, and for a long time refrained from taking the present proceedings. Some time back a case was before this Court of a similar character, and the defendant in that instance was ordered to pay a fine of £5. Since the day the summonses had been taken out Mrs. Flight had signed an agreement to complete the required work in 21 days. If this was done the Company had no desire to press for judgment, but they were anxious that it should be known all through the district which they supplied that these highly necessary regulations must be carried out. At present some 12,500 houses had been dealt with as required, but there remained about 3000 houses, the owners of which had failed to comply with the notices served upon them.

Mr. *H. J. Cutmur*, an inspector of the Company, was called, and proved the case. He added, however, that since these proceedings had been instituted Mrs. Flight had put the work in hand, and about a dozen houses had been done.

Mr. ELLISON, at the desire of Mr. Besley, directed an adjournment for three weeks, and added that if the work was not done the heavy penalties under the Act would be imposed.

In the second case, the son of the defendant appe[illegible], and declared he was not responsible. It was, however, clearly sho[illegible]hat he had acted as the agent of his father.

Mr. BESLEY said he had been given to und[illegible]t the property was to be sold, and therefore he asked for an or[illegible]

Mr. ELLISON said it was highly importan[illegible] matters required by the statute should be carried out, and that [illegible] property should be aware that they were bound to do so, or t[illegible]emselves liable to very heavy penalties. He ordered the defen[illegible] pay a fine of £[illegible], and £3 5s. costs.

BANBURY POLICE COURT.—MONDAY, JUNE [illegible].

(*Before the* MAYOR *and a Bench of Magistra[illegible].*)

DISCOUNTS FOR THE PROMPT PAYMENT OF GAS [illegible]COUNTS.

Mr. *John Mawle*, an ironmonger, of High Street, Banbury, was summoned for the non-payment of 14s. 11d. due for [illegible], supplied to him by the Banbury Gas Company.

Mr. J. GOUGH, who appeared for the Com[illegible]y, said the facts of the case were very simple. The price charged [illegible] the Company for gas supplied, within one mile of the Town Hall, [illegible]as 4s. 6d. per 1000 feet; but, in order to obtain prompt payment, t[illegible] Directors of the Company had given notice that for payment within a specified time of the end of each quarter a certain discount would be allowed, and on the Christmas account sent to defendant was the following notice:—"A discount of 6d. per 1000 feet will be allowed on the present quarter's account if paid to the collector on delivery, or at his office, No. 2, Market Place, or the gas-works, on or before the 13th of February next; but no discount will be allowed after that date." The amount then due from defendant was £6 14s. 5d., and he would have been entitled to discount provided the accoun[illegible] had been paid on or before the 13th of February, but this was not done. He, however, sent a cheque on the 18th of February for £5 19s. 6d., bein[illegible] the amount due, less the discount. This was received five days after the time fixed by the Company, and they said he was not entitled to the discount, but was indebted to them in the difference between £5 19s. 6d. and £6 14s. 5d. —namely, 14s. 11d. Defendant had stated that he would not pay till he was compelled; and the next quarter he paid his account in time, and received the discount; but the sum of 14s. 11d. still remained owing.

James Russell, formerly a meter inspector in the employ of the Company, deposed to having, on the 6th of January last, inspected defendant's meter, the index of which registered 29,900 feet as having been consumed during the previous quarter.

Walter Bateman, the Company's collector, stated that it was his duty to deliver the accounts to the consumers. On the 31st of January he took defendant's account to his place of business, and handed it to one of the assistants in the shop. On the 22nd of April he delivered the Lady-day account, which had since been paid.

Mr. *W. R. Cooper*, Manager and Secretary of the Company, stated that the Directors being anxious to sell gas to the public at a reasonable price, adopted the discount system. According to the inspector's report the sum of £6 14s. 5d. was due by defendant. Witness received a letter from him dated the 17th of February, in which was enclosed a cheque for the gas account. Defendant stated that he had had no application for payment, that he did not wish to lose the discount, and that he had always paid the collector when he called. Witness received this letter on the 18th of February, with a cheque for £5 19s. 6d., leaving a balance due of 14s. 11d. Defendant would have been entitled to receive that sum as discount if he had paid his account on or before the 13th of February. Witness made out the account for the quarter ending the 31st of March, which amounted to £6 2s. 11d., and this had been paid, with the exception of the 14s. 11d., which was included. On the 7th of May he received a cheque for £5 8s. from defendant, who wrote a letter stating that if the Company had any further claim on him, and could prove it, he should be quite willing to pay it, but not otherwise. He had since declined to pay.

In answer to defendant, witness said the accounts were due at the end of each quarter, and if they were not paid within a few days the Company could, if they thought proper, take steps to recover the amount.

The *Defendant* said his contention was that this was a demand for 14s. 11d. made in consequence of a circumstance over which he had no control. He did not have the gas account till three or four days only before it became due, and under these circumstances he considered the Company should not claim the 14s. 11d. He contended that the Directors could not charge two prices for their gas, nor did he think they had power to make conditions regarding its supply which, to a certain portion of the public, he believed would be an injustice. It seemed exceedingly hard on poor people, for instance, that they would not get this 6d. per 1000 feet reduction if they had not the money to pay in time. He looked upon the discount simply as a trade discount, as a facility for getting in the money; but he thought it was unjust and unreasonable to attach conditions to payment.

The CLERK: The terms of the reduction are mentioned on the account, and the Company have special power to recover their debts.

The MAYOR: We have the conditions before us, and I think this is all we have to do with. (To defendant:) We are bound to decide against you.

An order was then made for the amount to be paid, together with 7s. 6d. costs.

Miscellaneous News.

CHELSEA WATER-WORKS COMPANY.

The Half-Yearly General Meeting of this Company was held at the Office, Commercial Road, Pimlico, on the 24th inst.—JOHN DEEDES, Esq., the Governor, in the chair.

The SECRETARY (Mr. Albert Gill) read the advertisement convening the meeting, and the following report of the Directors and statement of accounts were taken as read:—

The Directors regret to announce the death in February last of the late Deputy-Governor, who, for many years, had been a member of the Board. They elected, on the 4th of March last, John Stone Wigg, Esq., as Director to fill the vacancy, under the powers conferred by the Act 8 Vict., cap. 16, sec. 89.

Sir William Henry Wyatt has been elected as Deputy-Governor of the Company.

The audited accounts of the Company for the half year up to the 31st of March, 1880, are presented to the Proprietors herewith.

The revenue for that period amounted to £49,554 7s. 11d., and shows, when compared with the revenue of the same period of last year, an increase of £1419 7s. 3d.

The charges for maintenance and management for the same period were £16,438 1s. 2d., and show, on similar comparison, a reduction of £1801 19s. 8d.

The capital account for the half year shows a further outlay of £1737 16s. 4d., incurred chiefly for extensions of iron pipes in the new districts, 2200 yards having been laid during the half year.

The total quantity of water pumped into the district during the half year was 1450 million gallons, being 80 millions in excess of the quantity pumped in the corresponding period of 1879.

The Engineers report that the reservoirs at Molesey are acting most satisfactorily; that the contract for putting the second pair of engines into sound repair is completed; [illegible] the mains, buildings, and machinery are in good order.

[illegible] been deemed advisable, in the interests of the Company, to oppose the scheme [illegible]ently revived by the Lower Thames Valley Main Sewerage Board, for the formation of a sewage farm at Molesey. A protracted inquiry in support of the scheme has been held by the Inspector appointed by the Local Government Board, but the decision of the Board has not as [illegible] made known.

The Propriet[illegible]tless aware that the Metropolis Water-Works Purchase Bill, [illegible] late [illegible]ment, has not been taken up by the present Parliament, and that a [illegible] Committ[illegible]e House of Commons has been appointed to inquire into the expediency of acqui[illegible]g, on behalf of the inhabitants of London, the undertakings of the several Metropolitan Water Companies; to examine into the provisional agreements made with them for the acquisition of the Companies undertakings, and to inquire and report as to their rating powers. It will be the duty of the Directors, in common with the Directors of the other Metropolitan Water Companies, to protect, to the utmost of their ability, the rights and interests of the Proprietors.

The Directors have the satisfaction to congratulate the Proprietors on the excellence and order of the works, on the absence of complaint on the part of the consumers as regards the quality and quantity of the water supplied to them, and on the progressive improvement of the Company's income. They recommend that a dividend at the rate of 6½ per cent. per annum be now declared.

The Directors retiring by rotation are Mr. John Deedes, Mr. William Henry Child, and Mr. John Stone Wigg, who respectively offer themselves for re-election. Mr. Borlase Hill Adams, one of the Auditors, also retires by rotation, and offers himself for re-election.

Dr.—REVENUE ACCOUNT, FOR THE HALF YEAR ENDED MARCH 31, 1880.

Maintenance.		
To Maintenance and repair of impounding and service reservoirs, filtering-beds, works, and pipes, or for obtaining and storing of water, including the cost of materials and labour	£662 13 4	
Maintenance and repair of mains, pipes, fittings, meters, and works connected with the distribution of water, including the cost of materials, labour, and renewals	2,380 5 3	
Pumping and engine charges, including cost of coals, wages, &c.	3,532 10 3	
Filtration, including the cost of materials and labour	388 5 7	
Salaries of Engineer, Inspector, Superintendent, and Clerks, and wages of Turncocks	2,102 12 5	
Thames Conservancy	1,000 0 0	
Rates and taxes, exclusive of income-tax	2,395 14 0	£12,662 10 7
Management.		
Allowance to Directors	£625 0 0	
Allowance to Company's Auditors	41 0 3	
Salaries of Secretary, Accountant, and Office Clerks	1,103 1 3	
Superannuation of servants of the Company	462 3 8	
Commission to Collectors	1,063 14 3	
Stationery, printing, and general establishment charges	274 10 4	
Law and parliamentary expenses	201 11 8	
Official Auditor and Water Examiner	59 4 0	3,775 10 7
Dividend and interest account for transfer of profits		30,916 6 9
Balance carried to next account, to provide for losses		2,200 0 0
		£49,554 7 11

Cr.—REVENUE ACCOUNT.

By Balance brought from former account		£2,000 0 0		
Less sums written off as losses—viz.:				
Empty houses	£1,772 5 10			
Bad debts	105 4 7	1,877 10 5	£122 9 7	
Water-rates accrued to date of this account			49,140 17 1	£49,263 6 8
Rent of houses and lands accrued to date and owing to the Company				260 16 3
Fees received for registration of stock transfers, &c.				30 5 0
				£49,554 7 11

The GOVERNOR moved—"That the report of the Directors be received and adopted, and entered on the minutes." After expressing the regret of the Directors at the death of the late Deputy-Governor of the Company, with whom they had been long associated, he drew attention to the report, and said that the revenue during the half year had been £49,554, and showed, when compared with the same period of last year, an increase of

Advertising and Printing in Connection With Gas.
Quay 1/12 1880 Gas & Coke

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TO CORRESPONDENTS.

L. M.—*Thanks for information and good wishes. Shall probably soon have an opportunity of referring to the facts to which you call attention.*

T. A.—*The proceedings are rather out of the work so far as our readers are concerned.*

Gas Meter Alde.—*Crowded out this week.*

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JUNE 8, 1880.

Circular to Gas Companies.

The Seventeenth Annual Meeting of the British Association of Gas Managers will have commenced its proceedings before this JOURNAL reaches our subscribers. The programme, which we published last week, contains material which promises to the large number of members who will doubtless attend, both interest and profit, and our expectation goes with such hope that the meeting of 1880 will prove in the truest sense a great success.

Our regret at the absence from the chair of the President for the year, Mr. John Douglas, will be generally shared. It will be remembered that when, last year, the choice fell upon Mr. Hulse, he was away on the Continent in search of health; but we hope that the trip has not unsuccessful, because it seems to say that the season was unsuccessful. We hope that for the sake of the Association which he has been a useful and valued member as well as for his own, he may soon be again the strong man we have known him. Under such circumstances, the Association is fortunate in having been able to fill, and that so satisfactorily, the gap by having Mr. Hunt thus called to "the front bench" as President of the Midland District Association, and the very able and practical character of the addresses he has delivered before the members of that Society, as also of the papers he has contributed to the Association itself, make us look with even special interest for the Inaugural Address this year. It is worthy of remark that this year, as last, the presidential chair of the present Association is filled by one who has held like office in one of the district offshoots. There has been much speculation in our columns and elsewhere, in recent years, as to the effect likely to be produced by the formation of these district societies [illegible] all over the country. Would they be an [illegible] or the contrary? It is difficult to say, so far, what, if any, has been the influence exerted. The proceedings at the meetings held have been generally of a distinctly valuable character to those who have attended or taken part in them, and anything which tends to benefit and improve the information of individual members should, and no doubt does, have a beneficial effect upon the Association as a whole. We think, however, that it is eminently desirable that some more positive gain should result to the central and representative body from such machinery as these district associations afford. The training of presidents is doubtless a high function; but there is a higher one—that of contributing as largely as possible to maintaining and increasing the high character of the Association; thus securing that the office of President will continue to be looked up to as one of distinguished honour by all members of the profession. In his address in 1878, the President of that year made a suggestion which, though well received at the time, does not appear to have borne fruit; it was that each of the district societies should charge itself with the responsibility of contributing from among its members one paper to the annual meeting. Last year Mr. Warner amplified this idea by proposing that the Association should depute certain subjects for investigation to the branches, and receive their reports at the annual meeting. How useful might be the results of such a practice may be inferred, not only from the illustration which Mr. Warner gave, but also from the excellent work which has been done by the Manchester District Association, in obtaining and tabulating information upon practical subjects from among its members. That the district associations should be in effect branches of the parent one, that the work in which they have been engaged during the year should produce some result, and find some record in the proceedings of the annual meeting, is clearly most desirable; and we shall rejoice if the proposals in this direction which have been repeatedly made should be referred to a representative Committee of the Association for consideration before the next annual meeting. With such a connection cordially accepted, the whole would enjoy the advantages and the strength of union; without it, the painful position might arise of the parent's pride in the growth of its offspring being checked by the spirit of unnatural rivalry, and by unseemly reflections upon the fate of the divided house.

Another question which has occupied much of the time and attention of the members at several of their too short meetings is that of the restrictions upon membership imposed by the present constitution. A letter which appeared in our columns last week, signed "An Assistant," stated the case very clearly from the point of view of those at present excluded. We observe that notice is given in the programme of an intention to amend the rules, and it is possible that the Committee may purpose substituting some proposition on this subject.

The formation of a class of Associates has much to recommend it, and we confess our inability to see what insuperable objections can be set against them. That the class, if formed, would embrace many men of greater information and culture, and of much higher social and professional position than some of those who by right are members of the one with the more dignified name, there can be no doubt; and that in the case in many other societies, and the feeling of "no sonship" can would be hurt by what is simply an inevitable necessity. From the numerous body of assistants in and outside gas-works—engineers, foremen, chemists, and others, there would be formed a class of earnest and intelligent men—the substance of to-day, the leaders of to-morrow—who would not only themselves derive help on their way, but who would, we feel sure, constitute much to the useful element of the Association as a whole. Such a class would, it seems to us, partake, if formed, of the characteristics of two sections of the Institution in whose home the meeting this year will be held—the Associate and the Student. There would be the same power in the hands of the Committee to veto the election of candidates. Members after, to determine the suitability of candidates, as under Rule 3, as amended a few years ago, there would remain to the Committee the right to nominate as members those whom the old rule excluded, and the proposed new one would relegate to the class of Associates. Retrial changes in any constitution should never be made lightly; but, on the other hand, neither should they be resisted when their expediency is clearly apparent. Especially is this the case if investigation has failed to discover evil likely to result from them as a set-off against the undoubted good. Burning questions are apt to become nuisances if their consideration is over-long delayed.

We are glad to observe that the number of papers on the

was reduced to 32° Fahr. at Munich, the loss of illuminating power, compared with gas at the ordinary temperature, was from 75 to 80—average 20 per cent.; whereas in my own experiments, when gas at 32° Fahr. was tried against the same gas at 280° Fahr., the disc of the photometer showed no change.

As already stated, I think there can be no question (supposing, of course, that the composition of the gas itself undergoes no change by deposit of illuminating substance) the better the gas at the point of ignition the more favourable will its temperature be to effective combustion; and that the lower in temperature the less favourable will it be to intensity of combustion.

Communicated Article.

EFFECT OF TEMPERATURE IN THE GAS AND AIR SUPPLY UPON THE ILLUMINATING POWER OF GAS-FLAMES.

By Mr. R. H. Patterson, F.S.S.

THIRD AND LAST PART.

The experiments made at Munich relative to the effect of the temperature of gas at the point of ignition upon the illuminating power of the flame, were carried both upwards and downwards from the ordinary temperature. As previously described, in my experiments in 1871 I found no difference in the illuminating power of the gas when supplied to the burner at the highest temperature employed at Munich, namely—212° and 288° Fahr. We come now to

THE DEFECTS OF COOLING THE GAS.

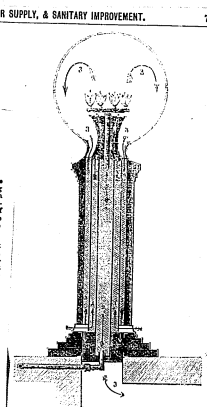
The results of cooling the gas below the ordinary temperature at Munich were as follows:—When the U-tube was immersed in snow, so as to bring the temperature of the gas down to 32° Fahr., the illuminating power was found to have fallen from 100 down to a point varying from 75 to 85; in other words, the light was reduced, on the average, to the extent of 20 per cent; and when the temperature of the gas was still further lowered by immersing the U-tube in a mixture of salt and ice (temperature 4° below zero), the illuminating power of the gas-flame was reduced by nearly two-thirds, ranging from 31 to 40, as against its ordinary illuminating power of 100.

The latter temperature (– 4° Fahr.) is one to which, in this country, the gas, as supplied to the public, is hardly ever subjected; and although I contemplated doing so, I did not carry the application of cold to this extent. But as regards gas at the freezing point (32° Fahr.), my experiments made in a very stringent manner as for the gas at this low temperature was tried against gas at the highest temperature employed at Munich. By means of a by-pass, gas at the freezing point and the same gas at a temperature of 280° Fahr. were supplied alternately to the burner, but without making the slightest difference in the readings of the photometer. The photometer was observed most carefully both myself and by Mr. W. Thompson, and we could not see the slightest difference.

Now, in this case I had expected a different result; not, however, of a kind affecting the real question at issue—viz., the effect of temperature in the gas upon the illuminating power of the flame—but owing to a change in the constitution of the gas itself, which would be a different matter. Just as a very high heat alters the composition of gas, greatly diminishing its illuminating power, so will extreme cold, from a kindred cause, produce a similar result. In the former case, there is a disintegrating chemical effect produced by excessive heat; in the latter, by the cold, a deposit of carbon; in the latter, there is the effective freezing, by which the water contained in gas in the form of aqueous vapour is deposited from the gas in the form of ice, and a portion of the illuminating hydrocarbons are condensed along with it. Neither of these circumstances, however, affected, to any appreciable extent, the effect of temperature upon the gas, so far as the illuminating power of the flame. Nevertheless I had expected that the effect of cold would have produced a perceptible loss of illuminating substance in the gas, and I found that this did not occur (as doubtless owing to the very brief time during which (not a moment) that the gas was subjected to the low temperature of 32° or even a little lower), was fully imparted to the gas, but that it took an instant before the gas sprang into flame at the point of ignition.

When results are obtained so discordant as those at Munich and in my own experiments, in which, I have to say, the co-operation of Mr. W. Thompson, the position of the gas is by no means satisfactory. For, as at Munich, both the gas and the air supply were at 32° Fahr., the illuminating power was only 4 candles, and at 288° it was 20 candles—was 16 per cent. But, theoretically (since the gas was cooled below the ordinary temperature is very striking; for when the gas

reaches it three-sixteenths (ibid., one-fifth) by a glass globe. At the lower part of the globe is an ordinary burner, with a regulating cock, and which serves chiefly to fill the globe with gas, and to supply it occasionally heat to them. The middle tube passing upwards, and the globe, is there burnt with the gas. The outside passing upwards tube is a chimney or ventilating tube. The arrangement and course of the current are shown in the figure. The products of combustion, in another space of the outside pipe, are then burnt with the products of combustion as they pass away from the globe, and the heat thus generated is imparted to the gas in the globe, and to the air in the connecting tube for its supply. The heat thus extracted is by conduction and radiation to the regenerators in the atmosphere, and also through the glass globe to the gas-flame. Air and gas are thus pre-heated, and the pre-heated air is burnt in proportion as the temperature of the flame, increased by the pre-heated gas, is raised above the temperature of the regenerators in the outer pipe. The increase of

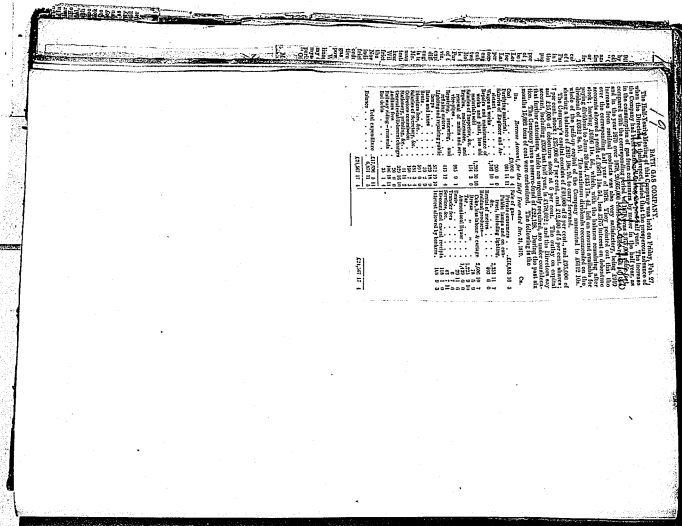


SIEMENS'S LAMP, VARIETY A.

temperature, and consequently of the illuminating power of the flame in globes of glass also until the cooling effect of the glass stops the direction of heat.

short, Herr Siemens places a burner (or several burners) on the of a pillar consisting of three concentric tubes, all of which are ed with wire gauze, in order to convey heat to the surface of the ne through the gas and air, instead of by direct contact between heating the gas. The central tube conveys the gas to the burner, ever, or middle tube, contains the air supply; and the outermost ries away the products of combustion, which, being at a y high temperature, communicate a portion of their heat to the gas in the two inner tubes. These passages, of course, lie next ne up to the burner, and the air-tube next to the gas-tube, so as ximum amount of heat to the burner; but the top of the burner is from the burner, in order that the products of com- may descend to the bottom of the outer tube, and there mix with the air ply and the burning gas.

this is a most ingenious and economical means of heating the air, ir, and consequently of the illuminating power of the flame in ases of combustion can in this manner be carried off without ing, as in the ordinary manner, the products of combustion would reduce the temperature of the products of combustion—i.e., accordingly but vapour into ith the gas-flame is resolved—absolutely into water and carbon. s lantern, immediately above the burner, and, descending in the e sides of the lantern, pass freely away down the tube into the space products of combustion (CO$_2$) are twice as heavy ounce of air, and would take such a course if they were cool; but is this case the products are very hot and lighter; and I think the general impression would have been that, in this lantern ing, the products of combustion would rise to the upper part, and at once, and would linger in the upper part, or indeed all through ere employed upon the construction of an "exhaust" lantern, of combustion are withdrawn from the lantern by means of a fan. of Herr Siemens's lamps is the lantern, or chimney tube; but Herr Siemens makes no mention of an exhaust, and also he does not refer solely upon the "natural draught." If this be so—and it cannot be doubted after Herr Siemens's statement to that effect—what Herr Siemens has thus accomplished, appears to me most valuable, as an example, with reference to the construction of gas-lanterns generally. The obvious inference from Herr Siemens's apparatus is, that it is not necessary to have any outlet at the top for the issue of



EXPERIMENTS IN IMPROVED STREET LIGHTING AT WOLVERHAMPTON.

On Wednesday last, at the invitation of Mr. Charles Hunt, Engineer of the Birmingham Corporation Gas Department, a number of Gas Engineers, principally from the Midland Counties, and others interested in the subject of improved street lighting by means of gas, assembled at the Windsor Street works of the Corporation, for the purpose of viewing a collection of lanterns and burners of large power which had been got together by Mr. Hunt for the purposes of comparative trials of their efficiency. Among those who were present were Messrs. J. Annan, Wolverhampton; T. Arnold, Borough Surveyor's Office, Birmingham; J. C. Bent, Birmingham; G. Bray, Leeds; T. Collett, Dudley; W. Cross, Leamington; W. Davis, Hereford; J. Deakes, Worcester; A. Dougall, Kidderminster; H. Hack, Saltley; T. Jackson, Birmingham; C. E. Jones, Chesterfield; A. P. Kerr, Birmingham; W. King, Liverpool; T. Layton, Redditch; J. Medir, Burton-on-Trent; W. North, Stourbridge; G. Parker, Oakengates; E. G. Paterson, Cheltenham; B. Peaty, Burslem; J. Pinnock, Hereford; T. Pryce, Birmingham; J. Rowley, Tipton; J. Reid, Derby; T. Roberts, Sheffield; T. Simpson, Rugby; S. Y. Shoebridge, Saltley; J. Shoosmith, Birmingham; E. Smith, Secretary of the Corporation Gas Department; J. Storer, Stafford; J. Taylor, Derby; T. Taylor, Derby; J. Tindall, Walsall; W. Winstanley, Newcastle-under-Lyme; H. Woodall, Leeds; J. Wright, Birmingham, &c., &c.

The burners and lanterns were fixed on the several parts of the works, three important ones being placed at distances of about sixty yards from one another on a large tract of unoccupied land to be eventually used for extensions. By this means the effectiveness of the burners in lighting a considerable and open area could be tested, a point much considered necessary to be pressed at the completeness of the trials. The following is a list of the burners and lanterns used, showing the consumption of gas by each burner, and the illuminating power afforded (when tested in the photometer-room), and the illuminating power obtained per foot of gas consumed :—

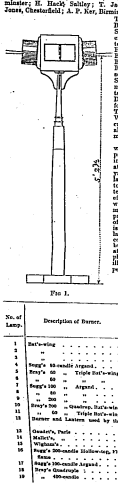


FIG. 1.

FIG. 3.

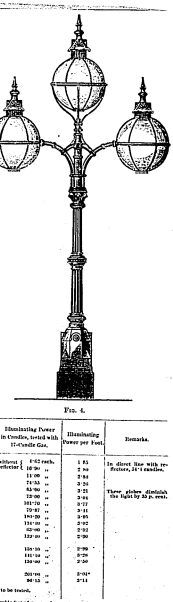


FIG. 4.

No. of Lamp.	Description of Burner.	Description of Lantern.	Consumption of Gas. Cubic Feet per Hour.	Illuminating Power in Candles, tested with Pa'cuadle Gas.	Illuminating Power per Foot.	Remarks.
1	Bat's-wing	Kitt's, fitted with Reflector	2·5 each burner.	without reflector	1·63 each.	In direct line with reflector, 18' 7 radius.
2	"	Collins's Patent "	6·0		1·83	
3	"	Ordinary Street "	2·0		1·66	
4	Sugg's 10-candle Argand	Sugg's Shadowless "	2·2		2·25	
5	Bray's " "	3 Fretted Globes, 24 in. diameter	24·4 each globe.		2·25	
6	" 100 " "	3 Clear " "	24·4		2·25	Three globes diminish the light by 22 p. cent.
7	Sugg's " " Argand	3 Opal Top " 20 in. diameter	12·0		2·21	
8	" " "	1 " " 20 in. diameter	12·4		2·17	
9	" 200 " "	1 " "	23·1		2·11	
10	Bray's 100 " Cockspur, Bat's-wing	Bray's Shadowless "	45·6		2·05	
11	Sugg's " " Triple Bat's-wing	" "	51·4		2·02	
12	Burner and Lantern used by the	Paris Gas Company, in the Rue du Quatre Septembre.	21·6		2·02	
13	Geuzet's, Paris	Geuzet's "	22·8		2·00	
14	Mallet's, "	Mallet's "	23·0		2·00	
15	Wigham's, "	Wigham's "	50·0		2·00	
16	Sugg's 200-candle Hollow-ray, Flat flame	Sugg's Octagon	66·0		2·00*	
17	Sugg's 100-candle Argand	Sugg's Octagon, new pattern	30·0		2·00*	
18	Bray's Quadruple	24-inch Circular "	80·0		2·11	
19	" 120-candle	Bray's "	Too recently erected	to be tested.		

* A better result—viz., 2·24—was obtained with a consumption of 45 cubic feet of gas per hour.

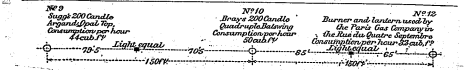


FIG. 2.

After a prolonged inspection of the various lanterns and burners, tests were made by a shadow meter (see sketch, fig. 1) between Sugg's 200-candle Argand (No. 9), Bray's 200-candle Quadruple Bat's-wing (No. 10), and the Burner and Lantern as used by the Paris Gas Company in the Rue du Quatre Septembre (No. 12), with the results shown on the diagram, fig. 2. These appear to agree very nearly with the photometrical results obtained from each burner, as shown in the preceding table.

The Argand and Bat's-wing candle that was made between the burners Nos. 9 and 10 on the diagram (the consumption of gas by each was raised to exactly 40·75 feet per hour) cast the shadow of the pencil-wood when the shadow meter was 21 ft. 2 in. from Bray's Quadruple Bat's-wing and 76 ft. 10 in. from Sugg's Argand.

It should here be mentioned that the Superintendent of the works, Mr. Alfred Colpe, rendered very efficient service in conducting these tests; in fact, to his able assistance Mr. Hunt is considerably indebted for the success which has attended the experiments all through.

In figure 3 is shown a sketch of one of the lamps of the Committee for the new lamp-columns to be erected in various parts of the town. These pillars, which have been specially designed and made for the Corporation by Messrs. Hart, Sons, and Peard, of London and Birmingham, were much admired for their substantial, yet ornamental and effective appearance.

At the close of the inspection, refreshments were served: after which

Mr. HENRY WOODALL proposed a vote of thanks to Mr. Hunt for affording them the present opportunity of witnessing the interesting experiments that had been carried through so successfully, remarking on the useful and judicious arrangements that had been made for the most reasonable comparison to be instituted between the various systems for public gas illumination now before the public.

Mr. S. O. PATTISON seconded the proposal, which was carried by acclamation.

Mr. HUNT, in returning thanks, expressed the pleasure he felt at seeing so many present. It might, he said, be desirable that he should offer a few words in explanation as to the circumstances under which the exhibition had been undertaken. Some experiments were initiated some fourteen months ago by the Chairman of the Gas Committee (Alderman Chamberlain, M.P.), who was desirous of showing in Birmingham what could be done with gas, in the way of street lighting, as compared with electricity. His (Mr. Hunt's) instructions were comprehensive: that he might say, liberal. He was to procure not only the most reliable burners, but also a lantern capable of diffusing the light to the greatest possible advantage, and, at the same time, of being fitted with the column, contributing rather to the ornamentation of the street than otherwise. As they all knew, the question of the burner involved considerations apart from the illuminating power obtained; but his experience was that the proper form of lantern was a far more difficult matter. He embraced this opportunity of acknowledging his obligation to the Committee for the indulgence they had shown him with regard to the length of time for the experiments had taken. He had contemplated for any one that the experiments had taken. He had contemplated for any one that the experiments had taken. He had contemplated for any one that he might say, liberal. He was to procure not only the most reliable burners, but also a lantern capable of diffusing the light to the greatest possible advantage, and, at the same time, of being fitted with the column, contributing rather to the ornamentation of the street than otherwise. As they all knew, the question of the burner involved considerations apart from the illuminating power obtained; but his experience was that the proper form of lantern was a far more difficult matter. He embraced this opportunity of acknowledging his obligation to the Committee for the indulgence they had shown him with regard to the length of time for

BURSLEM TOWN COUNCIL, GAS SUPPLY.

At a Meeting [illegible] Burslem Town Council last Tuesday—the Mayor (Mr. J. Meir) presiding—the report of the Gas Committee, which were presented, specified the report of the Gas Manager (Mr. E. Peake) as to the past year's working, the results showing a profit of £616 5s. 1d., being an increase of £1,000 over that of the preceding year. The Committee recommended a dividend of 5 per cent. and £616 5s. 1d. of these profits be placed to the credit of the sinking fund account.

Mr. W. Wardle, M.P., in proposing the adoption of the report, remarked that twelve months ago he had congratulated the Council upon the report the Gas Committee then presented, when £700 was handed over from the gas profits in aid of the rates. This year there had been an increase in the consumption of nearly 6 per cent., and he was happy to say that on the management account there was shown an increase of 10 per cent. upon the previous year. Consequently the Committee recommend the appropriation of £800 in aid of the rates. It must be remembered, however, that at the present time they were certainly embarking upon a period of trade that might be regarded as exceptionally favourable conditions. The value of coal, &c., was much in their favour, for it would be idle to hint they could expect to get it as they might, in years not very far distant, probably be subject to a increase in the cost of coal, &c. It would, therefore, perhaps be injudicious to look forward upon such large sums being appropriated from gas profits in aid of the rates. The policy of the Gas Committee had been to maintain the price of gas, and for that not for them, by improvements here and there as were found necessary, to increase the efficiency and enable depreciation which was always going on [illegible] connection with such works. The Committee, therefore, proposed to set apart, out of the profits, the sum mentioned in the resolution. During the four years that the works had been in the hands of the Council the total profits had exceeded £3000; but, as they were aware, a large sum was needed for working capital, and they had had to avail themselves of their profits at the bank, causing a very considerable charge from year to year for interest. A large sum of money had to be expended for carrying the Act of Parliament sanctioning the purchase of the works, and for the necessary loan for completing the purchase. The Committee, anyway, expected to maintain a sum that would represent the balance owing to the bank, which was decreasing; which, together with the fact that last year they had £700, and this year £800 [illegible], and the year £1000 in aid of rates, led him to think they had reason to be satisfied with the progress of the gas-works, and to feel that the Council were justified in purchasing them.

Mr. Sherratt seconded the motion, which was carried.

Mr. Worrall, then said that about a period time ago the Gas Committee [illegible] to their charge for lighting the public streets; but a very general feeling had been expressed in favour of the Council lighting themselves the whole of the streets, instead of for ten months of the year as at present, and in the Gas Committee's last report it was intimated that they were willing [illegible] same price that had been charged for ten months. [illegible] year he moved that the Gas Committee be instructed to light the lamps during the whole of the year upon the terms named.

Mr. Sherratt seconded that motion, which was also carried; and the Council proceeded to other business.

[illegible]TER SUPPLY, & SANITARY IMPROVEMENT. [May 11, 1880.

Manchester. In Liverpool, equal facilities for obtaining coal and canal cartel; and for a long period (during which the prices of gas was lower than in Manchester) the gas consumers here pointed to the price paid in Liverpool as the price which ought to be charged in Manchester. At the present time the price in Liverpool is 3s. 3d., whilst it is only 3s. 6d. per 1000 cubic feet in Manchester. Now, if Manchester gas consumers have a return of 10 per cent. upon the capital employed in the supply of gas ought to be obtained, for the benefit of the ratepayers generally? but—even if necessary to secure such return—it would be difficult to defend a higher price in Manchester than might be charged in Liverpool. The amount of profits made in any one year do not exceed the percentage allowed, or the appropriation of such profits, [illegible] Manchester, to the benefit of the ratepayers generally? But is it possible that the benefit of the profits should be enjoyed by the gas consumers?" The reply is easy and conclusive. The gas consumers do not pay for the improvements; they pay for gas, just as they do now when gone into the baker's shop pays for bread. The improvements are paid for by the ratepayers, and it is for them, and for them only, to determine whether the gas profits, which belong to them, shall (as now happens) be lavishly applied to be applied for that purpose, or whether such expenses shall be defrayed by means of an improvement-rate, and the gas profits be retained in the hands of the Corporation, to be applied for the purposes of the Corporation, or applied in any other way that may be deemed more beneficial to the inhabitants. Parliament would no doubt be quite prepared, at the instance of the Corporation, to alter the existing law, and to authorise the appropriation of the gas profits in any way and for any purpose which might be deemed to be most beneficial to the ratepayers. Having shown that the price of gas is altogether unaffected by the amount or the appropriation of the profits made in any one year, the inference, nothing more nor less than the question whether gas ought to be cheaper than it is, does not strictly refer to the proposal or suggestion made that the ratepayer, or a portion of the ratepayers, of the improvements should be defrayed out of, and by means of an improvement-rate. What is meant by this proposal is it difficult to understand. If it is proposed to keep down the price of gas below the market price, and by means of an improvement-rate to obtain the amount of profits which by such a course would, for the benefit of the gas consumers, be sacrificed, there is no doubt that such a proposal would be a most unwise one. The fact that an improvement-rate has to do with the price of gas appears not to be shown. It is quite possible that such rate may, in addition to the gas profits, be required to pay for improvements in progress or contemplated, but the exigencies or requirements of the Corporation in that respect, be they great or small, ought not in any way to affect the price of gas. When it was recently proposed to raise the price of gas 5d. per 1000, or to 3s. 5d. per 1000 feet, as charged in Liverpool per cubic foot, it is said would, considering the present low price of coal, be a most unwise proposal, and one which ought not to be subjected to, and it was argued that instead of any absence an improvement-rate should be levied, [illegible] such a proposal, if carried out, would affect the ratepayers, was clearly shown in a letter from a "Ratepayer," which appeared in the Manchester papers, and in which it was stated that "there are more than 30,000 householders who do not consume more than 650 cubic feet of gas per annum, which gives (at the additional price of 6d. per 1000 cubic feet) 1s. 10½d. per annum, and the consumption of the whole of these 30,000 would be represented by only the 100,000, and, calculated on the rental of 4 would be represented by only the 100,000, and, calculated on the rental of 4 would be represented by only the 100,000, and, calculated on the rental of 4

oppose the action of the London Gas Company to sell the sale of gas-stoves in its present duties."

The amendment was not, however, seconded; and the motion, on being put, was passed.

The only other paragraph in the report in reference to Gas Bills was the following:—"The Wandsworth and Putney Gas Company seeks power to raise further share capital to the amount of £100,000, and to borrow £50,000, the dividend on the share capital to be at the rate of 7 per cent. This Company is not exempt from the provisions of the Gas Works Clauses Act of 1860 only. Your Committee recommend that a petition be presented against the Bill, praying that it may be made subject to similar provisions as to auditing, mode of notice and dividend, disposal of new shares by auction, and other matters, as have already been applied to other Companies; and also that any new buildings to be erected by the Company may be governed by the provisions of the Metropolis Local Management and Building Acts."

This proposal was likewise agreed to.

The Artesian Metre System or Measuring.—At the meeting of the Kensington Vestry last Wednesday, the Gas Lighting Committee reported that The Gaslight and Coke Company have agreed to reduce the proportion of contract lamps in the parish from 1 in 20 to 1 in 21. The Committee therefore recommended that 40 matters be at once taken out of calculation. This was agreed to.

METROPOLIS WATER SUPPLY.

The Southwark and Vauxhall Water Company's Bill.—The Parliamentary Committee of the Metropolitan Board of Works presented a report at the meeting of the Board last Friday, in the course of which they say, in reference to the above-named Bill: "By the Southwark and Vauxhall Water-Works Company's Bill power is sought to enable the Company to raise additional capital for the supply of water within the Metropolis, subject to the consent of the Board of Trade. It appears to your Committee that it would be better that any proposal for enlargement should be brought before Parliament in a Bill, instead of being dealt with by the Board of Trade. The Company proposes to construct an additional pumping-station, reservoirs, and other works, and to raise £200,000 of additional share capital. The necessity for this should be fully proved by the Company, if the Bill be authorized; provision should be made for its basis by public notice or auction, in accordance with the

Canon Hawkins thought they could not do better than re-elect the same gentlemen, who had served them so well in the past. He proposed the re-election of Dr. Clay, who joined the Directorate at the time that he (Canon Hopkins) was Chairman, in the early days of the Company. He congratulated them upon the position the Company had attained, and the great benefit it was doing for the poor in providing them with an abundant good that it was doing for the poor in providing them with an abundant supply of wholesome gas at a cheap rate.

Mr. Chairman seconded by Mr. G. Fales, and agreed to.

The Master of St. Cuthbert's proposed the re-election of Dr. Percival as one of the Visitors, and, in doing so, took the opportunity of referring to the value of the shares of the Company, which had been disposed of at a recent sale at 14 15s. premium, which was the largest price that had ever been realized.

The motion was seconded by Mr. F. Pearce and adopted.

Dr. Percival returned thanks for his re-election, and spoke in complimentary terms of the way in which business was conducted by the Directors, and promised to do his best to serve the interests of the Company.

Mr. Clayton proposed, and Mr. Swan seconded, a vote of thanks to the Chairman, which was agreed to.

The proceedings then terminated.

ROCHESTER, CHATHAM, AND STROOD GASLIGHT COMPANY.

The Half-Yearly Meeting of this Company was held last Thursday—Mr. Thomas Wells in the chair.

The Secretary (Mr. W. Spicer) read the report of the Directors, which stated that the business of the Company for the past half year had been more favourable, the profits allowing of the writing off of a few items from the capital account in addition to paying the usual dividends. The new contracts were also about to be executed, and some other improvements made. The usual dividends at the rate of 10 per cent. per annum on the A and B shares, and of 7 per cent. on the D and E shares, were recommended. The statement of accounts showed a balance of profit on the half year's working of £1,000 4s. 10d.

The Hon. H. Nassau moved, and Mr. W. P. Hayman seconded the motion for the adoption of the report, which was agreed to.

The Chairman proposed the payment of the dividends recommended in this report.

Mr. Hayman seconded the motion, which was carried.

The retiring Director (Mr. J. Levy) was then re-elected; and Mr. W. Hayman, who was formerly Auditor, was elected a Director in place of the late Mr. N. H. Black. Mr. W. F. Hayman was appointed Auditor, vice Mr. Hayman.

A vote of thanks to the Directors, which was acknowledged by the Chairman, ended the proceedings.

EASTBOURNE GAS COMPANY.

A Special Meeting of this Company was held on Monday, the 21st inst. —Dr. Jeffray in the chair—for the purpose of considering and, if thought fit, of approving a Bill for conferring further powers on the Company for the purchase of land, the construction of works, the raising of money, and other purposes connected with gas-lighting.

The Secretary (Mr. J. H. C. Collins) having read the notice of meeting,

The Chairman stated that the Directors had, in the first place, consulted the Shareholders at the last meeting that the Directors received their sanction to apply to Parliament for powers to increase the capital of the Company. They had since then, with the assistance of their Parliamentary Agents, their Engineer, and their Secretary, drawn up a Bill which had been duly deposited with the Members and Standing Order of the House of Commons. The Bill had been referred to the Local Board, and examined by that body, and the only objection they had raised was that they desired increased pressure in the supply of gas. The Directors had taken the consideration, had, however, decided to let the Bill remain as it was, as a matter of opinion that what was sufficient for London was sufficient for Eastbourne. The only other objection raised was to a clause in the Bill, which, if passed, would give them the power to sell or let on hire gas-fittings, engines, machinery, &c. A municipal law had been received from the Solicitors of the Standing Orders Committee, which advised the exclusion of this clause from the Bill. The Local Board, however, had decided not to oppose the Bill, and would not have any objection to the Company supplying with gas-fittings, &c., those inhabitants of the town who asked them; and he could see why they had no objection whatever of commencing a gigantic trade in these articles. The Directors, however, had an opposed view, and reasons could only now be given from one reason—in opposition to the Bill meant putting it off for another year; while, on the other hand, to withdraw the Bill was to lose the custody of sixpence. The Directors did what they thought best, not only for the Shareholders, but for the town at large. It was not to the benefit of part of the Company to monopolize the trade of gas-fittings in the district; but they considered it would be to the advantage of the Company to have these powers, and if they obtained them it by no means followed that they would exercise them. The Bill had already, as he had said, passed the Examiners of Standing Orders, and no doubt Parliament would also pass it.

Mr. Hillman seconded the motion, and it was carried unanimously.

This was all the business of the meeting.

YORK UNITED GASLIGHT COMPANY.

The Half-Yearly Meeting of this Company was held on Thursday last—Mr. F. T. Tatham in the chair.

The Secretary and Manager (Mr. C. Sellers) read the notice of meeting and the following report on the Company's operations during the last six months:—

The profit upon the half year's revenue account amounts to £6612 2s. 8d. This sum, added to £23 4s. 6d., interest on money specially deposited at the Company's bankers, and £2 10s., balance of premium upon new shares issued, makes the total amount of profit for the half year, as per revenue account, £6637 17s. 2d. The Directors have appropriated £600 to the reserve-fund, and they now propose to apply the remainder to the payment of a dividend at the rate of £10 per annum on the old shares of the Company, and £5 per share, or £7 per cent. per annum on the new shares, for the half year ending 31st December. These payments will leave a balance of £37 17s. 2d. to be carried forward to the next account.

In accordance with the Company's Act of Parliament, a resolution to confirm the forfeiture of fifty-nine shares, not appropriated to the owners allocated to the Shareholders, was passed at the last meeting.

The two ventilators referred to

work. The Directors have in the last recent have been finished, and are now at work. The Directors have in the last recent have been finished, and are now at work. The Directors have in the last recent have been finished, and are now at

Canon Hutchens thought they could not do better than re-elect the same gentlemen who had served them so well in the past. He proposed the re-election of Mr. Glass, who joined the Directorate at the time of the amalgamation of Mr. Glass, who joined the Directorate at the time of the amalgamation of the Consumers' Gas Company with the Chartered Company, and the congratulated them upon the position the Company now occupied, and on the abundant good that it was doing for the poor, in providing them with an abundant supply of wholesome water at the low price of 2s. 6d.

The motion was seconded by Mr. H. Bates, and agreed to.

Mr. Glass, on behalf of the Directors, proposed the re-election of Mr. Perceval and Mr. Lawrence, two of the Directors who had been deputed to attend to the value of the shares of the Company, which had been disposed of at a recent sale at 71 10s. premium, which was the largest price that had ever been realized.

The motion was seconded by Mr. E. Pearce and adopted.

Mr. Perceval returned thanks for his re-election, and spoke in complimentary terms of the way in which business was conducted by the secretary, Mr. Cooke, and promised to do his best to serve the interests of the Company.

Mr. Clayton proposed, and Mr. Swan seconded, a vote of thanks to the Chairman, which was agreed to.

The proceedings then terminated.

ROCHESTER, CHATHAM, AND STROOD GASLIGHT COMPANY.

The Half-Yearly Meeting of this Company was held last Thursday—Mr. Horace Wigan in the chair.

The Secretary (Mr. Sydney Stone) read the report of the Directors, which stated that the Directors of the Company for the last half year had been more than usually successful, the profits allowing of the selling off of a few shares from the capital account in addition to paying the usual dividends. The new engineers were about to be erected, and some other improvements made. The usual dividend at the rate of 10 per cent. per annum on the A and B shares, and of 7 per cent. on the C shares, was recommended. The statement of accounts showed a balance of profit on the year's transactions of £3,000 odd.

Mr. Geo. R. Wheeler moved, and Mr. C. H. Hall seconded the motion for the adoption of the report, which was agreed to.

The Chairman proposed the payment of the dividends recommended in the report.

Mr. Wheeler seconded the motion, which was carried.

The retiring Director (Mr. C. Lovell) was then re-elected; and Mr. W. Hall, jun., was elected a Director in place of the late Mr. W. B. Hunt. Mr. W. F. Hayward was appointed Auditor, vice Mr. Hooper.

A vote of thanks to the Directors, which was acknowledged by the Chairman, ended the proceedings.

EASTBOURNE GAS COMPANY.

A Special Meeting of this Company was held on Monday, the 2nd inst. —Dr. Jeffrey in the chair—for the purpose of considering and, if thought fit, of approving a Bill for conferring additional powers upon the Company for the purchase of land, the construction of works, the raising of money, and other purposes connected with the undertaking.

The Secretary (Mr. J. H. C. Coode) read the notice of the meeting.

The Chairman stated that the Bill he approved. In doing so he reminded the Shareholders that at the last meeting the Directors were not in their sanction to apply to Parliament for powers to increase the capital of the Company. They had since that time, with the assistance of their late secretary Agents, their Engineer, and their Secretary, drawn up a Bill which had been duly deposited in accordance with the Standing Orders of Parliament. The Bill had been proceeded with by the Board, and examined by that body, and the only objection raised was that they wished for increased powers in the event of fire. The Directors were not unwilling to consideration, but, however, decided to let the Bill remain as it was, as they were of opinion that what was sufficient for London was sufficient for Eastbourne. The only other objection raised was to a clause in the Bill, which, if passed, would enable the Company to supply fire-grates, gas-fittings, stoves, meters, and gas apparatus generally. This was another introduction of the town dealing in gas-fittings, &c., who wished to exclude this clause from the Bill. The Local Board, however, withdrew their opposition to the Bill, and would not have anything to do with the removal from the gas-fittings. He (the Chairman) could not see that there could be any objection to the Company supplying with gas-fittings, &c., those who required them, if they wished to have them; and he might say they had an idea whatever of monopolizing a gigantic trade in those articles. The Bill, therefore, was an unopposed one, and he hoped would soon receive the Queen's assent. An opposition Bill was not contemplated for another year; while, at the present time, it would be promoted with a certainty of success. The Directors did what they thought best, not only for the Shareholders, but for the town at large. There was no wish on the part of the Company to monopolize the trade of the gas fitting in the town; but they considered it would be to the advantage of the Company to have them under their control. The Directors were of opinion that they would exercise them. The Bill had already, as he had said, passed the Examiners of Standing Orders, and no doubt Parliament would also pass it.

Mr. Hillman seconded the motion, and it was carried unanimously. This was all the business of the meeting.

YORK UNITED GASLIGHT COMPANY.

The Half-Yearly Meeting of this Company was held on Thursday last—Mr. Lee Norton in the chair.

The Directors and Managers (Mr. C. Sellers) read the notice of meeting and the following report on the Company's operations during the past six months:—

The profit upon the half year's revenue account amounts to £6152 9s. 5d. This sum, added to £23 0s. 6d., interest on money specially deposited at the Company's bankers, and £1 10s., balance of previous years the appropriations of fractional parts of shares, makes the total amount available for distribution £6,176 19s. 11d. The Directors have carried £500 to the reserve account, and they have now pleasure to apply the remainder in the payment of the usual dividend of 5s. per year per annum on the £50 shares, and at the rate of 7s. per year per annum on the £70 shares, for the half year ending the 31st ult., leaving a balance of £1,176 19s. 11d. These payments will absorb £5917 10s. 0d., and leave £59 9s. 11d. to be carried forward.

In accordance with the Company's Act of Parliament, a resolution to confirm the appropriation of profits shown, and apportioned in the usual dividend to the Shareholders, will be submitted to the meeting.

The two evidences referred to in the last report have been finished, and are now in use. The Directors also in their last report alluded to the remodelling of the retorts and the erection of a new purifier. This has been carried out, and now the whole of the retorting machinery, including the new retorts is occupied, and will overcome the heaviest demands of the coming winter. The purifier now awaits the completion of the new gasholder.

In anticipation of the latter circumstances, the main from Lawrence street Foss Islands road has been raised with a new 24-inch diameter, and forward to the Burnaby walk a 12-inch main is to proceed with on the part of the public that the Company should be in a position to meet the demands that have recently purchased on eligible site for offices in Coney street, York, which, from its central position, cannot fail to meet with public

TOWN AND COUNTY OF POOLE GAS AND COKE COMPANY.

The Eighth Half-Yearly General Meeting of this Company was held on Thursday last—Mr. Thomas Bond in the chair.

The Secretary (Mr. J. Bullen) read the notice convening the meeting, and the minutes of the last meeting.

The Directors' report, which was then read, stated that the Directors had much pleasure in presenting the accounts for the half year ending 31st December, and felt confident that the shareholders would be satisfied with the result of the year's operations. The profits for the half year ending 31st December, 1859, amounted to £1,000 19s. 6d., which, with £1 19s. 6d. brought forward from the last account, and £1 0s. 6d. interest on deposits, made a total of £1,004 19s. 6d. The Directors recommended the payment of a dividend at the rate of £5 per cent. per annum, leaving a balance of £4 19s. 6d. to be carried forward to the next account. The Directors had much pleasure in stating that the new gasholder, which was commenced in the autumn of last year, was completed, and in full operation. The Directors had also the pleasure to announce that the Company had been successful in obtaining the Parliamentary powers for the purchase of the Wimborne Gas Company's undertaking, and for the construction of works, the raising of money, and other purposes connected with the undertaking. The Directors were happy to say

... The Directors have to report ... to those consumers who ... on and after April 3, 1880, ... making with the previous outlays ... The balances of the subjoined revenue accounts, ... amount brought forward from the previous half year (after paying dividends), and £33 received for fittings, leave £1198 to meet interest on mortgages and temporary loans. These absorb £671, leaving (as stated in the report) £3827 applicable to dividend on the ordinary stock and shares.]

Gas Revenue Account, for the Half Year ending Dec. 31, 1879.

Dr.	£	s.	d.
Coals	£1159	8	5
Purifying	61	6	7
Salaries of Engineer, &c.	100	0	0
Wages	296	6	8
Repair and maintenance of works and plant	326	9	11
Salaries of Inspector & Clerks	129	11	8
Repair and maintenance of mains and services	79	8	9
Repairing & renewing meters	60	4	3
Lighting and repairing public lamps	89	2	7
Rent	3	10	0
Rates and taxes	89	1	4
Directors allowances	100	0	0
Salaries of Secretary and Accountant	83	6	8
Collector's commission	63	5	5
Stationery and printing	33	17	6
General establishment charges	62	13	4
Auditor's fees	2	12	6
Law charges	9	11	8
Bad debts and allowances	15	12	7
	£3298	9	10
Balance	2618	17	1
	£5917	6	11

Cr.	£	s.	d.
Sale of gas—			
Private rental	£4678	15	0
Public lighting	305	7	3
	£4984	2	3
Rental of meters	107	2	5
Residual products—			
Coke	615	14	1
Breeze	11	4	5
Tar	114	8	5
Sulphate account	27	15	4
Rent account	24	0	0
	£5917	6	11

Water Revenue Account, for the Half Year ending Dec. 31, 1879.

Dr.	£	s.	d.
Coals	£323	1	10
Wages	173	9	11
Repair and maintenance of works and plant	429	4	5
Salaries of Inspector & Clerks	25	16	8
Repair and maintenance of mains and services	71	5	7
Salaries of Engineer, &c.	50	0	0
Rent	11	11	8
Rates and taxes	89	1	4
Directors allowances	50	0	0
Salaries of Secretary, Accountant, &c.	41	13	4
Collector's commission	36	17	7
Stationery and printing	33	17	6
General establishment charges	62	13	4
Auditor's fees	1	6	3
Law charges	8	12	9
Bad debts	16	15	0
	£1431	7	2
Balance	1413	18	0
	£2845	5	2

Cr.	£	s.	d.
Sale of water	£2829	0	2
Rents	16	5	0
	£2845	5	2

The Chairman: It is now my business to move the adoption of the report and balance-sheet, and in doing so I shall not have occasion to detain you many minutes. I have made a few comparisons between the results of the last half year's business and those of the business of the corresponding period of 1878, and I find that the balance of profit is £3827 in the past half year, while at the same period of 1878 it was £2778, so

Mr. Martin ... their apparatus not being in order. Then they had ... storeage for liquor—sufficient for twice the quantity of coals they were carbonizing.

Mr. H. P. Stephenson said if the Company had ammoniacal liquor in stock they would, no doubt, have taken credit for it in stock. Probably 15 or 16 cwt. of sulphate of ammonia ought to be produced for every 100 tons of coal. The usual way was to deduct the cost of manufacture before the amount was shown in the balance-sheet, and he presumed this was done in the present accounts. He hoped, as the manufacture had been in operation only a short time, the Company might look for a considerable amount of improvement in the item.

Mr. Lass stated that the stock of liquor had been duly credited, and was included in the balance-sheet.

Mr. Sporne said there was no doubt that next year they would have far better returns. He supported the adoption of the report, believing it to be the best which had ever been presented to the Shareholders, and he was sure they could but congratulate the Directors, the Manager, and all concerned on the prosperous condition in which the Company found themselves. All they now wanted was a great many more customers in their large district, and there was no doubt the Company bade fair to be one of the leading Companies in the environs of the Metropolis.

Mr. London thought that the valuable statistics prepared by Mr. Lass and quoted by the Chairman should be printed, as the information they afforded was, he thought, something on which the Company might congratulate themselves.

The Chairman: We always send a report of the proceedings of the meeting to the Shareholders, and in that report will be included the figures I have quoted.

The motion for the adoption of the report was put, and carried unanimously, and the dividends therein recommended were declared. It was also resolved that the next meeting of the Company should be held at Barnet.

The Chairman then proposed the re-election of the retiring Directors (Mr. J. Glaisher and Mr. Joslin), both of whom, he said—the former as an eminent scientific man, and the latter as a resident in the neighbourhood of Barnet—took a great deal of trouble in promoting the interests of the Company.

The motion was carried unanimously.

Mr. Glaisher, in responding, thanked the Shareholders for again placing him in what he considered to be a position of trust. Up to this time he thought he might fairly say he had done the best he possibly could to advance the interests of the Company, which he believed would in the future occupy a high position. In five years they had increased their gas-rental by nearly 50 per cent., and their water-rental by 110 per cent., and he hoped, if they went on progressing, what he had said would be realized.

Mr. Joslin having briefly returned thanks for his re-election, the retiring Auditor (Mr. Lennard) was re-appointed.

Some conversation then took place as to the remuneration of the Directors, and it was at length resolved unanimously, on the motion of Mr. Plummer, seconded by Mr. London—"That the remuneration of the Directors be increased from £300 to £400 per annum." A further resolution was passed increasing the Auditor's remuneration from 7½ to 10 guineas.

The Chairman returned thanks on behalf of the Directors, adding that as it was always gratifying to them to express their satisfaction with the conduct of the staff, he had much pleasure in asking the Shareholders to give a vote of thanks to the Secretary (Mr. Lass), the Engineer (Mr. Martin), the Collector (Mr. Wright), and the staff generally.

Mr. Lass and Mr. Martin having responded, the proceedings closed with a vote of thanks to the Directors.

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REDHILL GAS COMPANY.

The Ordinary General Meeting of this Company was held on Friday, Feb. 20, when the following report of the Directors, on their operations during the past year, was presented:—

The reduction in the price of gas, referred to in your Directors in their last report, took effect on the 1st of April last; they are pleased to be able to report that the consequent diminution in the rental of the Company has been already to some extent compensated by the increased consumption, which has commenced to be felt; but at no very distant period they may be in a position to consider the propriety of a further reduction.

The anticipated better, for providing the necessary increase in the average capacity of the works, is being promptly carried out, as far as the state of the weather will permit. The castings are now in course of delivery, and the Engineer has every reason to hope that the holder will be completed and in working order early in the autumn.

The continuous increase in the business of the Company has rendered necessary the enlargement of the Meter Department, additions to, and improvements in the plant and machinery. These important matters concerning the special attention of your Directors, who are also maintaining the entire property of the Company in good state of repair.

Under such circumstances your Directors resolved to offer preferred scrip to the Shareholders, thereby creating 2500 additional £10 shares, which were taken up by the holders of those shares were all more applied for and allotted, and the first call has been paid.

The net profit on the working of the past year amounts to £3316 1s. 5d., out of which the Directors recommend that a dividend, free of income-tax, be made at the rate of paid-up capital of the Company of 10 per cent., with the addition of a bonus of 2 per cent. upon so much of the capital as was subscribed prior to July 1, 1870, towards making up the deficiency in the dividend paid thereon below the statutable rate in accordance with the Act of Parliament, leaving a balance of £1316 1s. 5d. to be carried forward.

The total shares and loan capital of the Company is £27,500—viz., £20,700 of 10 per cent. shares, and £3250 of debenture bonds. The sanitary on capital account, including £1623 expended last year, is £4,384; but the additional capital having been invested in anticipation of calls on the additional shares, the interest thereon, amounting to £219 4s. 10d., is paid out of the balance of the interest receipts account has been credited to the capital loan account, the interest on debentures not, and £266 carried to reserve fund (which will then amount to £2750), there will be £3050 available for dividend on the ordinary stock of the Company. During last year, 3106 tons of coal were carbonized.

Revenue Account, for the Half-year ended Dec. 31, 1870.

Dr.	£	s.	d.	Cr.	£	s.	d.
Coals, including expenses	1291	11	1	Sale of gas—			
Purifying materials, &c.	111	7	0	Private rental,			
Wages and salaries	156	18	9	including meters			
Repairs and maintenance of works and plant	201	6	5	hired at 4s. 6d. per thou.	1122	4	5
	£1760	3	3	Public lighting, 56 lamps, including extra lights	1020	5	6
Less old material sold	13	5	0	4s. per lamp .			
	£1746	13	3	1870, 17,052,500 cubic feet at 3s. 6d. per thou.	2982	2	9
Repair, maintenance, and renewal of mains and services	333	15	10	Public lighting and under contract.	1732	10	3
Repairing & renewing meters	7	17	3		£5857	8	3
Lighting and repairing public lamps	161	18	11	Rental of meters	266	13	0
Rates	19	8	6	Services, fittings, &c.	151	2	6
Taxes and taxes	127	19	9	Residual products—			
Management expenses	249	9	9	Coke . . .	1767	14	9
Salaries of Secretary, Clerk, &c.	69	3	0	Breeze . . .	4	0	0
Stationery and printing .	25	11	0	Tar . . .	225	7	11
General establishment charges	12	14	10	Ammoniacal liquor.	20	9	1
Law and parliamentary .	20	0	0				
Rent and establishment .	7	7	0	Rents . . .	1820	15	1
Sales, fittings, and sundries .	36	2	4	Rents . . .	150	16	0
				Transfer fees, . . .	6	16	2
				Sundry goods . . .	1	1	6
Total expenditure .	£3254	4	—				
Balance .	2333	11	10				
	£5587	15	3		£5587	15	3

WOLVERHAMPTON GAS COMPANY.

The Fifty-sixth Ordinary Meeting of this Company was held on Tuesday, the 28th ult.—Mr. J. Cochrane in the chair.

The Secretary (Mr. A. Jones) read the following report:—

Your Directors have much pleasure in presenting their fifty-sixth half-yearly balance-sheet and statement of accounts, duly certified by your Auditor, showing the amounts of revenue and expenditure for the half year ending Dec. 31, 1870, and the appropriation of the balance. The gross revenue for the half year, including the small balance of last account, amounts to £7132 19s. 3d. From this gross revenue there is proposed the payment of 8 per cent. dividend upon the consolidated stock, and 2 per cent. (less income-tax) upon the paid-up capital of the preference shares.

Your Directors have also much pleasure in submitting detailed accounts of the working of the Birmingham Corporation Gas-Works in connection with the results of the working of the Wolverhampton Gas-Works during the last year. The production of gas in Birmingham was 1,870,000,000 cubic feet, against 1,700,000,000 cubic feet in Wolverhampton, and the cost of manufacture and distribution in Birmingham, 2s. 2d. per thou., against £2s.2d.in Wolverhampton. From this it will be seen that the cost of production in Birmingham was 2d. per thou. more than in Wolverhampton. The coal-gas in Birmingham was £19,000, or against £20,000 in Wolverhampton, or 1d. per thou. more than in Wolverhampton. The total in Birmingham ranged from 16 candles to 17 candles, and in Wolverhampton from 17 candles to 18 candles. The price now charged in Wolverhampton is 4s. per thou., and in Birmingham 3s. 6d. per thou., with a discount of 10 per cent.

At the meeting three of your Directors retire by rotation—viz., Mr. Insemanger, Mr. Hordern, and Mr. Cochrane—who are eligible for re-election. Your Auditor, Mr. Smith, also retires, but is not eligible for re-election.

In conclusion, your Directors beg to assure you they will continue to devote their best attention to the interests of the Company.

The Chairman, in moving the adoption of the report, said that it met the balance-sheet were, as they had been regularly for many years past, the satisfactory. The increase during the half year, but he thought that, owing to the improvement of the mains and other things, which had been considered at their meetings from time to time, they had had fewer complaints of the quality of the gas during the past winter than they usually had. He was glad to say that the Directors had had the opportunity of visiting the works of the Birmingham Corporation Gas-Works and their own works. They found that the production of gas in Birmingham was about 1s. per thou. more than in Wolverhampton, but the quality was considerably better, and about eight hours as much. The latter was a feature in their corporation rarely ever knew that where there was a larger return the article was not better. The Directors had also had the opportunity of comparing the charges (as 4s. 6d. to 4s. 3d. per 1000 feet), whereas the Directors of the Company, after long consideration, had seen no reason to alter their

works is considerably higher in comparison than that of the water-works; but it is confidently anticipated that, with certain improvement, the annual result will, in the end, benefit by the purchase of the works, although it may be some time before the Company derive any direct advantage from the improvements that had been carried out. Upon the negotiations with the Town Council of Wolverhampton, he hoped, he should be able to report that the terms in the market, £17, and latterly, it is said, speculative buyers have given more than £20 for them.

OUR GAS CONTEMPORARIES AND THE ELECTRIC LIGHT.—

The *Journal of Gas Lighting* and the *Gas World* (organs of the gas interest) are recently given by some English and French papers to the fact that the Paris Gas Company was ill at ease in regard to the electric light, and asserted superiority of this light over gas for the illumination of public buildings and extensive establishments of the kind. Those were too indifferent or too prejudiced to inquire very closely into the matter. We find, however, that a class of persons who must be admitted to have some slight knowledge of what is a good and what a bad light for a picture—the artists themselves—have protested against the use of the electric light at the *Salon*, this being stated to be the most unfavourable kind of illumination for effectively showing their productions. The protest, however, comes rather too late. The agreement entered into with the Jablochkoff Company for the supply of the electric light has been carried out, and the latter, we suppose, remain in use until the end of the season, artistic protests notwithstanding. Again, when sober-minded, right-thinking people ventured to express a doubt as to the permanent adoption of the electric light by those shopkeepers in Paris who had been so ready to take it up as a novel and attractive, not to say startling kind of advertisement, their remarks were received by the worshippers of the rising luminary with all the impertinent contempt usually manifested towards opponents by converts to a new faith. Yet what do we find? The *Figaro*, whose office in the Rue Drouot was one of the first buildings to be illuminated exteriorly by means of the electric light, has positively abandoned that system, and substituted for it two gas-lamps similar to those used by the Paris Gas Company in the Rue du Quatre, Septembre, where, by the way, only half the original number of burners are now lighted, and yet the general illumination of the thoroughfare is, we learn, if anything, a trifle better than that of the neighbouring Avenue de l'Opéra, where the electric light still reigns supreme."

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, FEBRUARY 24, 1880.

Circular to Gas Companies.

THE Bill in Parliament promoted this session by the Corporation of the City of London, which passes under the somewhat complex title of "The Gaslight and Coke, Commercial Gas, and South Metropolitan Gaslight and Coke Companies Bill," was read a second time last week, in spite of the mild opposition offered to it by Colonel Makins. We have already given an abstract of the numerous provisions in question, and are bound to say that the one made out by Colonel Makins was a long one. Although provisions have been inserted, in recent Metropolitan Gas Acts, for testing the pressure of gas, they seem to have remained in abeyance, and it is only now that it is sought to bring them into active operation. We may say at once that these provisions must prove vexatious to the Companies concerned, and are likely to lead to some loss. The day pressure at six-tenths need not be objected to; but the pressure of one inch required from sunset to midnight, and which must be kept at some excess, may possibly increase the amount of unaccounted-for gas. Perhaps, too, it is hardly fair to saddle the Companies with the cost of the self-registering pressure-gauges that will be required. The tests are made in the interests of the consumers, and as a self-registering pressure-gauge is a somewhat expensive instrument, the cost might very well have been divided between the Corporation and the Companies. But as the latter have been required to furnish all other apparatus for the testing-stations, we suppose that this fresh imposition must not be objected to. We feel somewhat sorry for the Gas Examiners, whose duties will be considerably added to under the operation of such an Act as is now proposed. Their daily attendance at the several testing-stations will be requisite—not necessarily at any fixed hour, although it would be most convenient to change the registering papers daily at the same time. It will be seen, too, that the Examiners will have to diligently study an almanac, inasmuch as they will have to report on the maximum and minimum pressures between sunset and midnight and midnight and sunset. The duty that is proposed, requiring the pressures to be taken twice a week at the public lamps, is altogether new, and must cause some trouble. We therefore recommend the Examiners to ask at once for those additional duties to be considered in their salaries. In some respects the Bill as it lies before us is, as we have previously pointed out, favourable to the Chartered Company, inasmuch as it repeals the clause in the Act of 1876, which requires the Company to keep a register of the quantity of gas made at each of their stations, and fines them for deficiencies in illuminating power according to the amount of gas manufactured. Under the new Bill it is provided that a Company—say the Chartered—having a deficiency of illuminating power recorded at one station, shall only forfeit a specific sum, according to the amount of the deficit; and it is further provided that the same Company shall not be fined for defects at more than one station on one day. Considering how the gas from the several manufacturing stations of one Company is now mixed up, this is only a fair provision. The testings for purity are to remain as under the Acts of 1875-6, the average of three days being taken to represent the purity of one day.

Perhaps, however, it is superfluous to go on pointing out the provisions of this measure, as, from the opinion expressed by the Parliamentary Secretary of the Board of Trade, it seems clear that the Board will not allow the Bill to pass in its present form. It has been sent to the Metropolitan Gas Referees, with a request that they will give their opinion upon its provisions, and send a report, on receipt of which the Board will consider what shall be done. We can hardly too much admire the grandmotherly attentions of the Board of Trade to the interests of Gas Companies. The naughty boys of the controlling Authorities and the Companies might have had, in a committee-room of the House of Commons, a stand-up fight, which would have proved very expensive to all but the Metropolitan Board of Works, who, by obtaining a modification of the 21st section of the Bill, have left the Corporation to pay all expenses attending its promotion. The Board of Trade, however, propose to induce the parties to forego this fight, by calling them together to listen to a little lecture, and bidding them to shake hands and be friends. The proposal is that Companies and controlling Authorities shall consent to a measure to be called an "agreed Bill," which the Board of Trade promise to push through. Perhaps this will, after all, be the best course that could be pursued. If we might raise an objection, it would be that it virtually makes two of the Gas Referees the arbiters of the fate of the Gas Companies. There is no fear that the powers conferred on the Referees will be injudiciously exercised; but we must confess that we shall look with some curiosity for the report they may present on the Bill.

People have long complained of the lighting of Blackfriars Bridge, and their complaints have at last been brought to the notice of the Common Council. The Committee of the Bridge House Estates presented, at the meeting of the Council last Thursday, a report in which they proposed an alteration in the shape of the lamps, noticing the fact that the lamps at present in use are often broken, and more often extinguished, especially in gusty weather. The lighting of the bridge, as a member remarked, has been a disgrace to the Corporation. Advocates of the electric light naturally proposed that this mode of illumination should be tried on the bridge, the power being obtained from the electric station of the Metropolitan Board of Works at Charing Cross railway bridge. We fancy that the suggestion may be carried out, notwithstanding the past experience of the Corporation with the light upon the Holborn Viaduct. We cannot agree, however, that the electric light is superior to gas in the case of a fog. *A friend*

just state that Alderman Chamberlain speaks of a reduction of threepence per thousand feet having been made in four years, since the purchase of the undertakings by the Corporation. There is, however, no necessity to base upon a reduction which must have been made. The Corporation were, so to speak, gorged with profits, and there was no other course for them than to lower the price to the consumers. The fact is, that another reduction ought to be made about the present time, and this the Corporation can well afford if they will only give up their practice of applying profits in aid of rates. It may be said this is no business of ours; but the matter involves a principle. Alderman Chamberlain considers that as the ratepayers are responsible for the gas undertaking, they, quoad ratepayers, have the best right to the profits made. We, however, who do not consider that the ratepayers have any responsibility at all in the matters, think that the consumers should be first considered. Of course, seeing that the ratepayer and consumer are generally one, it follows that any benefit conferred by a low price for gas would be equally shared in. Alderman Chamberlain tells us, truly, that if twopence be taken off the price of gas for the benefit of the consumer, fivepence must be added to the improvement rate; and he sees very clearly that many consumers would pay the increased rate willingly if they could get a reduction in the price of gas. These would, of course, be the large consumers; but there must be in Birmingham a numerous class of persons occupying tenements of low rateable value, to whom low-priced gas would be a greater boon than a low improvement rate. But it is of no use to argue this question. A majority of the Birmingham Town Council have made up their minds that a large proportion of the gas profits shall be devoted to the improvement rate, while a very considerable balance is carried to the sinking-fund, which is calculated, at its present rate of increase, to pay off the purchase-money in twenty-eight years—a debt which Parliament has allowed them eighty years to wipe out. It is well, however, to make bay while the sun shines. The consumption of gas in Birmingham has relatively diminished, and the profits have, to a slight extent, decreased. There is also a prospect of their being smaller at no distant date, for coals are rapidly rising in price, and it is estimated that they will cost the Corporation £20,000 more for the present year than last. Consequently, if the Corporation do not make a reduction in the price of gas shortly, they will be compelled to do so in the future. Meanwhile, we would remind the consumers of Birmingham that, as the Corporation brought down their price to 2s. 3d. per thousand feet?

The annual meeting of the Imperial Gaslight Company was held last week. The balance of revenue account admitted of the payment of maximum dividends—namely, ten per cent. upon the A shares and seven and a half per cent. upon the B and C shares—and to carry forward a balance of £208 the B and C shares—and to carry forward a balance of £208 to the next account. In past times great complaints were made both of the illuminating power and of the sulphur impurities in the gas furnished by the Company, and the Directors seem now to have not rigorously to work to prevent any such complaints occurring. Their exertions, too, have made extensive improvements in their works, and are about to have erected new purifying plant of the most improved kind. For the time the Corporation and the Company appear to be at peace; but from what passed at the meeting it seems likely that the question of purchase may soon crop up again. The Company are about to issue new capital, which the Directors wished to put up to auction, but to this course the Shareholders objected, and it was eventually decided to allot the shares *pro rata* among existing Proprietors. The Bury St. Edmund's Gas Company held their half-yearly meeting on the 13th inst. The Company have been so far successful under the sliding scale that they are able to pay an additional one per cent. dividend. This is something, but the Chairman does not hold out any hope of being able for the present to make another reduction in price, so there is no prospect of further increased dividends. Nothing unusual occurred at the meeting except a dispute as to the duties of a Company's Auditor. The Solicitor to the Company sent in a bill claiming a lump sum of £250 for his services in obtaining the Company's last Act of Parliament. The account stated shortly that the amount charged was for "innumerable attendances and correspondence relative to the "new Bill," and other duties in connection therewith; and, without specifying each item, really gave a summary of all the work done. The account had, of course, been passed by the Directors, and was placed before the Auditor with a receipt as usual. This officer objected that details should be given in the account, and refused to pass it. The Solicitor, however, declined to do so, and the matter was referred to the Directors, who, after a long discussion, decided that the account should be paid. The Auditor, however, refused to sign the receipt, and the matter was left in abeyance.

STATE INSPECTORS AND GAS COMPANIES.

With the Report of Mr. Hinton, the Inspector of Gas and Gas Meters for the Commonwealth of Massachusetts, the above-named State upon the Atlantic seaboard has been favoured. Mr. Hinton appears to be a gentleman who has some knowledge of the subject of which he treats. Our readers have been made familiar, from time to time, with the views of Mr. Hinton's colleagues in other States, and with the history of legislation which could seem to be necessary to the proper performance of the duties established by the various Acts. Mr. Hinton appears to somewhat different lines of the generally-accepted lines of the average disgruntled gas undertaking—the gas authorities, who, as they [illegible] to do [illegible] justice to the gas consumer, even though that justice is sure to be injustice to their own pockets.

While Mr. Hinton, in the main, appears to be willing to do most what is right, his feelings always run to the side of the consumer. In making up his report, he has evidently had the interests of the consumer at heart, and has not regarded at all save omitted in the second table. Another curious statement which we find in this report is the statement that he found one meter which registered correctly. This is the first time we have heard of such a thing. He finds that the average error of all the meters about which complaints were made was 2·3 per cent. in favour of the gas company. Of course, we will consider that the average per centage of the mass of Massachusetts meters will be considerably more than this, and that the average error will be in favour of the consumer.

Another very suggesting feat to the constitutional gremlin will be apparent when he reads that "in each case, a careful inspection showed the gas to be of good illuminating power and free from ammoniac." The Inspector adds that the gas was "fairly well purified."

The most seeming thing in connection with this report (and the same unmistakable chorus which is evidenced towards the gas maker. The Inspector is often disposed to think that he is treated with injustice by the managers of a gas company should be suspected of such devious ways and the determination of interested consumers as to the best manner of manufacture and distribution are conducive upon sound and honest principles, and which, in the long run, will be found to be the best for all concerned. Then, this subject can only be dealt with by an Inspector who is thoroughly conversant with the whole question, and who is not hampered by any fear of [illegible] but who is free to have their doubts confirmed or dispelled by the proof of a practical test.

The reason why the Inspector thinks this is that he fears the gas-maker will take advantage of the notification, and instantly turn his energies to the production of illuminating power at the expense of purity. This is a fear which we do not entertain. The remedy proposed to obviate this evil is that the gas should be made at irregular intervals, not without previous warnings, but without any fixed time. This remedy appears to us to be worse than the disease. It would be impossible to obviate the evils that the Inspector fears by any such means as he suggests. The remedy proposed to obviate this evil is that the gas should be made at irregular intervals, not without previous warnings, but without any fixed time. This remedy appears to us to be worse than the disease. It would be impossible to obviate the evils that the Inspector fears by any such means as he suggests. The remedy proposed to obviate this evil is that the gas should be made at irregular intervals, not without previous warnings, but without any fixed time. This remedy appears to us to be worse than the disease. It would be impossible to obviate the evils that the Inspector fears by any such means as he suggests.

When this comes to pass, and we hope it will shortly, the latter it will be for all concerned. With fairness on all sides and with a disposition to do away with the old-world animosities—the gas meter—can be fairly trusted to do [illegible]

Printed by Messrs. Salmon and Son, Their Parliamentary Agent had been paid £ [illegible] Number of Words [illegible]

House of Commons, now submitted to the Proprietors, is approved of by them."

Mr. NORTHCOTE presumed it was the same Bill as that promoted by the Company last session.

The CHAIRMAN: It is very much the same. It does differ slightly in this way: In our original draft last year we took powers to manufacture and supply electricity, but we have thought it better to omit that clause now. The Bill will be subject to any modifications Parliament may introduce.

Mr. NORTHCOTE inquired whether there was any intention to ask for increased capital.

The CHAIRMAN: No; we have plenty. We do not anticipate that this will be an expensive matter. We may spend £100, £200, or perhaps even £1000; but we shall not spend a shilling more than we can see profit for.

Mr. BENJAMIN seconded the motion.

The CHAIRMAN: There is an amendment, so I will put the resolution that the Directors be authorized to take such steps as they may be advised to apply for Parliamentary powers.

The motion was carried unanimously.

Mr. NORTHCOTE supposed it would be somewhat irregular to ask any question outside the business on which they had been called together, otherwise he would have liked to ask if any progress has been made as to amalgamation.

The CHAIRMAN: No; not in any way. I may answer that question myself.

Mr. NORTHCOTE said he was not at all an advocate for amalgamation unless they could do so on proper terms.

The proceedings then terminated.

LIVERPOOL UNITED GASLIGHT COMPANY.

The Half-Yearly General Meeting of this Company was held last Tuesday—Mr. D. O. HAYMAN presiding.

The SECRETARY (Mr. P. P. Garnett) read the Directors report, which was as follows:—

The Directors have ceased to be required and submitted to them an estimate of the cost of the necessary for the half year ended at the 31st of December last, in accordance with the Company's Acts of Parliament, and have, out of the profits, resolved to recommend the Proprietors to declare a dividend, for the half year ended as above stated, of £3 on every £100 ordinary consolidated stock, and at the rate of £3 10s. for every £100 of the 7 per cent. and 5 per cent. stock, and on the capital paid up in respect of the new £7 10s. shares.

The consumption of gas has of late increased so rapidly as to necessitate an immediate enlargement of the Company's Gasworks at Bootle, and a Bill to give the necessary powers for the purpose has been deposited in Parliament, and is now before it.

The Directors have to record, with deep regret, the death during the past half year of one of their colleagues, JAMES LEIGH, Esq. The vacancy thus caused in the Board has been filled up by the appointment of THOMAS HERBERT, Esq., in Mr. Leigh's place.

The CHAIRMAN, in moving the adoption of the report, said that the Company had, during the past six months, been going on in their usual satisfactory manner and usefulness. During this time nothing had occurred that he knew of which required any apology or explanation from him. They had been allowed to go on quietly, and had not been the subject of any attack in the newspapers, whilst their arch-enemy, electricity, did not seem to have made very much progress—at all events, not such progress as to have done the Company great harm, if they might judge from the increasing requirements upon their supply. As the accounts were made up only in the previous week, he regretted that at this meeting, but the Directors had satisfied themselves that they had quite sufficient at the credit of profit and loss account to be able to pay the dividends recommended in the report.

Mr. J. A. TYLER seconded the motion, which was carried unanimously; and the dividends recommended in the report were declared.

A Special General Meeting was then held, for the purpose of considering the Company's Bill in Parliament, entitled "A Bill to enable the Liverpool United Gaslight Company to create additional gas-works, to extend their limits of supply, and for other purposes connected therewith."

The SECRETARY explained that though the Bill, as proposed to be now enacted, contained clauses empowering the Company to borrow further sums of money, these clauses had, by a resolution of the Board of Directors, been ordered to be struck out of the Bill, and would not be presented to Parliament. The Bill, as now proposed, would, he presumed, be read on the clauses, showing that the object of the Bill was to extend the limits of the Company for the supply of gas so as to include the townships of Bootle and Toxteth, in the parish of Sefton, and to enable the Company to enlarge their works at Linacre.

The CHAIRMAN said the Proprietors would pretty well understand what they were going to Parliament for. They owned 24 acres of land at Linacre, and 10 acres at Bootle, and the remaining portion of the land (making 34 acres was purchased at a subsequent time, and upon this the Company had no power to build; and as the Legislature was very jealous about the erection of any works which could possibly be a nuisance, the Company were obliged to go for powers to build upon this land, because the 10 acres at Bootle were not sufficient for the works they erected. Orrell and Ford formed a small district to the north-east of Bootle, where in which there was a large amount of building going on just now. They proposed to extend into the territory of the Company; and the new proposed straightened their boundary—in fact, gave them a more "scientific frontier." He went down to inspect the district with their Engineer (Mr. Thomas Hogg), and they found that they could light half-any-town seven streets, whilst the Company could only light one street. They could supply gas to them at one-sale they could light one of two houses under the same contract, and not the other. The proposed extension would cost very little; it would bring in a certain amount of revenue; and it would confer benefits on the inhabitants of the district. He moved—"That the Bill now submitted to the Proprietors, entitled 'A Bill to enable the Liverpool United Gaslight Company to create additional works, to extend their limits of supply, and to borrow further sums of money,' be approved by this meeting." He said, could quite understand that last section was rather obscure, and that they did not go for borrowing powers. The money clause they would have to defer until a future occasion, and there was no doubt that it would not be long before they went to Parliament with a more comprehensive Bill. The present Bill, therefore, that the powers it sought would be passed without opposition.

Mr. TINNE seconded the motion.

Mr. COPE asked if, in addition to studying the requirements of the out-townships, the Directors had ever turned their attention to the great good they might do by lighting up working men's houses in the parish of Liverpool. He was sure that no person could go round the town at night and see the hundreds of houses in the back streets, courts, and entries, without wishing there could be some mode of lighting up these places at a small charge, without the costly meter and deposit system. He would suggest a monthly payment guaranteed by the landlord, and that the houses should be lighted, say, for four hours a night. The cost would be about 1s. 6d. a month, and he was sure that it would be a source of incalculable good for the health and welfare of the inhabitants. When they saw them sitting in their miserable houses, lighted by a farthing candle, they could see a weather at the luxuriant going away to the bright, well-lighted public-house, and he was rather astonished that it had not suggested itself to the Board to appoint a Committee to consider whether the consumption of gas could not be more extended amongst the poorer inhabitants.

The CHAIRMAN said their price for gas was fixed; and they could not make fish of one and flesh of another. They were not a philanthropic company. They were not intended to supply gas for the benefit of the poor, but primarily for their own private benefit.

Mr. COPE said he was not aware that they were a philanthropic company; and he did not want them to supply gas for nothing, but he thought they might combine the two things—making money and philanthropy. He did not advise that the gas should be given away, but that it should be sold at the usual price, supplied for a certain number of hours, and then turned off by a tap.

The CHAIRMAN said he thought this was more a landlord's question. The Company were bound to sell the gas by meter.

Mr. COPE said he had not made the suggestion in their Act of Parliament obtaining all this difficulty. He thought the time was coming when meters would be abandoned to a certain extent.

The CHAIRMAN said it was quite clear they could not insert such a clause in the present Bill, which had been deposited.

The SECRETARY said it would have to be covered by the notices.

Mr. COPE asked whether, as he considered it a subject of vast importance, the Directors would appoint a Committee to inquire into it?

Mr. HARRIS said he thought the matter was to assist one of self-interest, the question having been made, they might safely leave it to the Directors.

The CHAIRMAN said the Board would remember what Mr. Cope had said, and would talk the matter over, and, if anything could be done which would not militate against the interests of the Company, they might consider it. In reply to a question, he said it was possible the Company would go to Parliament in a couple of years, but he believed that all the shares which were unsalled up on the 27 lbs shares would be spoil before they did so.

Sir THOMAS EARLE said he thought all the calls would be wanted for the works proposed in the Bill they were now going for.

The CHAIRMAN: We expect so.

The motion was then put and carried, and a vote of thanks to the Chairman, moved by Mr. DARBY, seconded by Mr. GASKELL, terminated the proceedings.

NEWCASTLE AND GATESHEAD GAS COMPANY.

The Annual Meeting of this Company was held on Wednesday last—Aldermen HEDLEY in the chair.

The SECRETARY, Mr. W. Hedley read the following report of the Directors:—

In accordance with the Newcastle-upon-Tyne and Gateshead Gas Act, 1873, the Directors have now to submit to the Proprietors a statement of the receipts and expenditure for the half year ending Dec. 31st, 1879, and to elect the Directors and Auditors for the ensuing year.

As announced in last year's report, the ordinary annual meetings will in future be held in the months of February and August instead of March and September, as formerly, and Dec. 31, which will thus be the date to which accounts are made up.

Although no half-yearly accounts have hitherto been published, the Directors beg to state that the quantity of gas manufactured during the half year was 1,000,000,000 cubic feet, viz. 10th, and the expenditure £94,284 9s. 10d., showing a profit, after full and account of £22,342 9s. 11d. After paying out of this sum £5,000 10s. 8d. Income-tax allowance and other charges, leave £17,341 19s. 3d., the balance brought forward from last year, £10,383 6s. 6d., which the Directors propose should be appropriated as follows:—

That year's Dividend, at 6 per cent.	£15,000
To reserved fund (making this fund £12,500)	1,500
Balance carried forward	225
	£16,725

The Directors propose that, from the 1st of January of this year, the price of gas be reduced from 3s. 6d. to 3s. 4d. per 1000 cubic feet, less 10 per cent. discount, which will make the net price 2s. 8d. per 1000 cubic feet—the lowest, they believe, that is charged in any district where the Company's Acts of Parliament are in force.

The Directors have to report that the Engineer-in-Chief, Mr. Thomas Hedley, and their Solicitors have been engaged in promoting the Company's Bill in Parliament, and that it has been laid aside for the present session. The Bill proposed to authorize the Company to make additional gas-works at Dunston, to extend the limits of their district of supply, and to raise additional capital. The Directors have also had under consideration the question of the Company's Act of Parliament, which expires in 1880, and have resolved to promote a Bill in Parliament for their own private purposes.

In order to meet these and future extensions, the Directors, a short time before the end of the year, purchased seven acres of land, on which the wrought and cast iron work necessary to complete No. 7 retort-house, at Redheugh.

The Directors have to report that, in accordance with the provisions of the Act of Parliament, they have called a Special General Meeting of the Proprietors, to be held at the termination of the ordinary meeting, at which resolutions will be submitted for the purchase of additional land, and for the erection of additional gas-works.

At the end of last year, the total mains and service pipes laid down amounted to 300 miles.

The Proprietors, at the present meeting, will have to elect Directors to hold office for the ensuing year, three of those who retire by rotation, and are eligible for re-election, being Messrs. Thomas Hedley, Thomas Hedley, junr., Thomas Hedley, Joseph Pleasance, James Douglas, John Bennett Alexander, Thomas Hedley, Joseph Addison, William H. Wilkinson, and Charles Henry Young. They retire, but offer themselves for re-election.

The Auditors are Messrs. J. H. Richardson and Mr. R. Y. Green, also retire, but offer themselves for re-election.

In addition to these gentlemen, there is to be a Public Auditor of the accounts of the Company, and the Directors have to recommend the appointment of Mr. Thomas Hedley, the elder No. 2, Gateshead, of the firm of Messrs. Hedley, Gateshead, whose duties and emoluments will have to be approved by the Corporations of Newcastle and Gateshead.

The CHAIRMAN moved the adoption of the report. After congratulating the Shareholders upon the very satisfactory condition in which the Company was, he said the balance-sheet showed that, after providing for a full dividend at the rate of 7 per cent., there was a balance of £15,725 to be carried forward to the next half year's account, and £1000 to the reserve fund of the reserved fund. In consequence of this balance the Directors had recommended that the price of gas be again reduced. Five years ago the price was reduced from 3s. 6d. to 3s. per 1000 feet, and in about two years the price was reduced to 2s. 8d., and now they proposed to reduce the price to 2s. 8d. less 10 per cent. discount—2s. 4d. net—to the ordinary consumers. This reduction would be followed by a like reduction to the general consumers in the large districts supplied by the Company. A reduction of 3d. per 1000 feet on the gas sold in the district amounted to about £20,000 a year. If nothing extraordinary occurred this year the Directors hoped to be able to pay the full dividend of 7 per cent., and somewhat their last Act of Parliament allowed them to do—pay 8s. more for the year. The Directors were not, however, in a position to declare more than 7 per cent. on the year if they could have for the twelve months of the present law price. It, in consequence of the improvement now going on in the low trade, coal advanced to higher prices, the Company had power to go back again to the price of 3s. 4d. per 1000 feet without reducing the dividend below 7 per cent. The balance of £15,000 carried forward, which was equal to a full half year's dividend, strengthened the Directors in their recommendation to reduce the price of gas, and to meet the ever increasing consumption. During the past year there had not been that great advance in the consumption of gas which there was in previous years; but they had held their own. Their works were still large and extensive enough to meet the heaviest demand in any week in the year. This heavy demand seldom continued more than two, three, or four weeks; but still they must have plant to meet the demands, or great complaints

Parliamentary Intelligence.

PRIVATE BILLS RELATING TO GAS, WATER, Etc.

SESSION 1880.

PROGRESS MADE TO SATURDAY, FEB. 21.

Title of Bill.		Petition for Opposed.	Bill Read 1st Time.	Bill Read 2nd Time.
Ackworth, Featherstone, Purston, and Stanley Gas Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Birkenhead Borough Bill	Commons	..	..	..
	Lords	..	..	..
Bristol Gaslight Company, Limited (Shaftesbury Potteries, Bill	Commons	Feb. 10	Feb. 16	..
Burton-upon-Trent Corporation Bill	Lords	..	..	..
Cardiff Water Bill	Commons	Feb. 9	Feb. 19	Feb. 26
	Lords	Feb. 19	Feb. 19	Feb. 23
Chester Gas Bill	Commons	..	..	..
	Lords	..	..	..
Cork Gas Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Cork Improvement Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Dagenham and District Farmers (Optional) Sewage Utilization Bill	Commons	Feb. 9	Feb. 19	Feb. 26
	Lords	Feb. 9	Feb. 19	Feb. 17
Dartford Gas Bill	Commons	..	..	..
	Lords	Feb. 9	Feb. 19	..
Denbigh Valley Water Bill	Commons	Feb. 10	Feb. 19	..
	Lords	..	..	..
Denton and Haughton Gas Bill	Commons	..	..	Feb. 16
	Lords	..	..	..
Doncaster Corporation Water Bill	Commons	Feb. 9	Feb. 16	Feb. 26
	Lords	Feb. 19	Feb. 19	Feb. 26
Eastbourne Gas Bill	Commons	..	..	..
	Lords	..	..	..
Edinburgh and District Water Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	Feb. 19	..
Exmouth and District Water Bill	Commons	..	..	Feb. 16
	Lords	..	..	..
Gaslight and Coke Companies (Consolidation) Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Gas, and South Metropolitan Gaslight and Coke Companies Bill	Lords	Feb. 9	Feb. 19	Feb. 17
	Commons	..	..	..
Great Yarmouth Water Bill	Lords	..	..	..
	Commons	Feb. 9	Feb. 19	..
Hinckley Local Board Gas Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Huddersfield Tramways and Improvement Bill	Commons	Feb. 9	Feb. 19	..
	Lords	Feb. 10	..	..
Hull Lighting Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Ilford Gas Bill	Commons	Feb. 9	Feb. 19	Feb. 16
	Lords	..	..	..
King's Lynn Corporation Bill	Commons	Feb. 9	Feb. 19	Feb. 16
	Lords	..	..	..
Lancashire County Justices Bill	Commons	Feb. 9	Feb. 19	Feb. 16
	Lords	Feb. 19	Feb. 19	Feb. 26
Lancaster Corporation Bill	Commons	..	..	..
	Lords	..	..	..
Lincoln Gas Bill	Commons	Feb. 9	Feb. 19	Feb. 16
	Lords	..	..	..
Liverpool Corporation Water Bill	Lords	Feb. 9	Feb. 19	..
	Commons	..	..	..
Liverpool United Gas Bill	Lords	Feb. 9	Feb. 19	..
	Commons	..	..	..
London Gaslight Company Bill	Lords	Feb. 9	Feb. 19	..
	Commons	..	..	..
Maidstone Gas Bill	Lords	Feb. 9	Feb. 19	..
	Commons	..	..	..
Malton Gas Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Oldham Improvement Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Phœnix Gaslight and Coke Company Bill	Commons	Feb. 9	Feb. 19	Feb. 16
	Lords	..	..	..
Portobello Water Bill	Commons	Feb. 10	Feb. 19	Feb. 16
	Lords	..	..	..
Prescot Gas Bill	Commons	..	..	..
	Lords	..	..	..
Preston Improvement Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Rathmines and Rathgar Township (Varsity Water Bill)	Commons	Feb. 16	Feb. 16	Feb. 16
	Lords	..	..	..
Rathmines and Rathgar Township Water Bill	Commons	Feb. 10	Feb. 19	Feb. 16
	Lords	..	..	..
Reading Gas Bill	Commons	..	..	..
	Lords	..	..	..
Rochester Corporation Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Sea Water Supply to London Bill	Commons	Feb. 2	Feb. 19	Feb. 16
	Lords	Feb. 10	Feb. 19	Feb. 26
Sligo Borough Water Bill	Commons	..	..	..
	Lords	Feb. 10	Feb. 19	Feb. 16
South Metropolitan Gas Company Bill	Lords	..	..	..
	Commons	Feb. 9	Feb. 19	..
Southwark and Vauxhall Water Bill	Lords	Feb. 9	Feb. 19	..
	Commons	..	..	..
Stafford Borough Bill	Lords	Feb. 9	Feb. 19	..
	Commons	..	..	..
Wakefield Corporation Water Bill	Lords	Feb. 9	Feb. 19	..
	Commons	Feb. 19	Feb. 19	Feb. 26
Wandsworth and Putney Gas Bill	Lords	..	..	..
	Commons	..	..	..
Wigan Improvement Bill	Commons	Feb. 9	Feb. 19	..
	Lords	..	..	..
Wrexham Water Bill	Commons	Feb. 9	Feb. 19	Feb. 17
	Lords	..	..	..
Yeadon and Guiseley Gas Bill	Lords	Feb. 9	Feb. 19	..
" "	Commons	Feb. 9	Feb. 19	..

HOUSE OF LORDS.

TUESDAY, FEB. 19.

Petitions against the following Bills were presented:—
Rathmines and Rathgar Township Water Bill, from Dublin Tramways Company.
Wakefield Corporation Water Bill, from Corporation of Halifax.

FRIDAY, FEB. 20.

Petitions against the following Bills were presented:—
Sea Water Supply to London Bill, from (1) Conservators of the River Thames; (2) Lambeth Water-Works Company; (3) Fulham District Board of Works.
Sligo Borough Bill, from Right Charles Parke.
Wakefield Corporation Water Bill, from (1) Henry Savile; (2) Owners, &c., of mills, &c. on R. Hebden and others; (3) Lancashire and Yorkshire Railway Company; (4) Aire and Calder and Aire and Calder Navigation Companies.

HOUSE OF COMMONS.

MONDAY, FEB. 16.

Petitions against the following Bills were presented:—
Burton-upon-Trent Corporation Bill, from Sir Henry Flower Every, Bart., and the Rev. Rowland Morley.
Dagenham and District Farmers (Optional) Sewage Utilization Bill, from James Stormonth Darling (by guardian of the estate of Peter Lauri Mackie, an infant).

MR. FAWCETT.—To-day I gave notice that he would ask the Secretary of State for the Home Department, on Monday, the 23rd inst., if he could state whether the answer the Bill relative to the Water Supply of London will be introduced.

MR. ROWLEY HILL delayed till yesterday the question of motion, originally fixed for Tuesday last, the 17th inst., "To ask the President of the Local Government Board whether, in view of representations from various districts to take water for their own supplies from watersheds with which they have no natural connection, the Government are prepared, in anticipation of legislation, upon the subject, to institute an inquiry into the whole question of water supply."

TUESDAY, FEB. 17.

GASLIGHT AND COKE COMPANIES, AND SOUTH METROPOLITAN GASLIGHT AND COKE COMPANIES BILL.

Alderman COTTON: I beg leave to move that this Bill be read a second time. The objects of the Bill are to enable the Companies to adopt a means of ascertaining the pressure of gas supplied over any particular district, by self-registering pressure-gauges known as a constant register at the testing-stations, and also by testing at the pressure at a certain number of the street-lamps, such number to be determined by the Metropolitan Gas Referees. It is necessary to adopt some means for obviating the present difficulty of ascertaining from the public manufacturing stations the gas supplied to any particular district, and to render it possible by those means to assess the penalties, which, under certain circumstances, cannot be done, the gas from many receiving stations being mixed before it reaches the district where it is consumed. The honourable member for the Chairman of the Metropolitan Board of Works is with us on this Bill. Originally, the Metropolitan Board opposed the Bill; but as they are now excluded from the first clause, they will not oppose the second reading.

Colonel MAKINS: I move that the Bill be read a second time this day six months. I am aware that the course I am asking the House to take is unusual, to reject a private Bill on its second reading—it is a course that is unusual one. At the same time, where a Bill is exceptional in its character, and is at all in principles and provisions in contrast to those recognized in the practice of the House, I think I shall have no difficulty in obtaining from the House that such a course ought to be taken. The Bill promoted by the City of London Corporation, and its objects are to regulate the testing of the illuminating power, purity, and pressure of the gas supplied to the City—points which have been very much dealt with in the Acts of the various Gas Companies. Both of these Acts were passed so recently as 1875 and 1876; and the Companies themselves, in a petition they presented last year with reference to measure brought in by The Gaslight and Coke Company, and in connection with other provisions, similar provisions to those contained in this Bill, stated that the regulations contained in the Act of 1876 had been most carefully considered, and were found to be most useful in their operation, having tended greatly to improve the quality of the gas. The Bill was read by the Corporation not later than last session; yet they bring in a Bill to alter and amend those regulations. The Bill is a Bill which, though promoted by the Corporation, deals with matters not outside their limits. We have heard the honourable member state that the Metropolitan Board are busy in promoting this measure. This, I need not say, is a recent conversion on the part of the honourable and gallant member for Truro will explain to us why it is that the Metropolitan Board of Works have changed their opinion on this subject, for no later than the 6th of this month they passed a resolution that the Board petition against the Bill. It may be that the Board of Works would be glad to have the Bill named, if they could bring it forward without having to call on the ratepayers for the necessary money. Knowing that the City has plenty of funds at its disposal, I may here point out that some such arrangement has been made between the City Bill and with these Companies, two of which supply gas outside the City. The third—The Gaslight and Coke Company—supplies an area more than five times as great as that of the City. Therefore the controlling power of the City is small compared with the power which the Bill seeks power to deal. My honourable friend (Lieut.-Col. Makins) will perhaps explain how his opposition on that point has been withdrawn. There is only one other objection—but it is a rather strong one—which we urge against the Bill. In all former arrangements for testing the purity and illuminating power of gas, the provisions have been placed on the Companies only, as to speak, by Parliament. The Companies have petitioned Parliament, and asked for increased powers to raise capital, Parliament, in exchange for the powers granted, required the Companies to submit, in the interest of the public, to certain restrictions. We have now a new way of dealing with

Gas Lighting Mch 26 1880 31

Miscellaneous News.

Gas Lighting March 26 1880

HARROW DISTRICT GAS COMPANY.

The Half-Yearly General Meeting of this Company was held at the Guildhall Tavern, London, on Wednesday, the 10th instant—JAMES GLAISHER, Esq., F.R.S., in the chair.

The ENGINEER and SECRETARY (Mr. J. L. Chapman) read the notice convening the meeting, and the following report and accounts were presented:—

The Directors have pleasure in again laying before the Proprietors the half-yearly statement of accounts.

There is a slight decrease in the gas-rental, caused by the depressed condition of trade, but still by careful management the profits have been increased.

The balance of profit and loss account shows a total of £1174 1s. 8d. The Directors recommend that a dividend at the rate of 6 per cent. per annum be paid (free of income-tax), and that £200 be written off the parliamentary expenses, which will leave a balance of £21 11s. 8d. to be carried forward to the next account.

One of the Directors, Mr. A. H. Baynes, F.R.A.S., and one Auditor, Mr. F. G. Fenton, retire by rotation, who, being eligible, offer themselves for re-election.

DR. *Revenue Account, for the Half Year ended Dec. 31, 1879.* CR.

DR.	£	s.	d.	CR.	£	s.	d.	£	s.	d.
Coals, including all expenses	£1119	15	5	Sale of gas—						
Purifying materials, &c.	33	14	1	Michaelmas quarter:						
Salary of Engineer	125	0	0	Private rental, 2,269,900 feet, at 6s.	£680	19	2			
Wages	206	10	1	Ditto, 309,600 feet, at 6s. 3d.	96	10	1			
Maintenance of works, &c.	238	12	2	Public rental & by contract	63	7	6	£810	16	9
Repair of mains and service-pipes	53	18	1	Christmas quarter:						
Renewing and refixing meters	13	0	5	Private rental, 5,881,600 feet, at 6s.	£1765	7	8			
Lighting public lamps	27	3	6	Ditto, 936,300 feet, at 6s. 3d.	292	13	5			
Rent, rates, and taxes	163	18	6	Public rental & by contract	172	9	0	2230	10	1
Directors and Auditors	150	0	0	Meter-rental, the half year				76	19	0
Salary of Secretary	25	0	0	Residual products—						
Collector's commission	30	0	0	Coke, less labour and cartage				345	15	10
Stationery and printing	17	2	3	Tar, " "				77	0	3
General establishment charges	72	4	2	Sulphate of ammonia				50	16	4
Bad debts	4	3	8							
Total expenditure	£2300	11	4							
Balance	1331	6	11							
	£3631	18	3					£3631	18	3

The CHAIRMAN, in moving the adoption of the report, said it was very much like the others which had been presented at their half-yearly meetings, but the Shareholders attention possibly might have been attracted by the large increase in the capital account as compared with previous half years. This arose from the fact that they found the Pinner Gas Company were laying pipes, and were within two or three yards of the boundary of the Harrow Company's district; and that the former Company were really coming into the Harrow district to supply a very large house. The Board at once prevented them from entering their district; but, of course, it became a matter of anxiety with them as to whether they should go into the Harrow Weald. It was a question of two or three miles of pipe being laid, and with a sparse population; but it seemed to the Board that this sparse population might be only for a time, and that as the Company would in all probability get a fair return for their money, they had better maintain their rights; and the decision of the Board was to lay the pipes into the Harrow Weald. They had done so, and this accounted for the increase in the capital account. He was sure that the matter was carefully considered, and he had no doubt it would have the Shareholders approval, because the capital had returned a fair amount up to the present time, and he had no doubt it would return an increased amount in the future. It would be seen in the second paragraph of the report that mention was made of there having been a slight decrease in the gas-rental. This was breaking the rule they had hitherto had, for usually there had been a slight increase; but in looking to the cause of it—it was stated in the report to be owing to the depressed condition of trade—it was found that one of their largest customers, the Greenford Colour-Works, had been so affected by the depression that they had consumed only half their usual quantity of gas; they had used from 100,000 to 150,000 feet of gas less in the half year than they had been in the habit of using. Then the railways had applied economy to the extent that the stations the Company supplied had used about 150,000 feet less of gas. This fully accounted for the slight decrease they had had in their rental. The sentence announcing this fact, however, closed with the statement that the profits had been increased, and this enabled the Directors to recommend the customary dividend, to pay off the usual amount from the parliamentary expenses, and to carry forward a small balance; so that, looking to the report in all its phases, he thought it would be seen to be satisfactory. The railway to which he had alluded on different occasions was now so far advanced that he was told it would certainly be opened on the 1st of June, and if this were so, he thought there was a certainty that the Company would have their coal very much cheaper in the ensuing winter than they had ever had it, and, as he had told the Shareholders before, whatever reduction they obtained in their coal they would apply in breaking through the heavy charge of 6s. per 1000 feet for their gas. They looked on the consumers as their best friends, and they wished to be working with them as far as possible. Therefore the full advantage of any reduction which the Company might obtain would at once be given to them, and it would be a pleasure to himself to do so, because he had always looked on the price of 6s. as being something they must alter as soon as they possibly could. This would be the first opportunity they had had. He did not know that there was anything further for him to say, inasmuch as the accounts gave so fully the financial position of the Company.

The DEPUTY-CHAIRMAN (Mr. John Chapman), in seconding the motion, said he quite concurred in what the Chairman had said as to the wisdom of extending their mains into the Harrow Weald, which would by-and-by become a most important part of the Company's district. As regarded the railway, all the bridges across the roads were completed, or nearly so, and there were only about 80 yards of line to be made to complete the system from St. John's Wood right through into Harrow Station, which was almost ready to be covered in. He thought the line was to be opened on the 1st of May. The Chairman had sometimes put before the Shareholders the prospect of 8 or 10 per cent. when this railway was completed, and therefore those dividends might not now be far off. With a reduced price of coal and a reduced price of gas, they hoped to see a large dividend for the Shareholders.

The motion was carried unanimously, as were others recommending the payment, free of income-tax, of dividends of 6 per cent. on the 10 and 7 per cent. capital of the Company, and that £200 be written off the parliamentary expenses.

The retiring Director and Auditor were unanimously re-elected, and briefly returned thanks.

The CHAIRMAN next moved a vote of thanks to the Resident Engineer and Secretary (Mr. J. L. Chapman, A.I.C.E.), and said that the Company were so dependent on the Engineer that, if he were to be careless and lose interest in the business, they would fall behind; but he thought the report showed that their Engineer had left no stone unturned to do the best he could for the Company.

Mr. C. HORSLEY, C.E., in seconding the motion, said he believed no more money was spent than in the case of any other company. He thought, as the Chairman had said, that the working must have been good to enable them to pay 6 per cent. on this occasion.

The motion was then carried unanimously.

Mr. CHAPMAN, in reply, said he certainly took a personal interest in the Company. He had begun with the Company, and hoped to continue with it, and he trusted they would soon get into the happy position of being able to pay 10 per cent.

On the motion of the CHAIRMAN, seconded by the DEPUTY-CHAIRMAN, a vote of thanks was passed to the Auditors.

Mr. A. H. BAYNES moved a cordial vote of thanks to the Chairman, saying that he did so feeling very much its force and justice. He could assure the Shareholders that no gas company could be better presided over than theirs was by Mr. Glaisher. He said this without the slightest affectation, and from his intimate personal knowledge of that gentleman's administrative ability. He congratulated himself as one of the Shareholders, that they had a gentleman of Mr. Glaisher's position to preside over their destinies.

Mr. T. C. HUDSON expressed his pleasure at seconding the motion. He had been on the direction from the beginning, and could, therefore, speak of Mr. Glaisher's value. He was always at his post, and ever ready to do the very best he could for the Company.

The motion was carried unanimously.

The CHAIRMAN, in reply, said he had hitherto done the best he possibly could for the Company, and would continue to do so. It was his duty, in redemption of the trust they had placed in him, and he would do all that lay in his power to advance the interests of the undertaking.

On the motion of Mr. G. RANDALL, seconded by Mr. KILBY, a vote of thanks was passed to the Directors, to which

The DEPUTY-CHAIRMAN briefly replied, and the proceedings terminated.

over

SOUTH SHIELDS GAS COMPANY.

The Ordinary Meeting of this Company was held on Thursday last—Dr. R. Wallis, J.P., in the chair.

The Secretary (Mr. J. H. Penney) read the notice convening the meeting, after which the following report was submitted :—

The Directors beg to submit to the Proprietors the accounts for the half year ending Dec. 31 last.

After the balance of the profit and loss (net revenue) account amounts to £3197 3s. 8d., a sum of which the Directors recommend the payment of a dividend for the half year ending Dec. 31 last at the rate of 7 per cent per annum.

The gas consumption for the past half year is 32,197,100 cubic feet, which shows an increase over the corresponding period of last year of 2,707,600 cubic feet.

The Directors have much pleasure in stating that the new purifying and meter-testing machine has been at work during the same period, and has given great satisfaction.

The Directors have effected a new arrangement by cancelling the contracts for a new gasholder and erecting the same on the site in the centre of town.

The Directors beg to recommend a reduction in the price of gas, to take effect from the beginning of the present quarter, which will be equal to a penny per thousand cubic feet. This will make the price of gas, in the parishes of South Shields and Jarrow, after delivering the usual discount, 3s. 4d. per 1000 cubic feet, and 3s. per 1000 cubic feet respectively.

The retiring Auditor is Mr. John Forster, who, being eligible, offers himself for re-election. The Directors retire from office each year in rotation.

Dr.—*Capital Account, for the Half Year ended* Dec. 31, 1879.

	Expenditure	Expended	Total
	Dec. 31, 1879.	Half Year.	Dec. 31, 1879.
To Expenditure to June 29, 1879 . . .	£111,981 10 0		£111,981 10 0
Since that date—			
New buildings, manufacturing plant, meters, stores works, &c.		£8,203 12 11	
New mains and service-pipes [incl. £1,000 for Jarrow] . .		170 8 10	
New meters [not in place of old ones] including fixing . .		121 7 5	
Costs of promoting special Act . .		1,000 0 0	
		11,195 9 3	
			£123,084 19 1

Cr.—*Capital Account.*

	Credited Receipts to June 30, 1879.	Receipts Half Year.	Total Receipts to Dec. 31, 1879
By £80,000 7 per cent. stock and share premium [as converted into South Shields Gas Consolidated Stock, at £91,500 per cent. . . .			£91,500 0 0
New stock . . . £5000 5 5			
Less calls unpaid 330 2 0			
		£7,340 13 9	7,340 18
Premium on issue of new stock . .		2,197 17 6	2,197 17
Loans on mortgages	19,950 0 0	50,000 0 0	69,950 0 0
Balance			£170,537 15 3
			2,197 17
			£168,661 1

Dr. *Revenue Account, for the Half Year ended* Dec. 31, 1879.

Manufacture of gas—		Sale of gas—	
Coals, including dues, &c. . £3,536		Public lighting . . .	£10,106
Purifying materials, &c. . 311 14	7	Private lighting and other sources	7,887
Wages of engineer and officers at works . . . 322	5		
Wages and gratuities . . 1,251	5	Rental of meters . . .	615
Repairs and renewals of plant 2,052	12	Residual products— Coke, less labour and carriage	662
Distribution of gas— Salaries of inspectors, &c. 105	6	Tar	1,000
Repair, maintenance, and renewal of mains, services, and meters		Sulphate of ammonia . . .	351
Repairing, covering, and re-laying mains . . 310	11	Rents	45
Gasholder rents . . 328	4	Transfer fees	6
Repairs and repairing gasholders 454	0		
Rents 140	0		
Rates and taxes . . . 496	7		
Collecting accounts— Collectors' salaries . . 160	11		
Salaries of Secretary, Accountant, and clerks . . 292	10		
Law charges 122	7		
Stationery and printing . . 111	10		
General charges and incidents			
Rates 170	11		
Income-tax 124	17		
Law charges 11	2		
Bad debts 12	15		
Total expenditure . .	£10,327	7	
Balance	3,197	3	
	£13,525	10	£13,525 10

The Chairman said since the Shareholders last met the Company had obtained the Royal Assent to the Bill they promoted in Parliament, and which, as they would see, created extended powers for the Act, and by which they were placed in a different position in regard to gas legislation. They would all have received the circular which explained the provisions of the Act, and if they would peruse that they would find the clauses were presented in a more comprehensive manner than formerly. The Directors had also consulted with counties with their Secretary and other officials. As they were aware, under the new Act of Parliament the old Shareholders of the Company were now in a position to divide over capital that might be created by new issues according to their interest in the Company, and the result of the Act was that it would be offered for sale by public auction. They had already disposed of one sale of shares, and the shares met with a very ready sale, and at a premium. This in itself was one of the most signs that the Company was in a sound and prosperous position. They had recently purchased the Jarrow Company, and the commercial relations which existed between the two companies would help to maintain their position amongst other mercantile concerns in the county. This decrease they had reason to believe would be closed, so that they might look forward to a new state of matters in regard to the development of the coal and industries of this country. They, in fact, saw on all hands a great revival in trade, and he was glad to observe that the receipts of the Stour Tyne Company, which for four had gone up 12 per cent. The iron and coal trades were looking forward to something more prosperous. With regard to the coal trade, he might say that the Directors had secured contracts, on most favourable terms, for the ensuing year—in fact, he might say that since they signed their contract coal had increased from 1s. to 1s. 6d. per ton. These were all signs of the times, and he was glad to say the Company were keeping pace with them. Comparing the corresponding half of the previous year with that of last year, they were in a most favourable position. Respecting the make of gas, in comparing the half year of 1878 with that just closed they had sold 2½ millions of cubic feet of gas more than in the corresponding half of the previous year, and in money value the increase was £991. These were all just sources of congratulation. Respecting the question of new legislation, he might say that the regulations of the Legislature were very strict, although at the same time fair and just. Instead of dividing the stock into shares of £100 each, as at present, the shares were sold at £10. The Shareholders, however, did not altogether lose the benefit, seeing that the premium realized went to increase the capital without increasing the dividend, and thus tended towards the reduction of the mortgage debt.

Mr. Ed. Jackson, in July and August cubic feet them 16s. 6d. per ton; in September and October, 15s. 6d.; and in November and December, 14s. 6d. The result was for the half year ending Dec. 31, 1879, 1s. 6d. per ton less than the corresponding period of 1878. He was glad to say that in the last month

MELBOURNE METROPOLITAN GAS COMPANY.

The Fourth Ordinary General Meeting of this Company, which supplies the whole of the City of Melbourne, embracing as it does the amalgamated undertakings of the late City of Melbourne Gas and Coke Company, the Collingwood, Fitzroy, and District Gas Company, and the South Melbourne Gas Company—was held on Wednesday, Jan. 28, when the Directors reported that during the half year to Dec. 31, 1879, the operations of the Company had been conducted in every department with efficiency and regularity, and had resulted satisfactorily. In compliance with the desire of the Conference of Municipal Bodies, acting under the authority of the Company's Act, the gas from the respective works had been conducted to the testing-room of the official Gas Examiner, Town Hall, Melbourne, with very satisfactory results. To provide more effectually for the requirements of the districts of Richmond, Kew, and Hawthorn, arrangements had been made for the erection of an out-station gasholder at Richmond. The purchase from the Crown of an additional area of 4 acres 3 roods 16 perches at the South Melbourne works would provide for all probable requirements of the Company at these works for many years to come. From the sum at the credit of net revenue account of £50,036 7s. 6d.,

The Directors recommended a dividend at the rate of 10 per cent. per annum, which would absorb . .	£27,860	10	0
To carry to a reserve-fund account	10,000	0	0
To carry forward to next account	12,175	17	6
	£50,036	7	6

The capital of the Company consists of £557,210 of shares, and £231,000 of debentures, £60,000 of which were issued last half year. The total expenditure on capital account to June last was £732,912, and during the past six months £18,895.

Dr. *Revenue Account, for the Half Year ending Dec. 31, 1879.* Cr.

Dr.	£	s.	d.	Cr.	£	s.	d.	£	s.	d.
Coals, including dues, &c. .	£40,038	10	5	Sale of gas—						
Purifying materials & labour	2,192	0	10	Consumed by meter . .	£85,923	16	8			
Salaries of Superintendents, Foremen, &c.	712	10	0	Public lighting and under contracts .	13,638	14	0			
Wages at works	7,331	6	3					£99,562	10	8
Repairs and maintenance of works and plant, less old materials sold	4,089	7	7	Residual products—						
Salaries and wages of Inspectors, &c.	1,847	1	0	Coke, less labour and cartage . .	£9,834	5	10			
Repairs, &c., to mains and services	1,508	15	7	Tar	3,802	18	4			
Repairing & refixing meters	1,602	4	0	Ammoniacal liquor . .	225	0	0			
Lighting and repairing public lamps	2,222	7	9	Other products . .	69	1	10			
Rents	261	18	9					13,912	6	0
Rates and taxes	562	14	0	Certificate fees				10	8	0
Directors allowances	675	0	0							
Auditors fees	42	0	0							
Salaries of Secretary, &c. .	2,901	13	8							
Salaries of Collectors . . .	1,470	0	0							
Stationery and printing . .	539	6	10							
General establishment charges and incidentals	282	19	8							
Gas Examiners and Assistants	154	18	10							
Law charges	100	6	3							
Bad and doubtful debts . .	1,347	14	8							
Subscriptions, as per vote of Shareholders	300	0	0							
Balance	42,696	11	7							
	£113,515	4	8					£113,515	4	8

Journal of Gas Lighting March 16, 1880

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MARCH 16, 1880.

Circular to Gas Companies.

The scheme for the amalgamation of the South Metropolitan and Phœnix Gas Companies still remains unconfirmed; but we are in a position again to state that not the least obstacle exists to its confirmation. It simply awaits the pleasure of the President of the Board of Trade in sending it forward to the Privy Council, and as there will be a meeting of the Council next Thursday at Windsor, we fully anticipate that in our next issue we shall be able to announce that the scheme has been sanctioned. The position of the Companies implicated in the scheme will not, of course, be changed. We have repeatedly said that the success of the proposal would involve the withdrawal of the Bill promoted by the Phœnix Company, and we understand that this has now been resolved upon. The measure promoted by the South Metropolitan Company will go forward, and we hope will be passed this year, as it is very desirable that the united Company should obtain the powers asked for as early as possible. It will be none too soon to commence next year their new works at Greenwich. To effect their completion will occupy a long time, and as soon as they can be brought into working order we are satisfied that the wants of the united district will require them.

We learn from Lieut.-Col. W. Haywood's report on the proceedings of the Commissioners of Sewers of the City of London during the year 1879, an abstract of part of which will be found in another column, that the experiment made with the electric light on the Holborn Viaduct was not a success, economic or otherwise. The light proved to be expensive—6s. 3d. per lamp per night—and the illumination was not more than twice that afforded by an ordinary gas-lamp. When so many complaints are made about a defective supply of gas to public lights, it is very satisfactory to find Lieut.-Col. Haywood reporting that the quantity contracted for in the City is regularly supplied. The Commissioners of Sewers have a certain number of metered lamps which establish this fact, and they also have inspectors whose experience enables them by the eye alone to decide that the full quantity of gas is being consumed in the other lamps. In all probability, in many cases, more than the contract quantity is being burned; for we have ourselves often been deceived, guessing that five feet were being consumed, when, as a fact, eight or more feet were burning. It is to be regretted that the use of the improved gas-lights in Queen Victoria Street was so quickly discontinued, but there is no answer to the fact that after business hours the traffic in that street is not great. The vehicular traffic is considerable up to a late hour; but foot passengers, except those on their way to the Metropolitan District Railway, get few and far between as the day closes.

We understand that the Trustees of the British Museum have determined to continue the use of the electric light *en permanence* in the Reading Room, and that the Royal Albert Hall Corporation have decided to re-introduce the Siemens light at the hall, with the improvements recently made by Dr. Siemens. The use of the electric light in large interiors seems likely to spread, more especially in such cases as where free ventilation cannot be effected, and we are not surprised to learn that the transformed tavern in the basement of the Royal Exchange is to be illuminated by its means.

The Hastings and St. Leonards Gas Company held their half-yearly meeting on the 4th inst. The report of the Directors necessarily showed a highly prosperous state of affairs. The working accounts for the past half year testify that the profits of the Company amounted to £4141. When full dividends on both classes of shares have been paid, there will remain a balance of £471 to be carried forward to the next account. Hastings, like every other south coast watering-place, grows, and larger demands are each year made upon the Gas Company. To meet these, the Directors and their indefatigable Manager, Mr. A. H. Wood, A.I.C.E., have decided to make considerable additions to their carbonizing plant. These, it is hoped, will be brought into use before the dark nights of next winter come on, and Hastings, with its extensions, will have the best gas supply the inhabitants could possibly obtain.

The Dover Gas Company held their half-yearly meeting on the 2nd inst. The Company, of course, pay their ordinary dividends, and, after adding to their reserve-fund, carry forward a considerable balance. In addition they also pay a bonus of one and a half per cent., in liquidation of the deficit of dividend in 1864. Better than this, the Directors are able to announce a reduction of threepence per thousand feet in price from July next, making the charge for the future 3s. 6d. instead of 3s. 9d. per thousand. The natural growth of the consumption of gas in Dover enables the Company to make this reduction without any risk to the dividends. There is, of course, the reserve-fund to fall back upon, and this will be sufficient to prevent any deficiency arising after the payment of full dividends.

The Directors report and statement of accounts of the Crystal Palace District Gas Company, issued in anticipation of the half-yearly meeting to be held on the 25th inst., are before us. The report of the Directors tells us in a succinct form the state of the balance-sheet for the past half year. The Company have made a profit during the half year to the amount of £11,986, which enables them, after clearing off all preference charges, to pay the ordinary Shareholders ten per cent., and to carry forward a balance of £1352. The report of the Gas Examiners shows, as usual, that the quality of their gas is well maintained, the illuminating power being above the standard; while sulphuretted hydrogen was entirely absent. In such well-managed works as those of the Crystal Palace District Gas Company, the absence of ammonia is not so much to be wondered at. Every grain of it is of value, and is fixed for the profit of the Company.

The Bromley Gas Consumers Company held their half-

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TO SUBSCRIBERS.

In consequence of the Easter Holidays, the next Number of the JOURNAL *of* GAS LIGHTING *will not be published until Wednesday, March* 31.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MARCH 23, 1880.

Circular to Gas Companies.

After a delay which is unaccountable to us, the scheme for the amalgamation of the South Metropolitan and the Phœnix Gas Company has received the sanction of Her Majesty in Council, and all, so far, is now settled. The delay of which we complain has, however, put the South Metropolitan Company to some inconvenience, inasmuch as the Bill they are promoting in Parliament this session, and which is highly necessary to them, still lingers at its second stage; though the Parliament which will break up to-morrow, and will be scattered the day after, might just as well have had the opportunity of passing this Bill. The duty of considering it is consequently relegated to the new Parliament about to be elected, it being understood that the measure will be taken up at the point at which it stands to-day. The importance of the combination just sanctioned can hardly be exaggerated. Nearly the whole of London south of the Thames will, for the future, be supplied with gas by one Company, whose interests will be at once to maintain the quality of the gas and reduce the price to the lowest possible figure. The arrangements as to the charge will be found in the copy of the scheme which we publish in another column; but we have referred to these in former issues, and need not here recapitulate them. It is sufficient to say that the consumers in the late Phœnix Company's district will reap an immediate benefit, and in the course of twelve months will share the complete advantages of the alliance with the South Metropolitan Company.

The Bill of the South Metropolitan Company, which may be called the Bill of the United Company, has been proceeded with as far as it could in the present Parliament. There is really no opposition to it, and but for the delay caused by the Board of Trade it might by this time have passed its third reading in the Commons. As matters stand, however, we must wait to see how it will fare in the new Parliament. We do not expect to see any great changes in the *personnel* of the representation in the south of London; but if any should occur, local influences could hardly affect the fate of this measure. All who are in any way acquainted with the position of the United Company will see how essential it is to them that the Bill should become law as speedily as possible. It is no wonder, then, that at the South Metropolitan Company's Whitsuntide meeting, held last Friday, a resolution of the Shareholders, consenting to the promotion of the measure, was passed unanimously. Some matters were pressed upon the attention of the meeting which really did not concern it. One of the Shareholders, for example, wished to know what the Directors were about to pay for the land they have engaged to purchase. We are astonished that any question should have been raised as to the necessity for the quantity of land, or as to the price it is proposed to pay for it. It seems to be forgotten that the Metropolis grows, and that the gas-works supplying it remain stationary, being in some instances utterly incapable of extension. The case of the late Surrey Consumers Company is almost one in point. They had space for small additions to retort-houses, but no possibility of making further storeage arrangements. The area occupied by the original South Metropolitan Company is extremely valuable, and offers peculiar facilities as a site for gasholders. Under these circumstances, it seems highly desirable that additional manufacturing power should be furnished in one quarter, while further storeage should be provided in another. We gather that the present works of the Phœnix Company are almost incapable of extension. It will thus be seen how urgently needed are the powers which the South Metropolitan Company's Bill proposes to confer. It is extremely unfortunate that a dissolution steps in before the completion of the work which had been cut out for the present Parliament. However, we are all victims of political vagaries; but in the present case we cannot help thinking that a few weeks will find this Bill far advanced towards receiving Royal Assent.

We are very glad to say that the Metropolitan Board of Works have withdrawn all opposition to the Bill of the London Gaslight Company. The objection raised by the Board to the Bill was of a most puerile character. It simply concerned the amount of capital which the Company should be allowed to employ in the new branch of their business which they are about to undertake—that of supplying cooking and heating stoves, and apparatus for the use of gas for other than lighting purposes. The Metropolitan Board were willing to sanction the use of £25,000 in conferring what we must regard prospectively as a great benefit to gas consumers; but the Company, very properly reviewing all the circumstances, found that they could carry on their stove business with loss, and so have agreed that only £20,000 shall be engaged in it. This amount of capital is small enough, and we are almost astonished that the Company should have proposed so low a figure. We have said before that for a business like the one projected, to be successful, it must be carried on in a most liberal spirit. There is a great future in store for any Gas Company who will enter upon the business of supplying gas-fittings, &c., on hire, and at the same time of furnishing gas at a fairly low price. We could point to many gas undertakings in the kingdom which have largely benefited by taking up the supply of gas stoves and apparatus for other than illuminating purposes; and the London Gaslight Company will, no doubt, be as successful as the rest. But the business must be carried on in no niggardly spirit. Of course, gas will be supplied at the customary rate; but, for the cooking and heating utensils, we should hope that the minimum price for sale and hire will be charged.

The Bristol United Gaslight Company held their half-yearly meeting on the 15th inst., at which, it is scarcely necessary to say, maximum dividends were declared. The new works of the Company at Stapleton are now in full operation, and the greatly increased demand for gas during the past dark winter has been fully satisfied. This is extremely gratifying, both to the Bristol and Clifton public, who will now find themselves fully assured of having an efficient supply of gas for some years to come, without further calls for capital and loud. We can hardly say that we entirely agree with Mr. Fiddes's determinations of light

DRAY'S BURNERS AND LANTERNS FOR STREET ILLUMINATION.

The accompanying illustrations show the burners and lanterns as manufactured by Messrs. George Bray and Co., of Leeds, for improved street-lighting purposes, the system which they advocate being, as our readers will know, the employment of large flat-flame burners in a specially constructed lantern. The system Messrs. Bray and Co. are introducing, though it may be said to be of only very recent date, has been tried by the public authorities of many of the principal towns of the kingdom, and in the Metropolis; and everywhere, as far as we have heard, is giving complete satisfaction.

Fig. 1 is an elevation, and fig. 2 a vertical section of the burner and lantern which Messrs. Bray and Co. have adopted for general use. The top ventilator is composed of two cylinders, *a* and *b*, and a cover, *c*, at the top. The chimney, *d*, is open at the top and bottom, and terminating at the top of the lantern, *d*, opens directly into it. Its top terminates in such a position in the

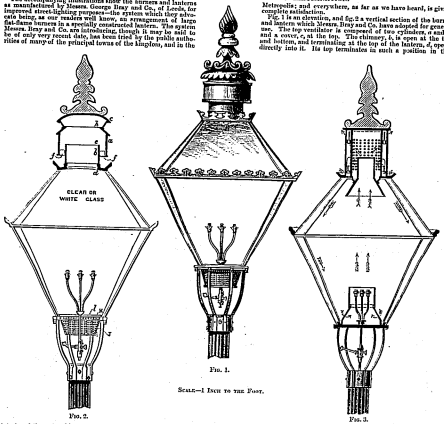

Fig. 1. Fig. 2. Fig. 3.

SCALE—1 INCH TO THE FOOT.

interior of the outer chimney, *e*, as with the aid of the tee cover, *c*, to prevent the wind getting into the interior of the lantern in whatever angle it strikes the ventilator. Between the inner and outer chimneys *a* and *b*, is an annular space, *f*, of about the same capacity as that of the inner chimney. The outer chimney, *e*, is open at the top, and is fixed a sufficient distance from the top of the lantern to allow a perfectly free downward exit of the products of combustion and air. The inner chimney, *d*, is contracted at the top, so that the area or aperture of about the same area as that of the inner chimney. This contracted portion is carried to a sufficient distance above the top of the inner chimney, so as to allow of the products of combustion and air to escape down through the annular space, *f*, when the top of the outer chimney, *e*, is almost entirely, as in fig. 2, a strong wind. It will be seen that the inner and outer chimneys, as well as the top cover are so arranged, that, while perfect freedom of exit for the products of combustion and air is provided, it is not possible for any current to pass into the lantern.

The inlet ventilator at the bottom of the lantern is composed of two distinct parts—the intake or diffuser, *g*, and the box of louvre boards in external at the top by a sheet of wire gauze, *l*. The diffuser takes in the air at the bottom of the lantern, and is, as will be noticed, quite it flares or diffuses it, while the small tubes in the centre, against each other, with the gauze on the top, conserve its passage into the lantern, forming a sort of vertical and quiet main. The intake or diffuser is made of perforated metal, of sufficient depth to take in the requisite quantity of air, and has concentric rings of perforated metal placed vertically inside. It deals with the air as follows:—When the atmosphere is at rest, the air passes in on all sides of the diffuser, and rises vertically through it; but when there is on one side of the diffuser only, and, striking against the convexities of it, has its force and eddies reduced by a small portion only, being turned up at a time in the passage horizontally through the ventilator, and by the currents being mixed up and turned in various directions by the perforations in the concentric rings.

Thus a proper proportioning of the respective capacities of the inlet and outlet ventilators is secured, and a perfect draught for the purposes of dealing with the flames are obtained, and are protected in all weathers by the louvre. In this column of air for the flame burners are set either slight, double, or in clusters, to suit the circumstances and the power of flame required. The burners are fixed either vertically or at a slight inclination from the vertical, so that the heated products may cause the flames to thicken and become empty in a current of air of the description the burners are slightly inclined, and the under sides of the flame are protected by projections, as shown in the engravings. By these means the flames are made to emit round the reverse way of the inclination, and are brought within the influence of more air, and the heat of the adjacent flame; the result being that the edges are made intensely white and brilliant, the flame being empty, as each burner is fixed in the centre.

Fig. 1 and 2, as before stated, are the lantern that Messrs. Bray and Co. have adopted for general use, in preference to figure 3, because of the necessity there is in that arrangement of a conductor chimney for conveying the required current of air to the flames. Fig. 3 is taken from the drawings of their first patent (No. 1451 of 1878), and is an arrangement wherein the top ventilator is made to answer as an inlet and outlet combined, the fresh air admitted through the perforations at the bottom of the outer cylinder passes over the conductor, and enters the lantern down its sides. The air is then conducted up to the burner—but before the flame—by a cylinder or chimney perforated at the bottom (seaborn in the drawing), or raised above the bottom of the lantern at a sufficient distance to enable the products of combustion to find an exit. In this manner a certain quantity of fresh air is conducted to the flame, and the heat of the flame is made to pass up to such volume and at such a rate of speed as will steadily increase the brilliancy of, and give control over the lighting power of the flame or flames admitted to its influence" and in the colours of air to "pass the flames, singly, doubly, or in clusters, and to each close proximity to each other, without touching, but that by the burners be increased, and the smoking tendency diminished."

Messrs. Bray and Co. have also more recently introduced an improvement in the rim of which the lanterns are made, which gives a maximum of strength with a minimum of light-obstructing surface. It consists of a doubled strip of metal being placed lengthwise, vertically, along the centre or gutter of the inside of the lantern rim, which, by this means, is made sufficiently strong to support the sash upon which the panes of glass rest, to form a squeezing bearer between the panes, and to prevent each pane encroaching upon the other portion of the rib.

SHEFFIELD WATER-WORKS COMPANY.

The Annual General Meeting of this Company was held on Monday, the 12th inst.—Mr. W. COCKAYNE, Chairman of the Board of Directors, presiding.

The following report was presented:—

"The supervising committee of the Company, formed on debenture, the sum of £25,000 10s. dividends on preference shares, £41,666 13s., the dividend after the rate of 2 per cent. per annum on the ordinary capital of the Company for the half year ending 31st December last, and the sum of £2,000 to the reserve fund, there remains in the net balance of income account as at that date, the year 1879, the sum of £29,310 7d. 9d., published with the report of last year, the sum of £29,310 7d. 9d., the balance of the

Mr. White's machines about the same time Mr. Wood bought his. I did that a great deal

and have obtained some very good results; but I have never made a thorough test at that pressure.

Mr. Vanderpool—Is it your impression that you could get as good results from a stove working under half an inch pressure as you could from one working under an inch pressure?

Mr. Goodwin—I think so.

Mr. Neal—How do you answer the objection that the stoves are returned in a great many instances, and that the reason given is that there is not pressure enough, when the pressure is an inch?

Mr. Goodwin—I would answer that by saying that I don't think they had anything like that pressure; there must have been a mistake.

Mr. Stinson—Mr. Neal has spoken about Mr. Gerould having stoves returned. I think he is mistaken about that, for my impression is that Mr. Gerould has told me to the contrary.

Mr. Gerould—I have never had but one stove returned, and that burned too much gas.

Mr. Goodwin—The great difficulty is that when the persons who are using the stove get through they do not turn off the gas. We got up a sort of lead pipe connection with a double back-action contrivance that would always turn down the gas the moment a pan or utensil was lifted from the stove and would turn it on when the pan or utensil was set on the stove; but that added to the expense of the stoves; they are too expensive." You see where I am drifting to now, and I want to say a few words upon that point right here.

A gentleman, at the head of a large gas company, and whom you all know, called at my office one day and we had a long conversation on this subject. During our conversation he said, "You charge too much for your stoves." I said to him, I will tell you what I will do; I will give you the cost of my stoves, and you shall name the price; the result was the present price. We introduced several thousand dollars worth of machinery in our establishment in order to reduce the expense of manufacture; but we had no sooner done so than the price of iron went up to such a figure that the advantage was entirely lost. Take, for instance, the foot of the stove. Where a man could make one dozen a day before, we have machines now by which he can make over 100 a day; but, as stated, we have lost the benefit of that by reason of the rise in the cost of materials. Wherever it is possible to introduce machinery we have done so.

In reference to this stove question, I will say that five years ago I bought a sample of every gas stove made in this country that I could get hold of, and I found they were not what was wanted—in my judgment. I tried in every direction, but could not get what I felt was wanted. I then sent one of my employees to Europe, and told him to travel in every direction where he could get any information. I kept him abroad five months, visiting England, France, Germany—everywhere that there was any information to be had; and he brought home all the information he could collect, as well as samples of the best gas stoves he could find.

Last year I sent another person abroad, and he was gone several months. He brought home all the information he could obtain, and other samples; and those stoves are the outgrowth of that investigation.

Mr. Harkness—What kind of coal did they use in the Cincinnati hospital where those tests were made?

Mr. Goodwin—The regular gas coal such as they use in the gas works there. They use nothing else in that part of the country but soft coal.

Mr. Neal—There is a gentleman present, Mr. Scott, who uses a gas stove every day in the year. Perhaps, he will favor us with his experience.

Mr. Scott—My stove is a retort stove. My family is small, and we use a gas stove every day, and find it economical, convenient, and very satisfactory.

Mr. Vanderpool—Mr. Goodwin asked me about the correctness of some figures that he gave in reference to the utilization of energy.

It is well worthy of consideration that the efficiency of gas engines, as evinced by their conversion of heat units into work, is very high. The consideration of this fact, and their successful running, have drawn the highest engineering journals to express the opinion that their adoption for light or for motive power is certain, and a mere question of time. It is probable that, with increased attention (there having been but comparatively little investigation in this direction) the gas engine will be much improved, and the consumption of gas will be reduced below 20 cubic feet per horse power per hour.

As just stated, the most perfect engines using at the rate of two pounds of coal per horse power per hour, convert into power about nine per cent. of the energy of the coal; whereas, an engine using at the rate of 10 pounds utilizes less than 2 per cent. A cubic foot of 16 candle coal gas has a calorific power of about 650 heat units; and if 20 cubic feet produce a horse power it is evident, the thermal equivalent of a horse power being 2555 units, that the utilization of energy is 19.3 per cent. The efficiency of the gas engine, as thus considered, is more than twice that of the best steam engine. There is another way of looking at this question; if we take one ton of coal, carbonized in the best manner, the weight of the ton actually used, in gas, coke, and waste, to produce 11,200 cubic feet of gas is 1781 pounds, and there should be left, of soluble residuals, in the shape of coke, tar, and liquor, 1461 pounds. The yield of gas per pound of coal, actually used, is evidently 11,200÷1781=6.3=14.4 cubic feet. As the cubic feet of gas make a horse power, we have one horse power produced by 20÷14.4=1.38 pounds of coal. If the gas engine is so perfected that 10 cubic feet of gas produce a horse power, as has been claimed by some engine builders (but these figures require verification) it is evident we will obtain one horse power by the consumption of less than three-quarters of a pound of coal. The theoretical consumption of 16 candle coal gas per horse power is 650÷600=3.88 cubic feet. Some interesting calculations upon these matters, by Mr. Lane, may be found in recent issues of *Engineering*.

There are evidences of a large demand for the gas engine in this country. I was informed recently, in a conversation with a representative of a certain engine, that there were unable to supply the demand, and that there were already in operation, in the city of New York, thirty of these engines that had been erected within a short time, and without particular solicitation on the part of the builders. It also appears that there is a large and increasing demand for gas stoves for cooking.

The indications are that, with proper attention on our part, we can largely increase our day consumption, which we know is of great importance, as bringing into use plant that lies comparatively idle during most of the 24 hours, and an increased consumption on the same capital means the capacity to sell at lower prices.

(To be continued.)

Spence's Metal—A New Metallic Compound.

We insert below a condensed report of Dr. Cole's lecture on this new metallic compound, read before the Society of Arts at a recent meeting, and followed by an interesting and useful discussion:

DISCOVERY OF THE METAL.

Nearly a year ago Mr. J. Berger Spence discovered that the sulphides of metals, combined with molten sulphur, formed a liquid. This liquid, on cooling, became a solid, homogeneous mass, possessing great tenacity, and having a peculiar dark grey—almost black—color. Nearly every metallic sulphide which is known combines, as experiments have proved, with an excess of sulphur, and curiously enough, all these combinations have the same properties. The combination, of which I have specimens here for inspection, consists of an ore of iron pyrites containing both lead and zinc sulphides.

CHEMICAL COMPOSITION.

Dr. Hodgkinson, chemical demonstrator at the Science Schools, South Kensington, has kindly sent me the following facts:

"It appears to be the easiest thing in the world to obtain homogeneous castings with it. Specific gravities of portion sent gave 3.3743 to 3.7006 (reduced to 0° C).

"When finely powdered, it is acted upon slowly by concentrated HCl and NO_2HO in the cold; in large lumps, little or no action takes place. As yet I have not been able to determine the organism equivalent accurately; it will require, however, to be small. The fraction is not estimable, as might perhaps have been expected, but somewhat like that of cast iron.

"I have not had time to try many 'utilization experiments' on the substance, but I have no doubt it would be exceedingly useful in the laboratory, even, for instance, for making the air-tight connections between glass tubes by means of caoutchouc, and a water or mercury jacket, whatever else is no disadvantage; the fusing point is so convenient, about 240°, that it may run into the outer tube on to the caoutchouc, which it grips on cooling like a vice, and makes perfectly tight.

"I don't know what you may call the material, but should think, as it seems to be more than a mere mixture, 'ferric thiide' would not be a bad or inappropriate name."

PROPERTIES OF THE METAL.

It has a comparatively low melting point, viz., 320° Fahr., or rather more than 100 above the temperature of boiling water. Here, then, we have in its favor the small amount of fuel needful to supply the necessary heat for reducing the metal to a condition for use.

2. It expands on cooling, a property not shared by the majority of other metals or metallic compounds. I believe that type metal and bismuth are two exceptions. Later on I think I shall convince you that, for an operation like the joining of gas and water pipes, this expanding property is of great importance.

3. It claims to resist atmospheric or climatic influences, as compared with bronze and marble. I noticed only a few days ago how the statues in bronze on the Holborn Viaduct, had been affected by our London fogs. And I have evidence to produce in the direction of showing the imperviousness of the metal to such degrading influences.

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TO CORRESPONDENTS.

PAUPER.—*Hall unsensational liquor with milk of lime and pass the vapours through free or air scrubbers. The last will be clever and colourless.*

3, C.—*We are much obliged to you for the information in your letter. At present the litigation going on between the parties you name precludes our publishing any part of it; but when the legal proceedings come to an end, we shall make use of it, or all events, of the facts you bring to our knowledge.*

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 25, 1880.

Circular to Gas Companies.

THE communication which we publish elsewhere from the Gas Engineer to the Leeds Corporation, coupled with the announcement which we are able to make that the South Metropolitan Company have determined to reduce the price of gas in the district of the late Phœnix Company to the one thousand cubic feet from the 30th of June next, form a remarkable commentary upon the observations in our last "Circular" as to the municipal acquisition and conduct of gas-works. As our readers are aware, the scheme for the amalgamation of the South Metropolitan and Phœnix Companies authorized the United Company to continue the price of 3s. 4d. in the Phœnix district for twelve months from the date of amalgamation—that is, until Jan. 1, 1881—without detriment to the dividends of the original South Metropolitan Shareholders. This would remain to the Company some £30,000 of revenue on the year—a sum probably especially welcome just now, as helping to cover the necessarily heavy charges incident to the amalgamation. By conceding the reduction from the earlier date, however, the Directors expedite to the same degree the payment to the holders of South Metropolitan and Phœnix shares an increased dividend of one-half per cent.

The initial price in the Act of the South Metropolitan Company being 3s. 6d. per thousand feet, the price now and for some time past charged in their district—viz., 3s. per thousand—warrants the payment of a dividend of eleven and a half per cent. The proportion of profits paid by the stock of the late Surrey Consumers Company (B) to that of the original £—th Metropolitan (A), under the scheme for the amalgamation of those two Companies, enabled the latter to share last half year a dividend of eleven and three-quarters per cent, while the former was reduced to eleven per cent. Although the usage of equal division of profits was raised in the Phœnix amalgamation scheme to eleven per cent. from ten and three-quarters, at which it stood in that of the Surrey, yet the great increase in the amount of B (contributing) capital, due to the absorption into that class of the whole of the Phœnix shares and stock, will enable the A whole of the Phœnix shares and stock, will enable the A holders to receive from June next twelve per cent. Shareholders to receive from June next twelve per cent. Thus the while the B take eleven and a quarter per cent. This while the B take eleven and a quarter per cent. This arrangement assents itself at once and naturally in its thirteenth place and congenial home, by inducing the earliest possible reduction of price and increase of dividend, or increase of reduction of price and increase of dividend, or increase of dividend with reduction of price, whichever way our readers may prefer to put it.

The action of the Directors of the South Metropolitan Company and their chief adviser, Mr. George Livesey, in this matter, is, as we have said, a perfectly natural and proper one. We think it is a particularly happy circumstance that the price is so promptly made uniform throughout the district, and we congratulate Directors, Shareholders, and Consumers alike. At the same time we feel that this prompt reduction points to one serious evil attaching to the present position of legislation on the subject of the sliding scale, and position of legislation on the subject of the sliding scale, and to it we draw the attention of our readers. How does it to it we draw the attention of our readers. How does it happen, we ask, that these considerable reductions in price happen, we ask, that these considerable reductions in price in the districts of the Phœnix and Surrey Consumers Com- in the districts of the Phœnix and Surrey Consumers Company's are possible *immediately* after amalgamation? The panies are possible *immediately* after amalgamation? The panies are possible *immediately* after amalgamation? The time which has elapsed is not sufficient to have brought time which has elapsed is not sufficient to have brought about any considerable economies in management or other- about any considerable economies in management or otherwise, and we are forced to the conclusion that the condition wise, and we are forced to the conclusion that the condition of the Companies themselves *before* amalgamation was such of the Companies themselves *before* amalgamation was such as to warrant, it not to require that the price of gas as to warrant, it not to require that the price of gas should be reduced. The Phœnix Company, for instance, need should be reduced. The Phœnix Company, for instance, need not to think that the filling up of the reserve-fund to the very not to think that the filling up of the reserve-fund to the very letter should necessarily precede a concession to the consu- letter should necessarily precede a concession to the consumers, and there can be little doubt in the mind of any one mers, and there can be little doubt in the mind of any one conversant with the character and traditions of the Com- conversant with the character and traditions of the Company that, under ordinary circumstances, the price charged pany that, under ordinary circumstances, the price charged would not have been kept at the price it was. The season is would not have been kept at the price it was. The season is not far to seek; The Company were under the necessity of not far to seek; The Company were under the necessity of applying to Parliament for more capital; with the increased applying to Parliament for more capital; with the increased powers they sought they must inevitably accept the sliding powers they sought they must inevitably accept the sliding scale; the initial price from which the sliding scale operated scale; the initial price from which the sliding scale operated would be determined by the rate at which gas was actually would be determined by the rate at which gas was actually supplied; therefore it was desirable to keep as high a price as supplied; therefore it was desirable to keep as high a price as possible, consistently with some regard for appearances and possible, consistently with some regard for appearances and fairness. fairness.

The unfortunate departure, in the case of the South Metropolitan Company, from the idea of an uniform initial price, which obtained when the principle of the sliding scale was which obtained when the principle of the sliding scale was accepted by the Commercial and Chartered Companies, opened accepted by the Commercial and Chartered Companies, opened the way to a fight in the case of each Company seeking powers; and the punishing of a well-conducted and successful Company, by giving them a low initial price because their position of affairs is objectionable on both sides. Companies legally the action of all those others to whom an application to Parliament was in any degree imminent. Thus the present position of affairs is objectionable on both sides. Companies may well complain if an honest fulfilment of their legitimate duty to their consumers—that of giving them the advantage arising from times of cheap production—is to be used as a scourge when they go to Parliament; and, on the other hand, the consumers have a clear and manifest ground of complaint if the price of gas is being kept up unnecessarily high, so that Companies may make out a better case for a high initial. How this condition of things is to be met is not easy to see. The application of the sliding scale to all statutory Companies alike would answer to *The Times* definition as "heroic" treatment. It would involve probably a laborious inquiry in half the towns in the kingdom, for the chances are that the acceptance of the present selling price as the normal one would be resisted in some cases by the consumers and in others by the Companies. Some way, however, will have to be found to reconcile the present antagonisms. For ourselves, we have not professed in the past, and we do not now affect an admiration which we do not feel for the sliding scale. We are old-fashioned enough to retain our preference for the earlier legislation, and to believe and maintain that the true interests of Gas Companies in the long run would have been better served by a faithful and loyal observance of the Gas-

INSTRUMENT TO DETECT COLOR BLINDNESS.—Herr D. Aubourg has devised an improved instrument for detecting color blindness, which embodies the principle of Young's theory, and distinguishes colors by placing much attention to the spectrum. The instrument is an adaptation of the spectroscope to the examination of the special case. The spectroscope contains a fixed and a movable collimator tube, so that two spectrums can be moved above the other. By means of a slide in the eye-piece any portion of the double spectrum may be presented to the eye alone, and will then constitute a good object for comparison.

Nov. 1 1879

to see the consistency of the Mayor's action. [illegible] the defunct Gas Company was present, and made the statement that, under the circumstances, the Company would have reduced the price of gas, the position of affairs fully warranting a reduction of threepence per thousand feet. This course, however, was rejected, as above stated, the decision eventually arrived at, causing some surprise in the Council—a feeling which is likely to be echoed outside.

Negotiations are to be entered into between the Corporation of Newcastle-under-Lyme and the Gas Company at present supplying the town, for the purchase by the Corporation of the undertaking of the Company. The question has been in abeyance for some time since it was first mooted, for various reasons, the chief apparently being that some of the more progressive members of the Corporation, at the time when the idea first took shape in a clause inserted in the Corporation Act of 1877, authorizing the purchase, have since failed to retain their seats in the Council, and the eclipse of these ardent spirits appears to have so far daunted the remainder of the members of the Corporation, that they have not moved in the matter with any great energy until the present time, when the imminent lapse of the period during which the Corporation will be allowed to make up their minds has induced them to bestir themselves. The whole question having been referred to the Lighting Committee, that body has reported favourably of the proposed purchase, and the Council unanimously resolved to take action in the matter, and we shall probably soon see whether the transfer is to be settled amicably or otherwise, as it seems to be inevitable.

The details of the gas accounts of the Rochdale Corporation, given in last week's issue, are eminently explicit. The item of most interest observable in the prefatory statement of the general results is the great success claimed for the St. John purifying apparatus and carburetter, which in six months winter working is credited with effecting a saving of £370, or an average yearly economy of about £1000. This is a surprising statement, and one which is scarcely intelligible on any theory of condensation generally accepted at present, by which gas may be enriched by its own accompanying liquid hydrocarbons. The production of gas was over 5 million cubic feet in excess of the corresponding period of the previous year, and the illuminating power was more than 18 candles—the usual standard for Rochdale gas—while the consumption of cannel was about 2100 tons less, the difference being made up with ordinary coal, the total weight of coal and cannel used being only about 40 tons more than in the period with which the comparison is made. The difference in the two results is certainly remarkable, and will doubtless attract attention from other quarters. It is difficult to believe that it is owing entirely to an apparatus of the kind mentioned; but no other explanation is offered, and we are bound to suppose that all other conditions have remained the same. Setting aside the increased rate of production, it is evident that a great impulse will be given to the solution of the question of the treatment of gas in contact with tar and hydrocarbons, by the publication of statements of this kind, of independent origin, and of accuracy guaranteed by the irrefutable logic of cash expended for work performed. Such are the facts as they are given to us, and we shall look with much interest for the production of any further evidence leading to confirm or refute the inference which in this instance has been drawn from them.

Chesterfield has the advantage of having its gas and water supplied by one and the same Company, which, in these days of trading Corporations, is an assurance of increasing rarity. Still the Chesterfield Corporation can scarcely be called happy, and some of their grievances have found their way into the local newspapers. A complaint is made that although the price paid for the public lamps was raised in consequence of the high price of coal in 1875, the subsequent fall in the value of the latter commodity has not been followed by a reduction to the old prices of the era before the coal famine. The Directors of the Company state, however, that the price even now paid does not give them a profit, so that eventually we find that the existing terms were agreed to for another year. Respecting the selling price of the gas to private consumers, the wish was expressed by a deputation of the Council who recently waited on the Directors of the Company, that a reduction from the present charge of 4s. per thousand feet might soon be made; but as the Company barely pay an average dividend of six and a quarter per cent. on the whole of their stock, and the consumption of gas is not of an elastic nature at present, the Directors did not see their way to promise an early reduction. We may indulge the hope, however, that the consumers will be allowed to participate in

Another of those [illegible] familiar, respecting the disposal of the surplus profits of undertakings belonging to Corporations, arose at the final meeting of the St. Helen's Town Council, when a very close division took place on the question whether a certain portion of the gas profits, left after various apportionments of the gross accumulated profits to capital account and reserve-fund, should be handed over to the borough-fund for the general benefit of the ratepayers, or be added to the reserve-fund recently established by the Committee. Strangely enough the vote was taken on an amendment which did not express the point upon which the discussion had really turned. The Gas Committee presented a report in which, after placing the round sum of £2000 to the credit of a reserve-fund, they proposed to hand over to the borough-fund £1126; when a rather vaguely-worded amendment to the effect that this sum should be applied to reduce the price of gas, was moved, and met with many supporters, including the Mayor, who, when the final vote was taken on a revised amendment dividing the sum[illegible] in dispute to the reserve-fund, found himself in the position of having to give a casting vote, the numbers being equal, and he then distinguished himself by voting against the proposal which he had permitted to take the shape of that to which he had previously given his adhesion. Certainly the two amendments were not identical; but the same principle—that the gas profits belonged to the gas consumers—was common to both, and it is therefore difficult

sibility. I may, however, say that the investigation is still proceeding.

In order to make the results strictly comparable, an experimental gasholder was filled before each series of observations. To effect contact of the gas with the tar, an apparatus 7 feet in height and 9 inches in diameter was used, which is accurately represented in the diagram, on a scale of 1 inch to the foot. The tower was filled with clinkers saturated with the tar, and the gas was passed through at the rate of .5 feet per hour. The tower was surrounded with a jacket, into which steam could be passed to increase the temperature; but it was not used in the experiments I am about to describe. The temperature of the gas was estimated by an accurate thermometer placed at the exit from the column. The lowest temperature recorded was 50°, the highest 60° Fahr. Before washing the photometer passing over the tar at the same rate, the gas gave, as a mean of 100 photometric observations, an illuminating power of 14·39 candles. This indicates a loss equal to 1·85 candles. In a second series of trials, a fresh sample of gas before contact with the tar gave an illuminating power equal to 15·10 candles, and after contact with the tar 13·01 candles; the loss being equal to 2·12 candles. As the difference between the first and second series of experiments is only 0·3 of a candle, it may, with perfect safety, be said that, under the circumstances indicated, the gas is injured to the extent of 2 candles. The photometric observations were made with Mr. Methven's standard light, which I found admirably suited for experiments of this kind.

Allow me to return to the coal tar colours for a moment, as I wish to remove an absurd impression which prevails among some persons that all aniline dyes are poisonous, and contain arsenic. It is true that magenta, as prepared by Medlock's process, contains traces of arsenic, but only enough to do the slightest harm to any one wearing any article dyed with the colour. All the other dyes are perfectly free from arsenic, and Mr. Anthony Nesbit has fed rabbits for weeks together upon food containing most of the dyes I have mentioned to-night, and, strange to say, their general health, if one may judge from their appetite and condition, was not in the slightest degree impaired. It is true that some pigments—cited, in error, as dyes—like orpiment and emerald green, contain large quantities of arsenic. Orpiment should never be used, as it gradually fades, and the deplorable way in which Sir Joshua Reynolds's pictures have deteriorated is partly due to the use of orpiment and carmine; this last colour, although perfectly harmless, becoming grey in the course of time.

Future of Coal Tar.—Permit me, in conclusion, to say a few words on the Future of Coal Tar. It may confidently be said that some of the products of coal tar are useless. A well-known chemist, several years ago, in a work which in many respects showed great cleverness, was unwise enough to reproach chemists for the enormous labour which they had bestowed on what he called such worthless substances as aniline. He, however, lived to see it become one of the most valuable substances in existence. It is true that the lucoline and pyridine series have not as yet been utilized; but to doubt that they will one day yield valuable derivatives would be to neglect all the teachings of our glorious science. Nothing exists in vain, and the chemists who, for the sake of pure science, study the physical and chemical properties of new and as yet useless substances, are preparing the way for the practical man, who will one day be thankful to those pioneers who have smoothed the road, and made the advance into new realms comparatively easy. Although the lucoline series have not yet been utilized, I found a quantity of a century ago that its isomer, chinoline, by alternate treatment with iodide of methyl and oxide or sulphate of silver, yielded superb coloured reactions; and doubtless, by suitable processes, the lucoline series will be made to afford valuable products.

I found also that chinoline treated with iodide of amyl, and then with caustic alkalies, yielded the superb blue colouring matter cyanine. This colour, from its peculiar constitution, forms quite a new departure in organic chemistry, and recent researches show it to be closely allied to our subject; as, from the observations of Hofie and Dewar, there seems to be little doubt that chinoline at times, and perhaps often, accompanies or replaces benzoline in coal tar.

There are also many other substances which have not yet been utilized, among which I may mention the solid hydrocarbons chrysene, retene, and pyrene. It needs no prophetic eye to see that, with the substances already known, there is room for an absolutely endless number of new combinations; and the Future of Coal Tar will be far more brilliant than the Past or the Present.

To me, gentlemen, coal tar, though "black," is "comely," and if I have failed to impart to you some of my own enthusiasm for it, the fault lies with me, and not with the subject, which I feel is worthy of treatment by a master-hand.

PAPERS READ.

(I)

EXPERIMENTS ON THE THERMAL POWER OF GAS HEATING APPARATUS.

By Mr. T. Travers, of Cork.

In a paper which I had the privilege of reading before you two years since, your attention was called to the fact that gas cooking and heating stoves did not, as a rule, give the full thermal effect practically available from them. To us this is a matter of importance, as one of the points with which we have to contend is to demonstrate the economy of gaseous fuel. At present this can only be done when gas is consumed under the most favourable circumstances.

Manufacturers of gas cooking and heating apparatus are succeeding very well in making them attractive to the eye. Both in style and finish they are suitable to grace, in many instances, a well-furnished room; but to render them more popular, attention must be paid to the mode of developing the largest amount of heat from the smallest quantity of gas. What I purpose showing is that in the majority of instances this is not obtained, and it is desirable that additional pressure be put on the stove makers, so as to enable us to speak with more confidence to our consumers. As a kindred case in point, you are aware that some years ago gas burners then in use did not give the same amount of light per foot of gas as we now obtain. If the electric light did no other good than to rouse the burner makers to the sense of the injustice they were so long perpetrating on gas makers and gas consumers, by impeding the full development of the illuminating power, it has done good work. In like manner let us spur on the stove manufacturers to that which will certainly prove to be of mutual benefit.

In order to be able to recommend to the gas consumers of Cork the best and most economical apparatus, I made, during last year, some experiments, and from the results of them I think it will be seen that the apparatus in general use are capable of such improvements as will lead to better results. I am fully aware that the effect of any kind of fuel is much greater on theory than in practice. I have, therefore, made the experiments on a plain, practical method, such as may be applied to the doings of every-day life.

Intimately connected with this subject is that of the thermal power of gas of various qualities, and I commenced operations by making some tests under this head. I noticed that the results are not quite in accordance with some I have seen in the journals. The apparatus with which I operated was capable of carbonizing 30 cwt. of coal per day. I was, therefore, able to make a comparative calculation of the cost of the gas from coal of various qualities. The coal was Scotch cannel, Newcastle coal, and coal from South Wales. The points noted were—

The illuminating power.
The evaporating power of the gas.
The net cost of coal per 1000 feet of gas.

Coal.	Illuminating Power.	Water Evaporated.	Gas Consumed.
Cannel	240 candles ..	1 gallon ..	2040 cubic feet.
"	220 " ..	1 " ..	1975 "
"	206 " ..	1 " ..	2000 "
Newcastle	175 " ..	1 " ..	2000 "
"	185 " ..	1 " ..	2000 "
"	168 " ..	1 " ..	2020 "
Scotch, Wales	190 " ..	1 " ..	2000 "
Do. do. and 25 per cent. cannel	240 " ..	1 " ..	2250 "

Of course the thermal theoretical efficiency of the various descriptions of gas is far greater than the results which are given above.

On the average it will be found by the experiments that 16 lbs. of water were evaporated by 1 lb. of gas. Newcastle

(From "Engineering.")

Gas Illumination.

When illuminating by means of gas was introduced in our thoroughfares on a prescient scale about 18 months since it formed such a marked contrast to the ordinary methods of gas illumination, greatly distancing them in brilliancy, that it was not unnatural that it should appear to the unreflective public mind that the days of gas were practically numbered. The possibility of gas illumination for public thoroughfares being capable of improvement was the last thing to be realised by some, while others, to whom such a possibility did occur, greatly doubted the possibility on account of the great cost which they conceived anything like a substantial increase in light would involve. True, they knew what could be and what was being done in shops and private houses of which a good light is one aim, but they also knew what the luxury cost, and they inferred that the cost of a proportionately liberal display of gas in our streets would be simply prohibitory. And so it would if the gas were burnt upon the ridiculous and unscientific principles which have hitherto very largely obtained in private houses and other establishments, and which still do obtain to an almost incredible extent. That the deficiencies of our street illumination, however, are not due to the impossibility of obtaining a better light by the aid of gas except at a prohibitory cost was amply proved on a large scale in three instances during last year. Those were the special lighting of a portion of the Waterloo Bridge Road, of Waterloo Place and part of Regent Street, and Queen Victoria Street, a generous, but not extravagant display of gas being exhibited in each case. The immediate result of the experiments was to show most conclusively that in order to obtain a good light the conditions of illumination must be considerably modified and the cost somewhat increased but not to anything like the prohibitory extent imagined by some. All this we clearly pointed out at the time, and our facts and figures remain for reference. The practical outcome of these experimental displays has been the adoption in many parts of London and the suburbs, and in many of our provincial towns, of the methods of gas illumination then employed. These applications have not, however, been made indiscriminately. The improved burners have been judiciously distributed on refuges, in wide streets, and at the intersection of thoroughfares where the traffic is heavy. Their success continues, while their adoptions increases.

The reason why gas illumination in general is so inferior is largely due to the prevalence of motives of economy, which economy is, as a rule, a false one, owing to a prevalent ignorance of the correct principles upon which gas should be burned. It is almost universally assumed that if the gas is not "blazing," as it is called, with an ordinary bat-wing or fish-tail burner, or not issuing forth in red flames from the chimney of an Argand burner, all must be going on well. Never was a greater mistake, for without these palpable indications of waste the veriest extravagance may, and generally is, going on, and this from the absence of any controlling power over the pressure of the gas from the main, which science has of late demonstrated to be one of the first essentials of economy. Nor is it only the consumer who is ignorant on these points; many a gas fitter to whom he entrusts his interests is similarly uninformed. Were it not for his ignorance, the fitter might be suspected of playing into the hands of the gas companies, as the son of the gas-waiting-fittings he supplies to his and their customers. Nor should the action—or rather inaction—of the gas companies pass without notice here. They remain perfectly apathetic under the circumstances, and, although it is not compulsory that they should show their customers how to use in an economical manner the gas that they supply to them, they at least lay themselves open to suspicion when they knowingly allow users to waste it from sheer ignorance. That "they manage these things better in France" is perfectly true in this, as in some other respects, inasmuch as the Paris Gas Company have several depots in the city for the exhibition of such burners and other gas appliances as they can recommend their customers to use.

The company, we believe, are not traders in this respect; they are simply the exhibitors of other people's goods, but they exhibit nothing of which they do not approve. Gas users make their selection at the depot, and order either through their gasfitters or purchase for themselves at the stalls of such burners or other articles as they may require, knowing that they bear, more or less, the guarantee of the Paris Gas Company.

The exercise of a controlling power over gas during burning has formed one of the chief studies of gas engineers ever since the first practical introduction of gas lighting. And it moreover continues to do so, notwithstanding the great advances which have been made in gas lighting in recent times. The power of control is the key to the efficient and economical use of gas—that is, the production of a good light at a low cost; and this governing power largely underlies all the most substantial improvements that have been made in gas lighting. It was the satisfactory solution so far of this question which enabled the gas companies to show a bold front when the electric light threatened to invade their territories, and it is that which will materially assist them in meeting the invasion now that it has practically commenced. It is unquestionable that to the electric light and some of those means of improved gas illumination have been brought prominently before the public, while it is not less due to it that others have been developed into existence. It may therefore prove interesting in the present lecture if we point out the direction which improvement in gas lighting has taken, and the means whereby such improvement has been accomplished. To render this clear it is desirable that we should revert to the first principles and the early practice of gas lighting, and briefly describe the gradual stages of development through which gas burners have passed from their primary crude state to their present comparatively perfect condition.

Upon the introduction of coal gas as a means of artificial illumination the object of the inventors was to render it an efficient substitute for the oil lamps and candles which were the only practical means in general use for obtaining artificial light. They therefore imitated the flame of a candle by forcing a little gas from a stopped end of a small cylinder, through which gas issued under a slight pressure. On being lighted a flame resembling that of a candle was produced, and this kind of burner is known as the single jet or nat-tail burner. It is of little use in artificial lighting, and has long since become obsolete except for illuminating devices and cigar lighters. The imitation of the old Argand oil lamp flame was readily effected by adapting the burner itself. The top of the annular space where the wick came out was covered in with a flat metal ring perforated with a number of holes, the gas being admitted where the oil was previously supplied to the lamp. Many old oil lamps were in this way converted into gas lamps. It was, however, soon found that if gas were made to issue under pressure from a slit cut across the stopped end of a cylinder it produced a flat flame. This kind of burner, being much less complex than the argand, and not requiring a glass chimney, consequently came largely into use. This burner received the name of the "batwing," from the fancied resemblance of the shape of its flame to the expanded wing of a bat. It does not appear to have occurred to any of the early gas engineers that the loss of illuminating power in these gas burners was very great, in consequence of the over-oxidation of the flame through the velocity with which the gas issued from the orifice. Another kind of burner even more destructive to the illuminating power of gas of such a quality as usually supplied for public use was also invented at a very early period in the history of gas lighting. This is the fish tail burner, which is made by piercing two holes in a diagonal direction at about right angles to each other in the burner top. The jets of issuing gas impinge upon each other, and produce a broad sheet of flame. This burner still continues in use, and at the present time is more extensively adopted throughout Great Britain than, perhaps, any other, its scientific defects notwithstanding. It is, however, very rarely used on the Continent.

At the outset of gas lighting a rapid deterioration in the manufacture of burners arose in consequence of the manner in which gas was supplied to consumers. Before gas meters were invented gas was supplied by contract at so much per light per quarter, and it was important to gas companies that consumers should not use more gas than they paid for. They therefore got their orifices or burners to use burners having very small—about one-hundredth part of an inch in diameter—so that the gas issuing from the burner was propelled with extreme velocity into the atmosphere. Thus it could not remain long in contact with the oxygen of the atmosphere to become thoroughly incandescent. It developed a greater amount of heat than it did of light. The difference between the method of burning gas adopted before the introduction of meters and the present method of burning gas by means of the best kinds of modern burners is very striking. With the old argand and fish tail burners the gas issued from the small holes at the point of ignition with a velocity of from 60 to 90 miles per hour. With the best known modern burner—Sugg's London argand—the gas issues from the holes with a velocity of only a little over one mile per hour. This forcibly illustrates the necessity for the governing power to which we have before alluded. It is a singular fact that the highest results in illuminating power are attained when the gas issues from the burner with the lowest velocity. The discovery was made by Sugg, in 1858, previously to which, however, several inventions were patented for reducing the velocity of the issuing gas, but these were mainly in connection with fish tail burners, and the inventors do not appear to have realized the fact that they were raising the illuminating power of the gas, or if they did, they did not proclaim it. The reduction of velocity attained in my case, however, was but small, and the most notable of these inventions were those of Belmer and of Desrioth. Both inventors adopt similar means for effecting their purposes, which consist in placing under the burner a small cylindrical chamber, through which the gas passes on its way to the burners, which has a much larger orifice than that through which the gas passes from the little chamber. The lower orifice admits the gas at a high velocity, and it issues at a reduced rate of speed from the burner, the speed varying with the kind of burner employed.

Notwithstanding the efforts of gas engineers and others to substitute economical for wasteful burners, there are a great number of burners in use at the present day which destroy the latent illuminating power of the gas consumed to the extent of from 20 to 50 per cent. In fact, there are burners in the market which are said to be both durable and economical, but which sadly lack the latter quality. For a consumption of five cubic feet of London gas per hour they should give 16 candles' illuminating power, whereas careful experiment has shown that they only give six candles for that quantity. In further respect to the Board of Trade, dated January, 1870, the Gas Referees state that the result of an examination of a large number of burners in use was the discovery that in London alone an annual saving of at least £250,000 might be effected by the use of good burners. But the possibility of using gas for lighting purposes by means of the crudest apparatus, combined with the ignorance and apathy of the public, still leads to its wasteful and unscientific abuse. Read by the light of the £250,000 wasted in gas in London alone each year, the indifference of the gas companies, too, can be understood, and they may perhaps be pardoned for not interfering in a matter which, commercially speaking, it should be no business of theirs to see sic right. The advent of the electric light, however, has roused them into action, and the immediate results were the examples of improved gas lighting to which we have already referred.

[To be continued.]

Société Technique de l'Industrie du Gaz en France.—The annual congress of the above Society will be opened in Paris on Monday next, and will probably extend over two or three days. The number of members who will be present is expected to be unusually large, and the nature of the communications submitted, before the body at the meetings, even this year will be a particularly interesting one. It is highly probable that permission will be granted by the Paris Gas Company for the members of the Society to visit the new works now in course of erection at Clichy, and if this should be the case, we feel sure that all who avail themselves of it will derive much gratification therefrom.

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not until they had generator furnaces. Then they had to get water-jackets, and tried several things, and were now putting up a little different arrangement. With regard to the compensating holder for reducing oscillation, the retorts they lighted up last year had not shown the slightest appearance of carbon on them, and had not been scurfed once. This was a different experience from that of Mr. Mitchell, and he could not understand how it was that that gentleman still had the same amount of carbon on his retorts after the oscillation was reduced. Mr. Morton said, "Would not the gas in the holder come in contact with the tar?" but he (Mr. Somerville) must remind him that it made all the difference what the specific gravity of the tar was. It did not matter about the tar of light specific gravity coming in contact with the gas. At the same time the tar in the holder was partly covered over with liquor which was nearly of the same specific gravity as the tar.

The PRESIDENT said it was very evident that the plan that had been described to them was a step in the right direction; but it was also apparent that more remained to be done. It had been pointed out by one speaker that what they had to aim at was to establish contact with the gas and tar under certain conditions of temperature, but also—which was of no small importance—to determine when this contact should cease, and to separate the heavier portions of the tar as soon as possible. This latter was partially effected by Mr. Livesey's arrangement, as proved by the specific gravity of the tar drawn from the first receiving main; but it was evident that the process required to be carried a little further. Mr. Morton had pointed out the undesirability of contact as promoted in the balanced gasholder, when the tar was comparatively cool. Mr. Somerville had answered this by saying that contact with tar of such light specific gravity would not injure the gas. He (the President) thought, however, that the question must naturally arise, how was this tar made? Was it not by union of the heavy particles carried forward with the lighter naphthas, the presence of which, could it be secured, would materially enrich the gas? Their aim should be to promote the separation, at as high a temperature as possible, of as much as practicable of the heavy carbon particles of the tar. To a certain extent this was done by the arrangement before the meeting, but more remained to be effected.

(IX.)

STANDARDS FOR ESTIMATING ILLUMINATING POWER.

By Mr. F. W. HARTLEY, A.I.C.E., of London.

The subject to which I request your attention on this occasion is an old one, but one which is of as much importance and interest now as it ever was; indeed, it may be said to be now of greater importance than in the distant past, inasmuch as testings for illuminating power are more general throughout the kingdom, are made in a more stringent and more refined manner, and, if statutory obligations are not met, entail penalties, dissatisfaction among consumers, and bickerings between gas companies and corporate bodies; causing discomfort to directors, and more especially, perhaps, to their engineers and managers.

That the method by which the illuminating power of coal gas is ascertained should possess, as far as is possible, the characteristics of accuracy and of constancy in indication of values, no one will dispute, and that such should be the case is of the highest importance to gas companies, for as long as the method pursued is one which is liable to fluctuations, which sometimes cause the value of the gas to be underestimated, and on occasions to be over-estimated, so long it will continue to be a necessity for companies to make gas of 1 or 1¼-candles greater illuminating power than mere legal obligation requires. This necessity in many instances involves the use of a considerable percentage of cannel coal, which might probably be dispensed with if the tests were made under conditions of a more certain and absolute nature.

I do not wish it to be supposed for a moment that I am an advocate for the reduction of the illuminating power of coal gas to the lowest statutory limit in any case; for companies best serve their own interests as well as those of the public by supplying gas of the highest quality which is consistent with possibilities and the rights of the shareholders. It is usual to do so now; but this is very different from being compelled to supply gas of superior quality in order to overcome and neutralize the evils which might arise under the present uncertain state of matters.

The estimation of illuminating power can only, in my belief, be satisfactorily arrived at by visual, or photometric comparisons between the light of flames, one of which is adopted as a standard. Upon this point, Mr. Vernon Harcourt observed in a paper "On a New Unit of Light for Photometry," which he read before the Physical and Chemical Sections of the British Association in 1877, "that since the value of an illuminant depends solely upon such parts of the total force radiating from a flame as affect the human eye, no test of illuminating power can be satisfactory which does not depend upon vision; at least until it has been proved that some other effect of radiation . . . is for all flames in direct proportion to the effect upon the optic nerve—a relation which seems very improbable, and which cannot be established until some exact mode of measuring the visual effect has first been found."

At the time when the foregoing extract was read, the radiometer was still attracting a good deal of attention, and some scientific men, accepting too readily the theory that with this instrument light was the sole operating force, jumped rather hastily to the conclusion that the radiometer was capable of being used for estimating illuminating power. As, however, the instruments were made more delicately, and especially as their chambers were more perfectly exhausted by the aid of the most improved form of the Sprengel pump, it became manifest that heat rays operated as powerfully as light rays in producing the rotation of the vanes. I have a radiometer which is so sensitive to heat rays that its vanes will revolve with considerable speed if the hands are placed round, but at an inch distance from the instrument. This rotation has been produced by the warmth from the hands, even when they have felt cold if applied to the face.

The selenium photometer also excited the attention of scientists for a time, but all interest in it seems to have died out. With this instrument an electrical current of regulated strength was caused to pass through a piece of crystallized selenium, which was shielded from light in a closed box. The current then traversed a reflecting galvanometer, which was so adjusted that under the conditions specified the spot of light produced by the reflection of a ray from a burner fell upon the zero of the scale. The box was then opened, and the selenium exposed for ten seconds to rays of light, which caused a diminution of the resistance offered by the selenium to the electric force and consequent motion of the galvanometer. The extent of motion or throw of the galvanometer appeared to be inversely proportionate to the distance of the source of light, or as the square root of the illuminating power, and therefore analogous to the indications of an ordinary photometer. This was a very interesting instrument, as it served for one thing to show that crystallized selenium was an exception to the well-known law of electrical science, that the power of an electrical conductor diminishes as its temperature increases.

The jet photometer and the dumbility test are both admirable instruments by which, with due care in using, to obtain approximate indications of illuminating power; but both fail, it appears to me, to satisfy the conditions which are essential in a standard test. Some reasons why they must so fail will be found in my observations on the jet photometer in the paper entitled "Remarks on Photometry" which I had the honour to read before the Association in 1870.

The visual determination of the relations in strength of light from flames which are contrasted with each other seems, then, to be the only method which can at present be deemed satisfactory, and in order that results may be expressed in terms which may be generally understood, a standard is required. As you are all aware, the sperm candle burning (nominally) at the rate of 120 grains of sperm per hour has long been, and is now, the photometric standard in this country as well as in some others. This standard has been tolerably well denounced, and, to a certain extent, deservedly so, for it is uncertain in value, as the light it affords varies greatly under conditions which appear identical, and with the slightest disturbance of the surrounding atmosphere, while its lighting power bears no known ratio to the rate at which the sperm is consumed. Nevertheless, and with full experience on the matter, I have spoken and written in favour of the sperm candle as a standard; and although I shall presently bring something under your notice which appears to be greatly superior, I am not prepared to propose the immediate abolition of the candle standard. It will be needful to retain the candle for some time, certainly until scientific men and Parliament are satisfied as to the constancy and convenience of any proposed substitute. The candle standard is a troublesome one, because, unless candles are tried, examined, and the imperfectly burning ones rejected, grave discrepancies may arise. Even when all these things have been done, the results obtained from one pair are not to

by the lime in granular aggregates from the gas purifier, but there still remains enough unchanged lime capable, under the influence of water, of absorbing carbonic acid from the air equal in amount to that first performed. This is Mr. Harrie's process.

By far the second quantity of work out of its lime, Mr. Harrie proceeds as follows:—The spent lime is taken from the purifiers, and is thoroughly air-dried through it, which in turn is made to traverse an order of iron purifiers, as it is found necessary to remove the sulphuretted hydrogen, which would otherwise in time impair the purifying quality of the lime if left in it. The lime is then removed from the purifying vessels, and is ground to a fine powder, and is then passed over sieves by revolvers with shovels, and then returned to the purifying vessels, where it is again exposed to the action of the gas. This exposure of the partially saturated lime to air destroys the lime and results in their conversion into carbonate of lime, and the sulphuretted hydrogen interfere the portion of lime still in the condition of hydrate, and which is capable of absorbing carbonic acid from the gas, is of this purified manner. The process, however, does not in any way affect the sulphur in the lime, which remains in the same state entirely differs from his process of exposing cakes of lime to air. A process as a cleaning and inert compounds of the whole. The partially exhausted lime, after the sulphuretted hydrogen has been removed from it, is finally exhausted, and is removed as waste.

Some experiments have been made on lime which is only partially spent, but which has been exposed to the air for a long time, in the purifiers of gas-works. The condition of my process is that in which it is returned to the purifiers, and not that in which it is removed from the purifiers. Lime which has the presence of free sulphur has not been experimented upon by me, but I have no doubt that a process could be devised for extracting the sulphur from the lime, and for thereby increasing its value per cent. There is also a large quantity of calcium hydrate in the lime which is spent, and which is not carbonated. The subject has been to devise a ready and efficient method of determining this quantity. I have found that the ordinary means of calculating its purifying capacity when it is again returned to the purifiers.

The surprising soluble character of calcium hydrate prevents the ordinary method of ascertaining the purifying capacity of the spent lime. The process I have devised for my present purpose is as follows:—A weighed quantity of the spent lime is put into a flask, with a weighed quantity of the lime. The calcium hydrate furnishes a precipitate of hydrate of copper, the carbonic acid and sulphuretted hydrogen having no effect upon it. Knowing how much copper salt was first added, and then determining the amount of copper left in solution, I am able to calculate how much of the two represents the amount of copper thrown out of the solution by the calcium hydrate. I then calculate how much copper hydrate in terms of calcium hydrate is the amount of calcium hydrate in the quantity operated on. I have practically found that 100 grains of spent lime, as it comes from the purifiers, will require 100 grains of copper salt (between 30 and 40 grains) was placed in a 100 cubic centimetre flask, and water added to the measuring line. The whole was allowed to stand for a few hours with occasional agitation, and then withdrawn by means of a pipette placed in a suitable cylindrical vessel, and some of the standard cupric chloride solution run in until the same depth of blue, white surface, was obtained. Ascertaining how much of the cupric chloride solution is equal to that present in 10 c.c.

Calcium carbonate. Free sulphur.
" hypersulphite. Naphthalines.
" sulphate.

Calcium carbonate is, of course, the most abundant constituent. Free sulphur is often found in spent lime, and does all that is possible under ordinary conditions. Sulphur is present in at most three forms, the total amount of the

cent. The difference represents a very appreciable value, as will be seen when we look at the total manufacture.

Reverting again to the beginning of the decennial, we find the total quantity of gas sold by the London companies was 8,895,807 thousands of cubic feet. The quantity made we are not told. Last year the gas sold was 17,324,000 thousands of cubic feet, showing that in about a couple of years more the consumption of 1870 will be doubled. The quantity of gas supplied to the metropolis is immense, amounting to about 4500 cubic feet per head of the population per annum, equivalent to nearly half a ton of coal. This represents an average of rather more than twelve cubic feet of gas per head per day. We are here travelling out of the bounds of Mr. Field's admirable "Analysis," though working on a basis which he has given us. We thus find that the light of nearly forty candles is available for each individual for the space of an hour. As a certain portion gas for heating purposes, we must make some deduction in order to get at the amount of illumination; but we may at least reckon the light as that of thirty candles for one-hour, or half a dozen candles for five hours. On the whole London ought to be pretty well lit, but there is a demand for more light, and either by means of gas or electricity the demand will have to be met.

The rapid increase in the consumption of gas in the metropolis is shown if we compare the figures given by Mr. Field with those of the population tables. Thus the population of London at the census of 1871 was 3,254,260, the middle of last year the estimated population was 3,620,968. The gas sold in 1871 was 11,316,914 thousands, whereas last year it was 17,324,000 thousands. Accordingly, we see the population increasing by little more than ninth, while the consumption of gas rises more than a fifth. The gas rental of 1871 was £2,104,863. Last year it was £3,001,263. The head of the metropolitan population there is a much larger consumption of gas than there was eight years ago. There is no doubt that the reduction in the price of gas has greatly promoted its use, and the companies may take encouragement from the fact. Comparing 1870 with its immediate predecessor, we find an increased consumption of gas to the extent of 1,341,132 thousands of cubic feet. This is obviously a much higher ratio than the increase of population, the growth of the latter being little more than 1·75 per cent., which would only account for an addition of 244,692 thousands of cubic feet to the quantity of gas. The increase in the sale of gas is in a ratio fully five times that in which the population increases. The companies, therefore, have no great reason to feel alarmed at the approach of the electric light.

By the sale of residuals last year the companies realised £789,023. The year before this source of revenue brought in £746,115. In 1869 the residuals realised no more than £573,053. The gross profit of that year was £746,987, whereas last year it was £1,166,104. The economy effected by consolidation is strikingly shown in the case of the Chartered Company. In 1869 the expenses of management in respect of this company amounted to 19·82 pence per ton of coals, and 2·21 pence per thousand feet of gas. Last year, the Chartered Company having previously absorbed the greater part of the gas undertakings of the metropolis, the expenses of management were only 10·64 pence per ton, and 1·12 pence per thousand feet. Among the exceptional items of the year we notice an item of £1785 by the Chartered Companies for "experiments street and electric lighting."

The coals carbonised last year were 7 per cent. cannel, and the average cost was 15s. 1·45d. per ton. In 1869, when cannel gas was more extensively used than now, the proportion of cannel coal was 12 per cent., and the average cost of the entire quantity, Newcastle and cannel, was 16s. 2·75d. In last year's accounts, deducting the receipts for residual products from the cost of the coals, the net cost appears as £624,603, being at the rate of 6s. 9·15d. per ton, and 9·74d. per 1000ft. of gas sold. In 1869, the net cost of coal was £581,955, or 9s. 11·21d. per ton, and 14·13d. per 1000ft. Deducting working expenses and the net cost of coal from the gas rental, and also deducting the expenses of lighting and repairing the public lamps, the profit on gas last year appears as £1,167,960, or rather less than 13s. 6d. per ton of coal, being a fraction under 1s. 4d. per 1000ft. In 1869 these two latter amounts were respectively 12s. 7·47d. and 18·66d., the entire profit on gas being £768,710. The actual net profit of the metropolitan gas supply last year was £1,031,531. Of this amount the standard dividends took £937,189, and the additional dividends £37,081, leaving a surplus of £97,261. The net profit on stock and share capital raised was 9·73 per cent., the standard dividend being 8·60 per cent. The total reserve fund and balance on net revenue account, after providing for dividend, was £693,792, in addition to £248,207 for insurances and other funds. In 1869 the whole of the reserve funds only amounted to £129,187, and the insurance or contingency fund to £43,003.

THE ENGINEER.

JULY 2, 1880.

PROGRESS OF THE LONDON GAS SUPPLY.

In 1869 London had thirteen gas companies, employing an aggregate capital of £7,888,844, and carbonising 1,171,598 tons of coal in the year. The number of the companies has now fallen to four. At the commencement of last year the number was six. Mr. Field's annual "Analysis of the Metropolitan Gas Companies' Accounts" is shrinking rapidly in its array of figures, but continues to grow in its totals. The slender but skilfully compiled book just published shows that the capital employed last year was £12,681,818, and the quantity of coal carbonised 1,602,847 tons. The coal employed in 1869 was at the rate of 20·12s. 6d. per ton, whereas in 1879 it was 2s. higher. The quantity of gas sold was 10s. 10d. in 1869, whereas last year it was 14s. 6d., thus showing a reduction. The gas sold per ton of coal carbonised was 8438 cubic feet at the commencement of the decennial, but has now risen to 9431. This saving of very nearly 1000 cubic feet per ton of coals represents no enormous gain, though perhaps a little drawback in respect to residuals. But some portion of the improvement is due to diminished waste. What this amounted to in 1869 does not appear. The first year in which Mr. Field calculated the amount of waste was in 1874, when gas "unaccounted for" appeared as 6·76 per cent. on the make. Last year it was 5·38 per

Dublin possessed in the Vartry scheme that which was undoubtedly the finest and best possible water for any undertaking anywhere in the world. The Vartry water supply in the very face of the Rathmines and Rathgar scheme, which, as he understood, there was no engineering difficulties, nor any of any other kind that had been mentioned, that should prevent the Rathmines and Rathgar township from participating in the Dublin supply. But there was a fear on the part of the township that if they obtained a supply of Rathmines water from Dublin the project of amalgamating the Rathmines and Rathgar township and the extra-mural portion of the city of Dublin would be facilitated, and that consequence would be very much to the advantage of the city of Dublin, but not to that of the township of Rathmines and Rathgar. He had no right to remind the House that there was at present, and had been for some years, a Commission sitting in Dublin to inquire into the question of re-adjusting the relations of the city of Dublin with the surrounding districts. This Commission was about to present its report, and it was understood that it had no doubt it would recommend that all the districts which should be amalgamated would be brought in, and they might avoid the difficulty complained of in the City of London, and which had prevented the carrying out of the great principle of local self-government. This, as far as he understood it, was the only objection that had been urged by the Commissioners had to obtaining their water supply from Dublin. Undoubtedly, if this scheme were carried out, the great inequality in the rating of the boroughs of Rathmines and Dublin would be remedied, and Rathmines would undoubtedly have to pay somewhat more, and Dublin somewhat lower, and the grievance of which they would be deprived. He had no right to refer to the negotiations of the water supply in Rathmines, he might mention that the Government supplied the barracks in the midst of the Rathmines and Rathgar township with the Vartry water at a cost of £500 a year. Every penny of this amount would have to be contributed by Dublin, and this would mean raising the Dublin taxes. Then with reference to the rate at which the Corporation of Dublin supplied, there would be no difficulty, because the Corporation were willing to leave that question to be decided by arbitration.

Mr. Very Lea supported the second reading of the Bill, and thought it was only necessary, depending on the part of the honourable member for Dublin to first interfere with a matter that had already been before the ratepayers, and had been fully discussed by them, with the result that out of 3000 ratepayers, only 12 expressed their dissatisfaction at the scheme. Mr. Pim Fletcher) was a ratepayer in Rathmines, and had every confidence that the Commissioners would carry out the scheme in a fair way. In 1871 that the Commissioners excluded the ratepayers of all the districts which did not pay any rate would be entitled to take water from the Vartry, unless the present time they were asking to rescind that Act. In 1875 they entered into negotiations with the Commissioners of Rathmines for the purpose of supplying the township with water, and after the Dublin Corporation decided they were requisitioned by certain members of the Corporation, and the agreement was not carried out. It was quite impossible for the Government they could go into the merits of the question on the preliminary moment they could go into the merits of the question on the preliminary moment of the House of Lords. There was no question of surplus in regard to the Bill, as all the facts brought forward by the honourable member for Dublin had been fully stated before the Lords Committee, and he (Mr. Pim) did not consider that to be a most unusual and improper attempt to throw out a Bill.

Mr. Dowsing said he did not propose to go into the merits of the case, but it appeared to him that the Bill which had received the sanction of the House of Commons and the House of Lords for seven days, when there was another scheme brought forward in opposition to it, which scheme, however, was unsuccessful. He could only remind the House that it was a very unusual course to oppose a Bill on the second reading except in such circumstances as these, and the fact of its having received a unanimous vote in the House of Lords was a strong reason why a Bill that time never be thrown out on the second reading. Such circumstances ought to be given to it by the Committee, before the House committed itself to the course of throwing it out. It seemed to him that the fact that the Bill should have been so thoroughly discussed was a reason why it should go to a Select Committee, and should not be disposed of in the summary way suggested by the honourable member for Dublin.

Mr. Lewis supported the second reading of the Bill. The honourable member for Dublin, he said, seemed to have forgotten that he had had the opportunity of pressing his objections on the House of Lords Committee, and this being the case he (Mr. Lewis) considered the objection almost was one that was very inconvenient to the House. Upon the second reading of a Bill—a preceding that was very rare—and one which, in the honourable member, he could not but think was a most unwise course. He was quite aware that the Bill had been before the House of Lords, also had had the Bill before them, and had conducted an investigation extending over several days. If this practice were adopted generally, the system of conducting private Bills through the House would become most inconvenient. If the honourable member thought he had a case, let him go before a Committee and state his objections to it. He would remind the opponents of the Bill were to state their objections to it.

Lord RANDOLPH CHURCHILL said that having had some acquaintance with the Water Supply of Dublin, he should support the honourable member in his motion for the rejection of the Bill. He had undertaken a very strong opinion that the Bill ought to be thrown out. The right honourable Mr. Balfour) had said that the Bill was before a Committee of the House for seven days several nothing but this—viz., the immense inconvenience of local local business being considered by Committees who had no practical acquaintance with the facts of the case. The facts were that the sanitary state of Dublin was about as bad as it could be, and that the United Kingdom, and various attempts had been made by the Corporation to remedy this state of affairs, but all of them with one thing which was decidedly needed in Dublin it was the supply of water, which might be said to be equal in quality to that of New York. The water-works were constructed at an immense cost about 30 or 40 years ago, but he believed constructed at an immense cost about 30 or 40 years ago, but he believed he was correct in saying that the mains passed through Rathmines and Rathgar. It was now proposed that the Rathmines people to have no authority whatever to supply water from another source, but to obtain their supply of water from the public work carried out by the Dublin Corporation seven years ago. But in no case could Rathmines obtain a better supply of water. The water which the Corporation offered to supply at a reasonable rate passed through Rathmines, and it was a strange thing that it was a case where the House of Commons should put its foot down and refuse to allow the Dublin Corporation to act in such a big-hearted manner.

The ATTORNEY-GENERAL for IRELAND thought that the course proposed by the honourable member for Dublin was exceedingly inconvenient. He could only repeat what had been said before—viz., that not only had the matter been thoroughly investigated by a Committee of the House of Lords, but it was also the subject of discussion by a most influential body the Rathmines Commissioners should not be permitted to supply themselves with water as they did with other necessaries. He had no wish to say against the protection of the supply of water to Dublin. Everybody said it was excellent, but this was no reason why Rathmines should not also obtain an excellent supply of water. There was no reason why the Dublin Corporation should have the privilege of selling water to the Rathmines Commissioners if the latter thought they could get better water elsewhere. In 1871 the Dublin Corporation expressly excluded the Rathmines Commissioners from their district, and they finished the people of the districts from coming and taking water, and therefore a claim of right was now made by Rathmines that no one excluded from the scheme of 1871 should be entitled to obtain water for themselves. He, therefore, thought that, on all grounds, to throw the present Bill out would be a very strong and unjustifiable proceeding.

Mr. A. M. SULLIVAN thought that the House should very carefully interfere with the passage of a private Bill in Committee, especially when the most exceptional circumstances existed such as a second reading. He knew very well, and pointed out that the honourable gentleman had reported that the so-called city of Dublin had formerly become so enlarged as to include a lot of districts, including that had grown up around the old Municipality of Dublin, and he would be most unwelcome if they allowed a number of these small, independent schemes for the supply of water to spring up, instead of having them all under one complete and central system of water supply. The noble lord (Lord R. Churchill), who was himself born with Dublin, was also personally acquainted with the Vartry water which was the finest he had ever tasted. The House would undoubtedly have cause to the future schemes of water supply which would constitute a group of petty districts, if it were allowed to pass. It was hoped the Bill would put a fork in it, and it was allowed to pass. It was hoped the Bill would put a fork in it, and it was allowed to pass. It was hoped the Bill would put a fork in it, and it was

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TO CORRESPONDENTS.

T. W.—Thanks for information received. Must defer notice till next week.

H. V.—American newspaper accounts, such as that you send, are generally so "padded" with untruths and exaggerations as to make it impossible to rely upon them. We prefer, however, much more than you suppose, to be entirely guided by facts.

Secretary.—Paper on "Tarbrush" on Gas its Faults.—We have received the report, just published, of the meeting of the Society, held at Lille, on the 26th of June last year. It contains much of great interest to the gas profession, and we shall take early opportunity of referring, in detail, to many of the subjects presented to, and discussed at the meeting.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

TO SUBSCRIBERS.

Subscribers who desire to avail themselves of the reduction in the subscription to the JOURNAL by paying in advance for the second half of the year 1880, are reminded that this can only be done during the present month.

Subscribers who have not paid their subscriptions for this, or for any previous year, are requested to remit the same forthwith to the Publisher, in order to prevent any interruption in the regular delivery of the JOURNAL.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 13, 1880.

Circular to Gas Companies.

The disastrous explosion which took place in the neighbourhood of Tottenham Court Road on the evening of Monday, the 5th inst., with its sad results in the destruction of life and property, is of absorbing interest to the whole of the gas world. A full and exhaustive inquiry into the cause of the accident, and into all the circumstances attending it, will doubtless be held promptly; and we shall therefore confine ourselves this week, as far as possible, to a statement of the facts so far as they are known to us, reserving comment till we have heard the evidence which will be forthcoming.

It was a singular coincidence that at the time we were going to press with our last "Circular," containing as it did some remarks upon the liabilities of Gas Companies for damage caused by escapes of gas from street-mains, this unexampled illustration of the gravity of those responsibilities should have been just happening. Although this disaster is almost—and, in its terrible extent, quite—unexampled, yet it is of a class which is generally appreciated by gas engineers, and the avoidance of such accidents in the past is a tribute to the care with which their work has been done and its contingencies provided for. Continually, both in the streets and on the works, it is necessary to shut off lengths of working mains, and cut out portions, in order to make connections. It is impossible to completely exhaust the gas from the sections thus made dead, and a mixture with atmospheric air within the explosive limit is the result while the work is being done. In such cases not only would the application of a light to an open pipe, as in the recent accident, before valves have been opened or bags withdrawn, cause an explosion, but the same effect would be produced by the using of overheated lead in the running of a joint, inflaming the yarn used in caulking. These are dangers which have been known to exist, and we repeat that the avoidance of harm from them says much for the care and watchfulness of those engaged in such work. The accident of last week resulted not from want of knowledge as to how to deal with dangerous conditions, but from absolute ignorance of the existence and presence of such conditions at the time.

The facts are, we believe, as follows:—The Chartered Gas Company have been making preparations this spring for supplementing the supply in their western and west central districts, by a direct connection with the main from their Beckton works. This was to be effected by laying a 36-inch pipe from Goswell Road, where it would be joined on to, and obtain its supply from the 48-inch (Beckton) main, through Bloomsbury to a point in Howland Street, a little westward of Tottenham Court Road. There it connected an existing 36-inch pipe, which, we presume, is at present the principal supply main in that neighbourhood from the western stations of the Company. The total length of this connecting-link main was rather over two miles. For the purpose probably of expediting the work, it was laid in two sections by separate gangs of men, but both in the employment of the same contractors. One of these sections extended from Goswell Road to the east side of Tottenham Court Road in Bayley Street; the other, that in which the explosion took place, from Howland Street, down Charlotte Street, through Percy Street, and across Tottenham Court Road, to meet the first section. Our readers unacquainted with the district will be helped in following the direction of this main by reference to the sketch which we give elsewhere; and we will, if possible, furnish a more detailed plan with our next issue. The eastern section, that from Goswell Road, is about a mile and a half long; the other rather less than half a mile. Early in March last, the working main in Howland Street was cut, and a T-branch put in, the outlet looking down Charlotte Street. On to this outlet, which was flanged for the purpose, was bolted a 36-inch valve, made by Messrs. Westwood and Wrights. A few lengths of pipe were then laid from the valve, so as to carry the excavation clear of Howland Street, and avoid again interfering with its traffic, and the short length so laid was capped up and left. The laying of the main itself was then commenced from the Tottenham Court Road, under which thoroughfare it was carried at a depth, we believe, of about nine feet, so as to clear the pipes already in position, and also a pneumatic tube used by the Post Office authorities. By about the middle of May the laying of this section was completed, and a connection was then made on to the short length already referred to, so opening up the whole main to the valve which severed it from that which was charged with gas. When this connection was made it is said that the air in the short length was pure, showing no sign of the presence of gas, thus confirming the Company's Chief Inspector in his confidence in the soundness of the valve. It will thus be seen that for nearly two months this section had been finished; it was capped up at its eastern end, the paving of the streets was made good, and no doubt was entertained that the valve which had shut out the gas from the short length would do so equally securely from the longer one. Meantime the section from Goswell Road was being laid, and a few days before the accident it was completed ready for connecting. No junction had been made with a live main in this case, and when the work was tested the length was closed at each end by a cap. If we are rightly informed that a pressure of over twenty inches was put within this main, and that it was maintained for twenty-four hours with no appreciable loss, there could be no better testimony to the care and accuracy with which the work had been carr' d out. The western section was tested on the day of the accident by pumping air into it through a two-inch pipe at the Bayley Street end. We have not heard what the result was, but we assume that it was satisfactory, because the two lengths were to be joined on the following day. This is a question of much importance, as we shall point out further on.

Parliamentary Intelligence.

PRIVATE BILLS RELATING TO GAS, WATER, Etc.

SESSION 1880.

PROGRESS MADE TO SATURDAY, JULY 10.

Title of Bill.		Petition for Bill Presented.	Bill Read a First Time.	Bill Read a Second Time.	Bill Reported.	Bill Read the Third Time.	Bill Received Royal Assent.
Ackworth, Featherstone, Purston, and Shardston Gas Bill	Lords	Comns. Bill	June 22	July 6	June 15	June 21	—
" "	Commons	Feb. 9	Feb. 10	March 8	—	—	—
Birkenhead Borough Bill	Lords	Bill with-drawn.	—	—	—	—	—
" "	Commons	—	—	—	—	—	—
British Gaslight Company, Limited (Staffordshire Potteries) Bill	Lords	Feb. 10	Feb. 10	—	—	—	—
Burton-upon-Trent Corporation Bill	Commons	Lords Bill	June 21	Feb. 23	June 17	June 22	—
Cardiff Water Bill	Lords	Comns. Bill	May 27	July 5	—	—	—
" "	Commons	Feb. 5	June 7	June 7	—	—	—
Chester Gas Bill	Lords	Feb. 16	Feb. 16	March 11	March 11	May 25	—
" "	Commons	Lords Bill,	March 11	Feb. 20	March 8	March 11	—
Cork Gas Bill	Lords	Comns. Bill	March 12	March 19	June 4	June 14	June 29
" "	Commons	Feb. 9	Feb. 10	Feb. 24	June 4	June 8	—
Cork Improvement Bill	Lords	—	—	—	March 2	March 11	June 29
" "	Commons	Feb. 9	Feb. 10	—	—	—	—
Dagenham and District Farmers (Optional) Sewage Utilisation Bill	Lords	Comns. Bill	June 22	March 1	June 16	—	—
" "	Commons	Feb. 9	Feb. 10	July 2	—	—	—
Dartford Gas Bill	Lords	Comns. Bill	Feb. 19	Feb. 16	June 15	June 21	—
" "	Commons	Feb. 7	Feb. 10	—	—	—	—
Dearne Valley Water Bill	Lords	—	—	Feb. 17	June 15	—	—
" "	Commons	Feb. 5	Feb. 10	—	—	—	—
Denton and Haughton Gas Bill	Lords	Feb. 10	Feb. 10	March 12	July 6	—	—
" "	Commons	Lords Bill	June 1	Feb. 24	March 16	May 27	—
Doncaster Corporation Water Bill	Lords	Comns. Bill	June 1	June 15	June 25	July 5	—
" "	Commons	Feb. 5	Feb. 10	June 10	June 28	June 29	—
Eastbourne Gas Bill	Lords	Feb. 10	Feb. 10	Feb. 16	March 17	May 31	—
" "	Commons	Lords Bill,	May 28	Feb. 16	March 16	May 31	June 29
Edinburgh and District Water Bill	Lords	Comns. Bill	May 27	June 8	June 25	June 29	—
" "	Commons	Feb. 9	Feb. 10	June 8	June 21	June 25	June 29
Exmouth and District Water Bill	Lords	Comns. Bill	March 5	March 19	June 28	June 29	—
" "	Commons	Feb. 9	Feb. 10	Feb. 16	July 6	July 9	—
Gaslight and Coke Commercial Gas, and South Metropolitan Gaslight and Coke Companies Bill	Lords	Comns. Bill	March 5	March 19	Feb. 26	March 9	—
" "	Commons	Feb. 9	June 22	June 3	June 4	June 10	June 14
Great Yarmouth Water Bill	Lords	—	Feb. 10	Feb. 23	June 11	June 24	—
" "	Commons	Feb. 9	—	—	—	—	—
Hinckley Local Board Gas Bill	Lords	Comns. Bill	Feb. 10	Feb. 17	July 9	—	—
" "	Commons	Feb. 9	July 6	—	—	—	—
Huddersfield Tramways and Improvement Bill	Lords	Comns. Bill	Feb. 10	March 4	June 25	July 5	—
" "	Commons	Feb. 9	July 6	—	—	—	—
Hull Lighting Bill	Lords	Comns. Bill	June 10	March 8	June 22	July 8	—
" "	Commons	Feb. 9	July 6	July 8	July 8	—	—
Hyde Gas Bill	Lords	Comns. Bill	Feb. 10	Feb. 16	Feb. 26	June 14	June 21	—
" "	Commons	Feb. 9	June 25	Feb. 16	July 16	June 11	June 28	—
King's Lynn Corporation Bill	Lords	—	Feb. 10	—	—	—	Preamble	not proved.
" "	Commons	Feb. 9	July 19	Feb. 23	June 14	—	—	—
Lancashire County Justices (Water, &c.) Bill	Lords	Comns. Bill	Feb. 10	—	—	June 7	July 8	—
" "	Commons	Feb. 9	July 19	Feb. 16	June 7	March 11	March 18	June 29
Lancaster Corporation Bill	Lords	Feb. 10	Feb. 19	March 16	June 15	June 21	—	—
" "	Commons	Lords Bill,	March 16	June 7	June 28	June 29	—	—
Lincoln Gas Bill	Lords	Comns. Bill	June 18	June 28	—	—	—	—
" "	Commons	Feb. 9	June 25	Feb. 16	June 28	June 29	—	—
Liverpool Corporation Water Bill	Lords	Comns. Bill	June 10	July 5	March 23	June 16	—	—
" "	Commons	Feb. 9	June 25	—	—	—	—	—
Liverpool United Gas Bill	Lords	Comns. Bill	Feb. 10	March 23	June 8	June 21	—	—
" "	Commons	Feb. 9	July 6	—	—	—	—	—
London Gaslight Company Bill	Lords	Comns. Bill	Feb. 10	Feb. 24	July 1	July 5	—	—
" "	Commons	Feb. 9	May 28	June 7	—	—	—	—
Maidstone Gas Bill	Lords	Comns. Bill	Feb. 10	Feb. 24	March 22	May 27	—	—
" "	Commons	Feb. 7	Feb. 19	July 6	—	—	—	—
Malton Gas Bill	Lords	Comns. Bill	Feb. 19	March 1	June 17	June 29	—	—
" "	Commons	Feb. 7	July 7	—	—	—	—	—
Oldham Improvement Bill	Lords	Comns. Bill	Feb. 10	Feb. 23	June 22	July 1	—	—
" "	Commons	Feb. 9	June 22	July 5	June 24	—	—	—
Phœnix Gaslight and Coke Company Bill	Lords	Comns. Bill	Feb. 10	March 8	June 11	June 24	—	—
" "	Commons	Feb. 9	July 6	—	—	—	—	—
Portsmouth Water Bill	Lords	Bill with-drawn.	Feb. 10	Feb. 16	June 17	June 24	—	—
" "	Commons	—	—	—	—	—	—	—
Prescot Gas Bill	Lords	Feb. 10	Feb. 10	Feb. 16	May 31	—	—	—
" "	Commons	Lords Bill	June 4	June 14	—	June 3	—	—
Preston Improvement Bill	Lords	Comns. Bill	June 10	June 14	June 14	—	—	—
" "	Commons	Feb. 9	June 25	June 24	March 12	June 17	—	—
Rathmines and Rathgar Township (Variety Water Supply) Bill	Lords	Comns. Bill	June 22	July 5	—	May 27	June 29	—
" "	Commons	Feb. 12	Feb. 16	Feb. 16	June 17	June 22	—	—
Rathmines and Rathgar Township Water Bill	Lords	—	—	March 11	June 7	June 23	Preamble	not proved.
" "	Commons	—	—	—	—	—	—	—
Reading Gas Bill	Lords	Feb. 10	Feb. 10	Feb. 16	June 7	June 14	—	—
" "	Commons	Lords Bill	June 16	July 5	—	—	—	—
Rochester Corporation Bill	Lords	Comns. Bill	June 22	March 1	June 17	June 28	—	—
" "	Commons	Feb. 9	June 25	July 5	—	—	—	—
Sea Water Supply to London Bill	Lords	Comns. Bill	Feb. 10	Feb. 16	July 9	July 9	—	—
" "	Commons	Feb. 9	June 25	March 5	Privately	Privately	—	—
Silpe Borough Water Bill	Lords	Feb. 10	Feb. 10	Feb. 16	—	—	—	—
" "	Commons	—	—	—	—	—	—	—
South Metropolitan Gas Company Bill	Lords	Bill with-drawn.	Feb. 10	Feb. 16	June 11	June 16	—	—
" "	Commons	—	—	—	—	—	—	—
Southwark and Vauxhall Water Bill	Lords	Feb. 10	Feb. 10	June 22	—	—	—	—
" "	Commons	Bill with-drawn.	June 10	—	—	—	—	—
Stafford Borough Bill	Lords	—	—	—	—	—	—	—
" "	Commons	Feb. 9	Feb. 10	—	—	—	—	—
Wakefield Corporation Water Bill	Lords	Comns. Bill	June 1	Feb. 27	July 1	—	—	—
" "	Commons	Feb. 9	Feb. 10	July 1	—	—	—	—
Wandsworth and Putney Gas Bill	Lords	Comns. Bill	Feb. 10	Feb. 23	July 2	July 9	—	—
" "	Commons	Lords Bill,	March 19	June 7	March 17	June 1	—	—
Wigan Improvement Bill	Lords	Comns. Bill	Feb. 10	July 4	March 11	March 16	—	—
" "	Commons	Feb. 9	June 25	March 5	June 25	July 2	July 9	—
Wrexham Water Bill	Lords	Comns. Bill	June 22	March 8	June 8	June 24	—	—
" "	Commons	Feb. 9	Feb. 10	July 5	—	—	—	—
Yeadon and Guiseley Gas Bill	Lords	Comns. Bill	June 22	July 1	June 11	June 24	—	—
" "	Commons	Feb. 9	Feb. 10	March 4	June 25	July 5	—	—
			June 25	July 5	—	June 21	—	—
			March 10	March 10	June 11	June 22	—	—

[From the "London Journal of Gas Lighting."]

Seventeenth Annual Meeting of the British Association of Gas Managers.

INAUGURAL ADDRESS OF THE ACTING PRESIDENT, CHARLES HUNT, ESQ., OF BIRMINGHAM.—DIFFERED THROUGH ILLNESS FROM A YEAR AGO.

Gentlemen:—The circumstances under which I have to ask for more than the usual measure of that indulgence and support which have been so freely accorded to every former occupier of this chair are fully known to you. It has unfortunately happened that the President of your choice has been compelled by persistent ill health, in the midst of his term of office, to retire into your hands the dignity conferred upon him. Our regret at the necessity for such a step remains profound; and I am sure that you will wish me to convey thus publicly to Mr. Douglass the assurance of your sympathy, and of your earnest wishes for his speedy and complete recovery and future prosperity.

As you are doubtless also aware, our esteemed Secretary, Mr. Bennett, has during the last few months been laid prostrate by a serious illness, from which he is happily to a considerable extent restored. While congratulating him upon his recovery thus far, we have it in our power to testify, in the most practical manner possible, to our regard for one to whose exertions the Association is so greatly indebted, by assisting in the work of this meeting when assistance would be of service, and by the exercise of as much forbearance as possible during the continuance of it.

During the past year we, as an Association, have lost through death five of our number. These are—Mr. George Berry, formerly and for many years Manager of the Ashford Gas Works, in Kent; Mr. A. F. Livesay, formerly part proprietor of and otherwise officially connected with the Ventnor Gas Works, Isle of Wight; Mr. R. W. Brothers, late Manager of the Chorley Gas Works; Mr. H. S. Pierson, formerly Inspector of Mains, in the service of the Chartered Gas Company; and Mr. Claudio Gil, of the Gas Works, Barcelona; all of them most worthy representatives of the profession to which they belonged.

It is fitting here to record also the death of one who, although not a member of the Association, yet took a warm interest in its welfare, as in everything connected with the gas industry. It was only last year that we had to lament the loss of the familiar reporter of our proceedings, and now the keen yet kindly critic has gone from among us. Mr. T. W. Fewtrell, F.C.S., whose death we now deplore, took for several years an active part in the management of the *Journal of Gas Lighting*, succeeding, in a great measure, the late Mr. T. G. Barlow. His intimate knowledge of chemistry rendered his criticisms upon the subject of gas manufacture of especial value; although his name will probably be held in remembrance chiefly as co-editor of Mr. Newbigging of "King's Treatise on Coal Gas," the most valuable and comprehensive work of the kind yet attempted.

If the present total number of members be compared with that for the year 1870, when it was 314, it will be seen that the Association has constantly more than doubled during the past ten years, proving it to be possessed of an amount of vitality greatly in excess even of that with which the manufacture of gas is ordinarily credited. Nor will it be found upon examination that its augmented membership suffers in comparison with this great accession to its numbers. Year after year fresh fields for investigation have been opened up, new problems have been presented for solution, until there is hardly a detail, intimate or remote, of the complex art of gas manufacture that has not been made the subject of free, exhaustive, and instructive criticism. Our discussions have made of individual knowledge common stock; our published transactions will be found to be a faithful relief of, almost without exception, the most advanced opinions upon all technical matters relating to gas.

These annual gatherings afford to the gas manager more and more favorable opportunities for throwing off that crust of isolation by which he is apt to be enveloped, and for freeing himself of crudities that are so often engendered by a life of comparative self-dependence. It is not necessary that his voice should have been heard at those meetings; he may have been a mute participator in our proceedings; yet if he has not returned to his work improved by contact with his professional brethren, quickened in his desire to do the best that he can both in and for his calling, he will have proved himself to be insensible to one of the most powerful appeals that could be addressed to him. Such, in brief, has been the work of the Association, and such may it long continue to be.

My object, however, in thus referring to it is not one of laudation merely; there is, as may be readily imagined, a reverse side to this pleasing picture, which I conceive it to be equally my duty to place before you. Some there are among us who do not feel entire satisfaction at the past career of the Association, and who desire to mould its future more in accordance with their views of an enlarged sphere of usefulness. With these it is impossible not to feel a certain amount of sympathy. There can be but few who, looking back along the road they have traveled, have not to recall some opportunities disregarded, some aspirations unfulfilled. As with the individual, so it may also be with the Association.

It is objected that its aims have been metropolitan rather than cosmopolitan; its actions mechanical rather than progressive. Toward the satisfying of a grievous feeling on the part of members for more frequent opportunities of discussing matters of immediate importance, it has made no effort; and hence the formation of district associations; of sections, bound to it indeed by the strongest ties of sympathy, but owing to it no other allegiance than that which is secured to it by the force of superior numbers, position, and influence. In the conduct of its affairs it has adhered, without sensible variation, to its original programmes; our annual volume, while increasing in bulk and, let me add, in value also, remaining what it was at the commencement—a report solely of the proceedings of two or at most three days in every year. There seems to be no good reason why, except perhaps on the ground of expense, this should not be made of still greater value to us all. Following the example of similar associations, it might, through the instrumentality of a Committee of Publication, be constituted a complete record of the progress of gas manufacture in all parts of the world. This would be accomplished by the selection, and translation where necessary, of such extracts from both British and foreign journals as might, in the opinion of the Committee, possess a permanent interest in relation to gas. In this way we should be kept informed semi-annually or oftener if found desirable, of the advances made in connection with gas lighting abroad, and at the same time be building up for ourselves an epitome, for reference, of the most valuable and comprehensive kind.

In another direction also it seems possible that we might with advantage imitate the practice of kindred societies—namely, in the encouragement and promotion of original research. I am not unmindful of the fact that the Association has in its gift at least one medal, besides premiums at will, and that in the bestowal of these it is unlikely that the claims of the meritorious investigator could be overlooked; yet do we not fall somewhat in our aims by not giving, to a certain extent at least, point and direction to the labors of the latter, and by abstaining, in our collective capacity, from all attempts at elucidating some of the apparent mysteries of gas manufacture? Such, at any rate, are among the suggestions that occur for extending the usefulness of the Association; and I venture to hope they may not be deemed unworthy of your consideration.

Whatever of truth there may be in the saying that "London is not England," certain it is that its gas polity is reflected far and wide, possessing an interest extending beyond even the limits of the realm. Here was first rendered manifest the evil consequences of the failure of active competition when applied to gas undertakings; and here also, following within the space of a few brief years the rejection of this principle, was first accepted, in its most comprehensive sense, the very opposite one of amalgamation. It is not necessary to justify the combinations that have taken place, and of which we cannot yet have witnessed the last, by pointing to reductions of price that have followed, or are expected to follow; that advantage has been made apparent enough during the past few years by the disappearance from crowded neighborhoods of works that could not but be inconveniently and uneconomically conducted. The growing requirements of an overflowing population had, in fact, rendered amalgamation a necessity altogether apart from financial considerations; yet the concentration of manufacture in the most suitable localities thus made possible, must of itself, from its greater economy and the higher degree of skill that it admits of, have eventually secured great and lasting benefits to the consumer, had they only possessed what has been called the "magic of distance" to assist of fruition.

One legislation, however, like Parliament itself, seems destined every few years to undergo a more or less complete revision; and in the fulness of time, albeit precipitated by events that need not now be recalled, it was considered desirable to stimulate the action of the companies toward further reductions in the price of their gas. The introduction of the sliding scale of dividend is recognized as having been mainly the work of one of our past-presidents, and now an honorary member—Mr. George Livesay; and it is an achievement of which he may justly feel proud. Without of necessity indorsing every argument that was advanced in support of so great a change, it may be accepted, at this distance of time, as the first, as it remains the only attempt to apply to what, in the hands of companies, are essentially commercial undertakings, sound commercial principles; and for this reason if for no other any effort to disturb it would be a matter for regret. Nevertheless it is to be appreciated that the public will regard with increasing jealousy adjumentations of dividend for which only a bare justification can be shown to exist.

The permanence of the sliding scale as an institution depends, it may be said, upon its good behavior. It may be expected to continue in favor so long as it operates, or is believed to operate, more for the benefit of the consumer than the legislation it superseded; but it might quickly fall into

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Kimberley Water-Works Company, Limited.—The Company was registered on the first inst. with a capital of £300,000, in 50,000 shares of £6 each. The object is the construction of water-works in the South African colonies.

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TO CORRESPONDENTS.

E. M.—*A simple stamped receipt is quite sufficient.*

A. E.—*There are many gas and water works already established, some under companies and others under municipal control. To what town in the colony do you refer?*

FIRTH.—*Next week.*

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 18, 1880.

Circular to Gas Companies.

SHORT though the parliamentary session must be which commences its real work this week, it may yet prove of importance to the interests of Gas Companies. A reconsideration of the question of the Water Supply to the Metropolis is for many reasons probable, if not inevitable, and it will hardly be surprising if the subject widens so as to embrace the gas supply also. The present House of Commons, containing as it does so many new members with the proverbial disposition to work hard and thoroughly, is more likely to err in the direction of attempting too much than too little; and the task of reconciling the demands of ratepayers and consumers with the rights of shareholders in Metropolitan Gas and Water Companies has been so often attempted, and has so often failed—it has led to so large an expenditure of time and money and temper—that its accomplishment would be an achievement not unworthy of those "golden hours" from which so much is expected, and there are not wanting signs that the effort will be made. Whether the larger question of the reform of the Municipal Government of London, threatened or promised years ago by Mr. Gladstone, will not absorb and delay these minor matters, which may be regarded as fragments of that great whole, time will show. However this may be, it seems probable, having regard to the character and experience of some of the men now at the head of affairs, that any such inquiry would be conducted with a view to laying down lines that will serve not only to guide the relations of Metropolitan Companies with the Municipal Authorities, but which shall be applicable also in regard to similar questions as they may arise in the towns of the country generally.

As our readers are aware, *The Times* has lately been giving its attention to the question of electric lighting, and has passed through a period of tribulation because of the miscarriage of certain prophetic ventures as to the future relations of gas and electricity. Perhaps it is partly with the object of showing how baseless were the anticipations then expressed, and the panic which resulted from them, and also with a view to utilizing the information so painfully gained, that what is generally called the "leading journal" has now entered upon an inquiry or argument as to the propriety of the compulsory municipal acquisition of gas and water undertakings, and has treated the question so far without a word of reference to the competition—so formidable a few short weeks ago—of the electric light. Even we were scarcely prepared for such an evidence of the shallow and ephemeral character of the agitation then experienced. A letter signed "A Member of the Council of the Incorporated Law Society," published on the 13th inst., commences with the statement that "There is a well-founded desire and "growing necessity for Municipal Corporations to possess the "right of public supply of water and gas within the limits of "their districts." Our columns have borne abundant evidence of the truth of a moiety of this statement—viz., the "desire," the distinctly "growing" desire on the part of Municipalities to acquire gas undertakings, provided only that they are sufficiently prosperous. The *necessity* for such acquisition, and the principles on which the desire is said to be "well founded," are not so apparent. The desire may be said to have grown in intensity directly with the profits of the Gas Companies; and this explains a conspicuous anomaly in the proceedings of Municipal Authorities—viz., that it has been the successful and well-conducted Gas Companies which have been the objects of this most determined attack, rather than those where, from any causes, the success has been small, and the field for improvement proportionately larger. We distinctly question the *bona fides* of Corporations generally in this matter, believing that the object avowed—that of securing to the consumers a better and cheaper supply of gas—is, in the vast majority of cases, secondary to the purpose unavowed—of becoming traders with a view to the making of profit, and thus obtaining the advantage of increased revenue without the usual accompaniment of apparent increased taxation. We have repeatedly pointed this opinion by reference to the conduct of gas affairs in Manchester, Birmingham, and other towns similarly placed in this respect. Another illustration occurs to our mind in the case of the opposition offered this session, by the Corporation of Hanley, to the Bill of the British Gaslight Company. Hanley is one of the five or six towns constituting the Staffordshire Potteries, and all of them were at one time supplied with gas by the British Company. One by one these towns have started competing Companies, who have bought out the interest of the British Company, and, after varying periods of independent existence, have transferred their undertakings to the Corporations of their respective towns. But in each of these places the price of gas is maintained at the same amount as that charged by the British Company in Hanley, though each shows a balance sufficient to justify a reduction. The inference is a fair one—that should the Town Council of Hanley also succeed in obtaining possession of the gas-works the price of gas will not be reduced, but will at once be accepted as a fair and equitable one.

In Paris the Municipality are charged only one-half the price paid by private consumers of gas, and, still further, the Gas Company pay to the same authority a large sum annually, being an agreed proportion of the profits in excess of a given amount. This is an arrangement which would be impossible in any town in the United Kingdom. The political intelligence of the inhabitants would protest against so palpable an unfairness to a section of the community, and also against the direct inducement—which might almost be called a bribe—to those who are appointed to watch over the interests of all alike, to permit the overburdening of a part. Impossible as such an arrangement would be with us, where the supply of gas is in the hands of a Company, we fail to see any marked difference in principle between it and the system of municipal management of gas-works as usually conducted, where one section of the ratepayers may urge on a wasteful and oppressive expenditure, knowing that the money to meet that expenditure will have to come from other pockets than their own.

In the special article in which *The Times* deals with its correspondent's letter, and which is written all through in a tone and temper of great fairness, it remarks: "Where the "Municipality has the control of the water or gas supply, the "consumers obviously (?) enjoy all the advantages of co-

MR. SUGG ON THE SCIENTIFIC USE OF GAS.

As already briefly noticed in our columns, Mr. Sugg, on Tuesday, the 20th inst., delivered a lecture, on "The Scientific Use of Coal Gas," before the Hull Literary and Philosophical Society. The lecture, which was abundantly illustrated by diagrams and experiments, was very well received; but with the exception of a portion of it our readers would be little interested, as it was a recital of experiments which they are, of course, familiar with, and known, in many cases, which deserve notice in our columns, and we take the opportunity to do so.

After alluding, in a popular kind of way, a description of how gas is produced and what are its constituent parts, the lecturer dwelt on the necessity of the properly proportioned burner fittings for burning gas, affecting the question of pressure. At this point he exhibited Zaslin's patent apparatus for accurately measuring the flow of gas by simple inspection. This apparatus, a description of which is appended, was fixed to one of the burners shown, and showed the flow of gas that passed through the burner on a very ingenious little apparatus, the invention of Mr. George Joslin, of Colchester. It is simply a taper glass tube, which is connected with the gas that supplies the burner. It may be placed on any convenient pipe conveying the gas. The taper tube is fixed to the burner. Within the glass tube is a small tube of mica, of such a diameter that when it falls to the bottom of the tube it fits closely to the sides. When I turn on the gas the mica disc is forced up the tube to a height at a point at which the quantity of gas required by the burner can escape from under it by the space between its edge and the sides of the tube. As the tube is taper, it is clear that the higher it goes the greater the space will be between the circumference of the disc and the sides of the tube, and consequently it is necessary to refer to know at a glance how much gas is passing. I have only to read the figures or degrees marked up the outside of the tube. These have been verified by trials with an experimental meter.

The lecturer then passed on to the question of the use of burners with and without governors to the effect of actinism, and the value of each on the eyesight. On this latter point he dwelt somewhat at length, his remarks being as follows:—

I have now to bring before you a subject of the greatest possible interest in relation to the use of artificial light. It is indisputable fact that there is not the present day a large proportion of a number of young men and women, and even children, who are obliged to work by artificial light. France and Germany, as well as in England, this subject has attracted the attention of scientific men, and it is one which must not be allowed to drop until every reasonable actinic condition is fulfilled. Many of the dull of eyesight, which compels young boys and girls, and also young men and women, to work, a great deal of their time, is due to their work by the aid of candles, others by factory; but the great number employ gas. The light is, however, mostly insufficient and of a very unsatisfactory kind. Most of the evil complaint arises in relation to artificial lighting—it is the quality of the light, regarded from a chemical point of view. Sir light, as we are aware, is composed of rays, light rays, heat rays, and chemical rays, which on a ray of light is made to divide itself, or split up, by being passed through a prism, into the seven colors composed of the colors—red, orange, green, green, blue, indigo, violet. This is called its spectrum. The red is the heat ray, and this rays on the spectrum are the longest, and this changes into the green, then becomes less, and finally ends in violet. The greatest heat is found to be beyond the red ray of the visible spectrum, while the greatest chemical effect of light is in the violet, or the visible spectrum on the other side. The chemical or "actinic" rays are the most powerful in relation to producing the greatest effect upon a photographer's sensitive plate, and without this ray we could not obtain a satisfactory photographic portrait.* But there is a certain condition of the eye in a state of daylight with respect to the chemical property diffused in the day. At early dawn there is light almost without actinism, or chemical ray; but as soon approaches the light of day increases in actinic power, and in the afternoon rapidly declines, till at evening no actinic ray is present. Now, this chemical actinic property, in the shape of the actinic ray, or chemical ray as it is usually called, to distinguish it from the other component parts of light, is the most important ingredient in photo plate, so is acts upon that most portion of all photographic apparatus, the human eye.

Light which contains a great quantity of actinism injures the optic nerve, and renders it insensitive, exactly as a photographic plate is rendered insensitive by the same agency if it is over-exposed to it. Therefore, it is most natural thing that occurs to all human beings is to get out of the blinding glare of light, and to shut our eyes or shield them from it when there is light with too little actinism. The great diminution of this chemical property of light towards the close of day is the reason why clearly that the eye must not be exposed for too great a length of time to the action of the actinic rays. Consequently, it seems to me that what we want as an artificial light is that kind of light, as opposite to natural light, we have on summer evenings—white and diffusive, but almost devoid of actinism.

Now, if we read by the light of a candle placed too far from us, the pupil of the eye is abnormally dilated, and the consequence is that it is opened to its widest extent; so it is on all the rays of light possible. This is a arrangement, which is quite suitable to the construction of a cat's eye, is altogether unsuitable to the human eye. The delicate nerves are overstrained, and, in time, become permanently injured. If we use the candle at a proper, or the greatest amount of the sharp-pencil of light falls on the eye, so that we can see from seeing so distinctly the object we are looking at. The greater and more intense the light, the less the pupil of the eye is dilated. The extreme is reached when we place the unshaded gaslight directly in front of the eye, and in close proximity to it. All the disagreeable and hurtful effect of strong daylight is produced upon the eye, without its immense diffusion and perfect steadiness. Sharp bright rays are darted into the eye when we look up, and a strong glare is produced as symbols of the downcast eyes. The flicker of the light keeps the diaphragm of the eye constantly trying to adjust itself to

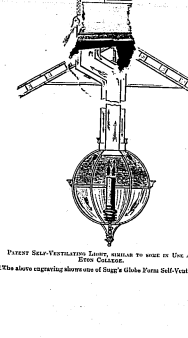
* Cecelia Abergy, of South Kensington, has demonstrated that the red ray as well as the violet rays can be photographed.

variable light, causing great fatigue. In addition to this, the heat of the lamp is thrown full on the front part of the head. Nothing is more contrary to the wise provisions of nature than the position we have to take to "shade" our eyes from it. But this is the condition of things in relation to the art; just light which is used by our young men and women who are engaged in work. In fit, then, to be wondered at that the eye become prematurely old and insensitive—less their brightness and all the fine nerves of vision waste away, and form with which nature originally endowed them? Is it wonderful to argue that there are instances of persons who have studied for years that they can read by gaslight, and still have good eyesight. Instances can be easily be found of persons who have done everything they possibly could to destroy their eyesight, but have not succeeded; but by far one person who has not impaired his sight by the injudicious use of artificial light in pursuing his studies, through the light which we have done on education to your children, and they impair their eyesight in a high-class establishments of the great advantages and their high education, and are heavily handicapped in the race of life by the fact of their being obliged to wear spectacles. This is entirely possible was the case before the introduction of artificial light, and is greatly owing the course of their lives.

But you will naturally ask me, How can we alter this state of things? I reply, a very simple and easy one, and yet well worthy the aid of a candle, let it be a good one, and provide yourself with a proper shade for candle, candles, not opaque, but slightly translucent, so that the candle may be visible inside, so that a red colour light falls on the eye. It is a large thing, and, therefore, not objectionable, but opaque shades—do not answer the lower edge of the shade, just a little curtain of pale rose paper or silk round the lower edge of the shade, so that the light falls on the eye. Green shades or other coloured non-conductors of heat should be interposed between the hand and the light, so that a current of air may not be created to the eye. The reason for it is that the actinic rays of light are stopped by glass is an impediment to heat, and also to a great extent. Green glass is the best light for drawing, writing, or reading by, therefore, in my opinion, the Argand burner should, in the manner I have indicated, with a screen of ruby glass, be placed between the eyes and the artificial light, and the same. This is one of the non-actinic reading lights. [Lampshown and explained.] Although, as I have said, I prefer the ordinary light equal to 20 candles, I find by experiment that a burner of that light equal unsafe from weakness of sight to read by any artificial light. Even a 10-candle burner has been said to be so without fatigue. But for myself I can only say such a light equal to 16 candles or so will be found best.

It is a common error to think that Argand burners are the most powerful, though even powerful in that Argand burners are the most powerful, though even powerful in that Argand burners are the most powerful in light-giving properties with the consumption of gas than fishtail or flat-flame burners, and this is the reason why Argand burners are more suitable for producing a soft and non-actinic light than the latter. Thus, for example, a flat-flame burner giving a light equal to 16 candles, with, say, proper reduction, attached to a reading lamp, is pernicious to the eyesight; an Argand burner, equal to 100 candles, requires nearly the same time to consume the same quantity of gas. The inference, therefore, is that the Argand burner with the chimney lessens only half the actinic power of the open flat-flame burner; and it is the actinic power or the ratio of the light to the chemical property diffused by the outdoor daylight is diminished to more than one-half by the opposition of the glass in the windows to the entrance of the actinic rays.

The lecturer then called attention to the complaints made about the heat and the consequent injurious effects on the eyes of the products of the combustion of gas on pictures, libraries, and museums. In connection with the question of drawing of a light, he referred to the new picture gallery, at Bristol. The light given by each set arms or sunlight, picture gallery, at Bristol. The light given by each set arms or sunlight, picture gallery, at Bristol. 1000 candles, and the products of combustion are to be equal to from 100 to of fresh air to the gallery per minute. The ventilation and the supply were in which the light is given placed, a in connection with the Grand Club in London. It was, the two of these lights, each light equal to 300 candles, and the two of these lights, each increased in the heat. ture of the room was not



PATENT SELF-VENTILATING LIGHT, SIMILAR TO THOSE IN USE AT ETON COLLEGE.

(The above engraving shows one of Sugg's Globe Form Self-Ventilating

Lights for 100 or 200 candle burner. The lantern is of clear glass below, and white glass in the upper part, the two being divided by a copper moveable ring, similar to that immediately above the globe, and surrounding the inlet and outlet tubes. The ring, or inlet flue—the outlet being contained within it—may, of course, be connected with any required currents of air to both directions as indicated by arrows.

The lecture concluded by a reference to the use of gas in engines for obtaining motive power in the place of heating purposes; and, in connection therewith, the means of electrically lighting railway carriages.

JOSLIN'S APPARATUS FOR ASCERTAINING THE HOURLY RATE OF GAS CONSUMED BY BURNERS.

This ingenious little instrument, referred to in the above lecture, is the subject of a patent dated June 15, 1872 (No. 2126), the inventor being Mr. George Joslin, of Colchester.

The object of the apparatus is to provide the means of ascertaining the hourly rate of the consumption of gas by any burner—as, the rate of consumption at the time of inspection calculated at the quantity that would pass in the course of an hour—by allowing in a glass or metal tube or cavity of a disc supported by the gas at a height corresponding to the rate of gas being consumed.

The apparatus consists of a taper tube of glass, metal, or other material, of round or other form in its horizontal section, and increasing upwards in area. Into this taper tube is a thin disc or discs of tube, aluminium, or other material, and of the same form as the horizontal section of the taper tube. If one disc is used, it is maintained in a central position by a piece of metal or other material attached to it, or two or more discs may be connected together. The taper tube is connected with the burner or burners, and the gas is admitted at the bottom of the taper tube connected to the wall it arrives at the figure which corresponds with the hourly rate of the gas passing. After the gas has passed the disc it flows from the upper part of the taper tube to the burners. The taper tube may be enclosed in a tube, the diameter of which is greater than the disc, or other means may be used to indicate by figures upon a graduated scale the hourly rate of consumption; or the indicator and figures may be placed outside the tube or case before mentioned, and projected by a lens, or otherwise, upon a screen or surface, or upon a fixed sectional elevation of one form of the apparatus: A being a brass tube, B a taper glass tube, and C a cap to allow the position of the mica glass, D, to be noted. It is a glass tube, slightly conical, the lower part of which is open, while B is the burner in position to be tested. The glass tube, B, is graduated so that it indicates the hourly consumption of gas.

CONTENTS.

Communicated Articles.

EFFECT OF TEMPERATURE IN THE G. AIR SUPPLY UPON SOME ILLUMINATING P GAS-FLAMES.

By Mr. R. H. PATTERSON, F.S.S.

SECOND PART.

The only reasonable motive that there can be for A when supplied to a burner is, that this preliminary enable the gas-flame to acquire a higher temperature, combustion, and consequently burn with greater bril can be no doubt that an advantage is obtainable ordinary fuel in grates or furnaces. But there is difference between that case and the use of gas for purposes; because ordinary fuels, such as coal, presents resistance to ignition. A feuller match, for example, or of them, may wholly fail to ignite it; heat or flame in strength or mass is required before ignition is effected; course is the same thing dynamically, a small flame mus to coal for some length of time before combustion is prod then, is something to be saved or economized. Eith amount of heat, or a shorter application of it, will suffi fuel which has been heated. Also, in a grate or furn always some part of the fuel not actually ignited; and so i is the case it is obvious that the higher the temperature of th portion, the less heat will be absorbed from the burning produce combustion in the rest.

Still more clearly is it of advantage to heat fuel which is *added* to a fire or burning furnace; for the first effect of duction of cold fuel is necessarily to reduce the temp combustion—indeed, *any* addition of fuel which is not burning must operate in this disadvantageous manner. A lies the greatest defect in the present system of gas-making four or six hours the retort is emptied of its mass of high more by the charge of fresh coal; so that no sooner is the temperature attained than it is suddenly pulled down to point to allow of the distillation being effectively carried way of remedying this (although there are serious practical in applying it) would be to heat the retort steadily in it mense of small-sized coal in a hopper, and the other is t coal which is about to be supplied to the retort. But to ha any considerable extent means also to vaporize a port combustible and illuminating substance; and unless the vapours thus discharged from the coal by heat are pres utilized, more damage may be done to gas-making than is sated by the intenser combustion produced by this heating the retort.

But the obvious advantages obtainable from heating fuel ignition and combustion, are not paralleled when the same is applied to gas. The more sluggish any combustible ma the other words, the more slowly combustion extends from part—the more valuable is the effect of prior heating; i the whole mass springs into a blaze the moment the requisi tature is applied, to any part of it, it is hard to see what a

* "Gas-Works Statistics, 1880;" and "The Gas and Water Manual Directory, 1880." London: C. W. Hastings.

prior heating can confer. No one thinks of heating gunpowder in order to intensify its combustion; and coal gas, when employed in jets for illuminating purposes, burns for all practical purposes with not less instantaneousness and spontaneity. It is true that in some of the thicker gas-flames there is a tiny core of *gas not burning*; but this is not owing (as in coal) to what we may call sluggishness of combustion, or resistance to ignition, but merely because that part of the gas is for the moment excluded from the air. When first spread out and in contact with air, coal gas, owing to the exceeding minuteness of its combustible particles, burns with almost instantaneously; and, as is well known, even when gas is in bulk an intermixture of air sufficient to explode it, the mere touch or impact of a lighted lucifer match—even the smallest spark of fire—sets any of gas, or the whole hundred jets of the Wigham burner, instantaneously into full combustion, and at as high a temperature as the gas-flame can develop. Thus, in a word of flame, the gas is raised from the ordinary temperature of 60° or 70° Fahr. to about 3000° Fahr. What difference, therefore, can it make whether the unlighted gas has a temperature of 60° or 600° Fahr.?

And such a temperature—viz., of 600° Fahr.—will be found, by any one who makes the experiment, an exceedingly troublesome one to produce in gas. Moreover, as is well known, if coal gas be raised to this temperature—at least, by any means hitherto employed —there will be found some deposit of carbon upon the surface of the burning burner. The same experiment will prove an ordinarily high temperature unless the tubes or chambers in which it is contained are filled by a mass or network of conducting material—such, *for instance*, as wire gauze—which conveys the heat from the outer surface of the pipe or chamber. This is quite the case of the gas-stream; and, whatever the material thus employed for conducting the heat, and incidentally applying it to the gas, it will be found coated with carbon when the temperature of the gas rises to 600° Fahr., or even less. The gas, in short, begins to suffer from "dissociation," some of the richer hydrocarbon compounds being broken up, with a deposit of carbon, which is the illuminating substance.

Upon these various grounds, it seems to me that the result which I obtained from the experiments in 1871—viz., that the heating of the gas added nothing to the illuminating power of the gas-flame—is an inference not unreasonably drawn. And this is my opinion on the question as it at present stands; but no one will be more ready to change it than myself were he, or any other experiments should point to an opposite conclusion. Also these experiments show the necessity for the heat being applied close to the burner, otherwise the gain will return to its ordinary level before it reaches the point of ignition.

Temperature of the Burner.

But there is another phase of the question to be considered; and it is entirely distinct from that of heating the gas, although practically it becomes mixed up with it. Although there may be no advantage to be gained by heating the gas, it is manifestly of importance that there should be no withdrawal of heat from the gas-flame. Now such an abstraction is always taking place, more or less, and I have already spoken of the air supply, the heating of which undoubtedly lessens the withdrawal of heat from the flame, or enables the flame to attain a higher state of combustion; and I need not speak further of the cooling effect of the atmospheric surroundings of the flame. But there is another source of heat-absorption—viz., the burner itself. That every gas-burner absorbs heat from the flame is demonstrated to the touch. The burner quickly becomes so hot that it cannot be touched. This is especially the case with the Argand, in which the mass of the burner, and notably the surface in direct contact with the base of the flame, is much larger than in flat burners, both bat's-wings and fishtails. When Mr. Sugg was constructing his new Argands, with the small separate supply-tubes fitted into the bottom of the burner, he found that if the burner was made of metal (brass or the like) it would burn over until the very part that the "soft metal" employed in soldering-on the small tubes was melted; and yet, if the burner was made of glass, by making the body or gallery of his Argand of steatite was to obviate this difficulty. Even the steatite burners become so hot that they cannot be touched. Even the steatite Argands so hot that it is easy to handle them while the gas is burning; and metal Argands become so hot that Mr. Sugg alone their temperature at from 500° to 600° Fahr.

This heat, of course, is entirely obtained from the gas-flame. But this absorption of heat by the burner is somewhat different in character from the other form in which a withdrawal of heat from the flame takes place—viz., by ordinary radiation into the surrounding atmosphere. Air is a bad conductor of heat, whereas metal, like brass or iron, is one of the best conductors; accordingly, relatively to the extent of radiating surface of the flame exposed to these rival absorbents of heat, more heat will be withdrawn by the metal than by the air. On the other hand, the heat absorbed by the air is more completely or suddenly lost, than that absorbed by the metal burner; because the former is dissipated at once, carried off instantly into the general atmosphere, whereas the burner contains a portion of the heat which it absorbs. Nevertheless, the burner is constantly parting with its heat to the air; and this radiation prevents the heat accumulating in the burner beyond a certain point; but this accumulated temperature—say 500° Fahr.—is only maintained by the constant absorption of heat from the flame commensurate with the heat which the burner is constantly giving off into the air.

Now, were it possible to keep a burner hot, irrespective of the flame, the heatness of the burner would be of some advantage; and if the burner could in this manner (*i.e.*, by independent means) be kept so hot as altogether to stop its absorbing heat from the flame (in which case the burner would require to be as hot as the flame itself), there would be a considerable advantage. But the case is different when the hotness of the burner is produced by an abstraction of heat from the flame itself. Obviously, it would be better if the heat remained in the flame, instead of passing into the burner. Further, what happens is not merely a transference of heat, but also a loss of it. Were it possible for the burner to retain all the heat which it absorbs from the flame, this abstraction would be of merely momentary disadvantage; for the burner would quickly acquire its highest possible temperature, after which the abstraction of heat from the flame would cease. But, as needs hardly be said, this is not the case; for although the burner becomes hot, it is constantly losing a part of its heat by radiation, and this last heat is being constantly made up by an equal absorption of heat from the flame.

Thus the advantage which Leslie and others thought was obtained by the burner becoming hot is an illusion. Undoubtedly, *per se*, the hotter the burner the better, but not when the heat is obtained from the gas-flame itself, and under circumstances where the burner is parting with its heat almost as quickly as it is abstracting it from the flame.

These considerations help—perhaps suffice—to explain what, *prima facie*, is a mystery. It has been found that steatite Argands give a higher light than metal Argands identical in structure. This seems certainly a very puzzling phenomenon. Mr. Sugg made the reasonable conjecture that this was owing to the coolness of the gas as it issued from the burner. The steatite being comparatively a non-conductor of heat, the gas in the cylinder of a steatite Argand must ungoverningly be cool, at least compared with what it is in a metal Argand. And, in fact, this was, at first sight, the only apparent difference; and therefore it was a natural inference that it was the coolness of the gas which gave to it its higher illuminating power when compared in a steatite burner.

Effect of Non-Conducting Burners on Illuminating Power.

It is important to observe at the outset how this matter stands. There is no question that the cooler the gas the smaller is its volume; and therefore the heavier it is, containing a larger amount of illuminating substance. But this consideration must be here excluded, because in the experiments in question the gas has the same temperature as it passes through the meter and the governor of the gas as it issued from the burner. The steatite being comparatively a non-conductor of heat, the gas in the cylinder of a steatite Argand must ungoverningly be cool, at least compared with what it is in a metal Argand. And, in fact, this was, at first sight, the only apparent difference; and therefore it was a natural inference that it was the coolness of the gas which gave to it its higher illuminating power when compared in a steatite burner.

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We notice that Mr. Frederick Colyer, M. Inst. C.E., having retired from the firm of Messrs. G. Waller and Co., gas and water engineers, with whom he was so long connected, announces that he intends practising in all matters connected with gas and water works will be continued there in all matters connected with gas, gas and water engineer, Westminster.

We understand that the Rudiman and General Iron Company (Messrs. James Cowan and Samuel Segenworth) have been awarded in them for "anti-corrosion Exhibition that a gold medal has been awarded to them for "anti-corrosion tubes and fittings," treated by Professor Barff's rustless process. They have already supplied goods to fifty or sixty of the leading gas and water companies, and have had numerous repeat orders.

The Provincial Economic Gas Company, Limited—Among the new companies recently registered is one with the above title. The Company proposes to acquire certain terms of an agreement of the 6th ult. between [illegible] and Co., of Leeds, and Mr. Thomas Hall, of Leeds, for the sole use of the latter's process for the manufacture of gas from petroleum and other hydrocarbons, and to erect works for the manufacture of such gas in the district of Leeds. The nominal capital is £50,000, in 5,000 shares of £10 each. The subscription list will be opened on the 20th inst.

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TO CORRESPONDENTS.

M. W. B.—*A map showing the districts of the London Water Companies can be obtained of Mr. Stanley Lowes, of 8, Victoria Street, Westminster.*

W. Sugg.—*We regret being obliged to hold over your letter, in reply to "Alex. M'Ivor," till next week.*

M. O. T.—*Will notice in an early number the information you have kindly furnished.*

J. Barker.—*Letter received too late for notice in to-day's Journal.*

Erratum.—*For "42,000 tons," in line 21 of column 2, page 1002 of last issue, read "9000 tons."*

We notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JUNE 29, 1880.

Circular to Gas Companies.

The Liverpool Lighting Act of last year is no longer, of its kind, a solitary legislative phenomenon, and the Corporation of Liverpool have ceased to stand alone in the possession of the powers which that Act conferred. The Bill lately before Parliament and the Preston Improvement Bill have respectively been passed by Committees of the House of Commons, and may be considered certain now to obtain the full sanction of the Legislature. These Bills are in effect identical with the Liverpool Act, and there are now consequently three Municipal Corporations enjoying parliamentary sanction and right to expend the money of the ratepayers upon experiments in electric lighting. We say "experiments" advisedly, because in each case it is admitted that the work proposed to be done is partial and tentative, and the Corporations are refused permission to reap a profit as the reward of their labours and expenditure. It is reasonable to suppose that Parliament has now done enough for the encouragement of scientific inquiry in this matter; and we are entitled to expect that some really instructive and practical demonstration will be made before further powers of this character are sought for, or granted to other Municipalities. It is unusual, and we think the practice in several ways open to very grave objection, for each Corporation to have authority given them to spend money in speculative investigations. In this country, at any rate in recent years, there has been no lack of private enterprise or capital to examine, develop, and apply inventions or processes of a novel character which have given any promise of commercial success. The electric light is no longer a novelty; it has proved itself suitable to the work of illumination in several special applications, and its superiority over all others, where single centres of very great intensity are required, is generally accepted. We maintain, however, that this latter position of superiority is limited strictly to lighthouse purposes, and that for all others, lights of amply sufficient volume and power can be obtained from gas.

The success which has attended the introduction of several of the applications of electricity for lighting purposes, both on the Continent and in England, has been attributable to a great extent to the formation of more than one Electric Light Company, and a Municipal Corporation or any other body or person desiring to spend money upon further experiments, will find no lack of enthusiastic helpers. What is more to our purpose, however, such a Corporation would also, we believe, find no difficulty in obtaining definite tenders from several responsible firms or companies ready to undertake any such duty as the lighting of "streets, parks, or places of public resort," in the same manner as the Société Générale d'Electricité has contracted with the Metropolitan Board for the lighting of the Thames Embankment, and this would, in our judgment, be the more prudent and legitimate method of procedure. The House of Commons Committee of last year reported: "It is desirable" that Local Authorities should have power to give facilities "to companies or private persons to conduct experiments;" while they also reported that "if Corporations and other "Local Authorities have not power under existing statutes to "take up streets and lay wires for street lighting or other public "uses of the electric light, your Committee think that ample "power should be given them for this purpose." Yet the former quotation shows that it was rather with the view of enabling contractors to do the work for them than that the Corporations themselves should become traders in electric, as so many are, and so many others desire to be, in gas lighting.

We take this point for the reason that we do not regard with unmixed satisfaction the condition laid upon Corporations supplying the electric light, that they shall derive no profit from its sale. The effect of this limitation is that performs the new light must enter into competition with the old one at an unfair advantage, inasmuch as the comparison of expense will be between the first cost of the one and the commercial selling price of the other. We do not need to remind our readers how great is the difference between the two. In a town, for instance, where gas is being sold at 3s. 6d. per thousand cubic feet, not more than half that amount should be reckoned when making comparisons with the electric light under the conditions laid down for it at Hull and elsewhere; but this aspect of the question is persistently lost sight of by those who argue in favour of the economy of electric lighting. If the Corporations then had determined to grant concessions to private firms or companies to undertake the work as a matter of ordinary business, the public would have known what was a fair price for the new light comparatively with gas, because either the price charged would have been one sufficient to pay a fair profit to the contractors, or, if no profit resulted, it would be seen that the charge was too low. In any event, there would be no difficulty in arriving at a right conclusion as to what the price should be. As it is, the Gas Companies and their Engineers in the various towns where these experiments are being or are to be made, will do good service by watching closely, not only the experiments themselves, but also the figures that will be found in reference to them; and the duty seems to devolve upon them of protecting the public, not only of their own towns but generally, from being misled by either ignorant or interested statements.

These considerations apart, we are glad of any movement which promises to lift the question of electric lighting, as compared with gas lighting, nearer to the region of fact and competitive with gas lighting, nearer to the region of fact and demonstration, and away from that of mere talk, to which it has hitherto been so largely confined. Bearing in mind the character and position held by many of those who have been actively engaged in promoting electric lighting, and the many opportunities which have already been afforded for exhaustive

Cooper's Gas Compound.

For Dull and Feeble Corporations (Electric Lighting) Bills.

For Gas Companies and Others.

For Gas Managers.

For Gas Engineers.

For Gas Consumers.

For Gas Shareholders.

For Gas Directors.

For Gas Inventors.

For Gas Patentees.

For Gas Lecturers.

For Gas Students.

For Gas Professors.

For Gas Chemists.

For Gas Analysts.

For Gas Photometrists.

For Gas Meter Makers.

For Gas Fitters.

For Gas Stove Makers.

For Gas Burner Makers.

For Gas Governor Makers.

For Gas Pipe Makers.

For Gas Retort Makers.

For Gas Retort Setters.

For Gas Coke Makers.

For Gas Coke Users.

For Gas Tar Makers.

For Gas Tar Users.

For Gas Ammoniacal Liquor Makers.

For Gas Ammoniacal Liquor Users.

For Gas Purifier Makers.

For Gas Purifier Users.

For Gas Purifying Material Makers.

For Gas Purifying Material Users.

For Gas Exhauster Makers.

For Gas Exhauster Users.

For Gas Engine Makers.

For Gas Engine Users.

For Gas Pump Makers.

For Gas Pump Users.

For Gas Valve Makers.

For Gas Valve Users.

For Gas Station Meter Makers.

For Gas Station Meter Users.

For Gas Governor Makers.

For Gas Governor Users.

For Gas Holder Makers.

For Gas Holder Users.

For Gas Holder Tank Makers.

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For Gas Holder Guide Makers.

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For Gas Holder Lubricating Material Users.

For Gas Holder Packing Makers.

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For Gas Holder Roofing Painting Material

Water and Sanitary Notes.

THE Gas and Water Committee of the Corporation of the City of London, in obedience to the reference of the Court of Common Council, duly applied to the Home Secretary for an interview; but Mr. Cross declined to see them, on the ground that any action on the part of the Corporation at the present moment would only complicate matters. We may infer from this that the Home Secretary has settled in his own mind the plan he will adopt next session in dealing with the Metropolitan Water Question. When the reference to the Committee was made, we suggested that after Mr. Cross had pledged himself so strongly, both to the House of Commons and to the country, to take up the much-vexed question of the London Water Supply, it was a little indecorous on the part of the Corporation to interfere with his actions. The Common Council have received what we do not care to call a snub, but they have been told not to interfere in the matter until their advice is asked, and we know when that will be. As was pointed out in a recent number, it was possible that the conference of the Committee with the Home Secretary might resemble "interviewing" in the American sense of the word, he was about to pursue. The Home Secretary is a matter-of-fact man, and not a humourist, or he would have derived some fun from the Gas and Water Committee. We shall not endeavour to anticipate what course the Home Office will pursue. We read in a morning contemporary that the Parliamentary Draftsmen of the Treasury are busy in the preparation of a Bill which is to transfer the management of the Metropolitan Water Companies to a "Water Trust "of some kind or another, not probably that foreshadowed in a parliamentary notice which we commented upon last week. The source of our contemporary's information we do not know; but, as the organ of the beer and spirit trade, it is not likely, we fear, to be in the secrets of the Government respecting the Water Question. The matter, we believe, may be safely left in the hands of Mr. Cross. The Water Companies, too, are perfectly able to take care of their own interests.

The report of the Directors and the accounts of the Lambeth Water-Works Company have been issued in anticipation of the ordinary half-yearly meeting to be held this day. The occasion is not without importance. A crisis is impending in Metropolitan water affairs, and we are happy to see that the Lambeth Company are well prepared for whatever may happen. In the first place, the Company have faithfully fulfilled all their public duties. They supply water purified by long subsidence and perfect filtration, and they are quite willing to extend as rapidly as possible a constant supply with hydrants all over their limits. We are somewhat astonished to see that the Metropolitan Board of Works are at last moving in this matter. They have stood aloof so long as to fall into merited discredit. Now we may hope that hydrants and the constant supply system will be universal all over the Board's limits. But for this we shall not have to thank the like the Kent, the New River, the East London, and others, were endeavouring to carry out the provisions of the Metropolis Water Act of 1871, which it was the especial duty of the Metropolitan Board to promote. They are now roused, as we have said, into something like activity; but it is too late. We fancy that they will discover, in a very few months, that any pretensions to a control over the Metropolitan Water Supply will have vanished from their grasp. We cannot help thinking that the Act of 1871 afforded the Board an opportunity, but they shrank from incurring the odium which might have ensued from the carrying out of the regulations of the Board

[illegible] Company. The

[illegible] Companies, and does not take into consideration the amount and quality of [illegible] obtained, nor the consequences and inconveniences resulting from sel[illegible] many methods which are obviated in the Healy system.—*Springfield Republican.*

[Omissions of Gas Companies from Page 548.]

Statement of the Receipts and Expenditure of the Gas Companies in the Metropolitan District, and the Quantity of Gas Sold, during the Year ended the 31st December, 1878.

Name of Company.	Receipts for Gas.	Receipts for Residuals.	Total Receipts.	Expenditure.	Quantity of Gas sold.
	£	£	£	£	Cubic Feet.
Bow, Bromley, and District	39,000	3,000	42,000	30,000	1,000,000,000
Brentford	10,000	1,000	11,000	8,000	300,000,000
Chelsea	40,000	4,000	44,000	30,000	1,000,000,000
Commercial	30,000	3,000	33,000	25,000	800,000,000
Crystal Palace	10,000	1,000	11,000	8,000	300,000,000
Equitable	30,000	3,000	33,000	25,000	800,000,000
Great Central	30,000	3,000	33,000	25,000	800,000,000
Great Northern	30,000	3,000	33,000	25,000	800,000,000
Hampton Wick and Kingston	10,000	1,000	11,000	8,000	300,000,000
Kensington	30,000	3,000	33,000	25,000	800,000,000
Kent	30,000	3,000	33,000	25,000	800,000,000
London	30,000	3,000	33,000	25,000	800,000,000
Malden and Coombe	10,000	1,000	11,000	8,000	300,000,000
Metropolitan	30,000	3,000	33,000	25,000	800,000,000
Metropolitan District	30,000	3,000	33,000	25,000	800,000,000
New River	30,000	3,000	33,000	25,000	800,000,000
Phœnix	30,000	3,000	33,000	25,000	800,000,000
Ratcliff	30,000	3,000	33,000	25,000	800,000,000
Richmond	10,000	1,000	11,000	8,000	300,000,000
Shepherd's Bush	10,000	1,000	11,000	8,000	300,000,000
South Metropolitan	30,000	3,000	33,000	25,000	800,000,000
Southwark and Vauxhall	30,000	3,000	33,000	25,000	800,000,000
Surbiton	10,000	1,000	11,000	8,000	300,000,000
Tottenham	10,000	1,000	11,000	8,000	300,000,000
Uxbridge	10,000	1,000	11,000	8,000	300,000,000
Wandsworth and Putney	30,000	3,000	33,000	25,000	800,000,000
West Middlesex	30,000	3,000	33,000	25,000	800,000,000
Westminster	30,000	3,000	33,000	25,000	800,000,000
Woolwich	30,000	3,000	33,000	25,000	800,000,000

to yield an annual rental of £4117. A Company in this position are entitled to much consideration from the Government. We will not say more consideration than any other of the Metropolitan Water Companies, who have equally well fulfilled their duties to the public, and have, as the Directors of the Lambeth Company put it in their report, in all cases sought to levy rates, under their parliamentary powers, in a reasonable and equitable manner.

It is impossible to refer to all the various reports of sewerage difficulties which are brought under our notice. We may mention, however, East and West Looe, situated in a remote district in Cornwall, where the sanitary conditions under which the inhabitants live are as bad as they can possibly be. Dirty narrow streets, with the houses imperfectly furnished with water or closets, or any other decent conveniences, are thickly inhabited by people who carry out their refuse after twilight, and throw it into the sea. This is not a matter for us to comment upon; but looking over, as we do, the whole of the country, we feel bound to say that the drainage of East and West Looe requires the attention of the Local Board, and the interference of the Central Authority. Such matters as these should be settled by the Local Authorities concerned, without the smallest difficulty or trouble; but they will not settle them, and until influence is brought to bear upon them by some Central Authority, they will go on and act exactly as they please, always looking at the rate, but never at the comfort and convenience of the ratepayers. Now, we are the firmest friends of local self-government, but we may say, once and for all, that the proceedings of these wretched Vestries and Local Boards are not to be tolerated. We have pointed out over and over again, that nothing effective would be done for the drainage and water supply of England, until the whole country was mapped out into drainage and watershed areas. If this had been done in Cornwall, and the work had been carried out by a strong Central Authority, all the disorders which now pervade the district, when water supply and drainage schemes are discussed, would long ago have ceased. There is one thing that can be done, and that is for six responsible ratepayers to make application to the Local Government Board, and bring down an Inspector, whose instructions must be fully carried out. Local self-government is, in many cases, a simple blunder. The people who are benefit into authority are commonly the most ignorant and selfish in the locality, and the sole thing which brings them into power is the wealth which they have amassed by their selfishness. Let us have, for the regulation of sanitary matters, an honest despotism; but, in any other case, we must leave such people as constitute the Local Authority of East and West Looe to do what they can.

GAS LEGISLATION FOR 1879.

(*Continued from p. 732.*)

THE *following Acts*, for the most part, authorize the purchase of gas undertakings by local authorities, or confer further powers upon local bodies already in possession of gas undertakings. It will be seen that some Acts are introduced in this section which do not properly come into our classification, but the omission is unavoidable.

The *Birmingham Gas (Nechells and Yardley) Act* scarcely comes within the scope of the Acts with which we are now dealing. It is simply to repeal a section in the Birmingham Gas Act, 1875, carried over from the Birmingham and Staffordshire Gas Act, 1864, which allowed a differential charge for gas to be made in the Northfield, Yardley, and Solihull districts, of 1s. per thousand feet beyond that charged in the borough.

The *Blackburn Improvement Act* extends the limits of the Corporation, so as to include a portion of the township of Lower Darwen and that portion of Little Harwood which was not until now included in the district of the borough. The Corporation have power to borrow £30,000 for the improvement and extension of their gas-works, and the sum is to be paid off in the usual manner by means of a sinking-fund, the customary returns being made to the Local Government Board.

The *Blackpool Improvement Act* is to extend the borough so as to include some surrounding townships. It further empowers the Corporation to borrow £36,000 for extending and improving their gas-works, and also to employ the electric light for the illumination of the promenade and other places of public resort, but for no other purpose, for a period of five years. The expenses of the light are to be chargeable to the district-rate, and whatever profit may be derived is to be carried to the credit of that rate. The Act gives the Corpora-

Abstract and Summary Notes.

The Gas and Water Committee of the City of London, in reference to the recommendation of the Common Council duly applied to the Home Secretary for an instructor; but he declined to do so. The Committee have, however, succeeded in obtaining the services of Mr. Bunnett, who has had considerable experience in the laying and working of gas and water mains, and who will act as instructor to the Committee's men. Mr. Bunnett has already entered upon his duties, and will shortly commence a course of lectures to the Committee's men, which will be followed by practical instruction in the trenches.

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[Official Report.—Continued from page 154.]

Tenth Annual Meeting of the New England Association of Gas Engineers.

Held at Boston, Feb. 18th, 1880.

[Concluded.]

Mr. Stiness—I was at the Corliss Engine Works about three weeks ago, and in conversation with Mr. Corliss he claimed that with the very best results they have never been able to get below 2¼ pounds of coal per horse power per hour. In addition to that, I think Col. Armington remembers that when we visited the Conant Thread Works, they stated that for a year's work with a 1000-horse power engine their result was 2¼ pounds of coal per horse power per hour. Mr. Corliss questioned that any engine could run with less than 2¼ pounds of coal per horse power per hour, and you put your figures at 2 pounds.

Mr. Vanderpool—I would say that I do not know of any engine that does that work right along. Now I refer to first-class condition, and with new boilers, and all the conditions favorable, these figures may perhaps be reached for a limited time; but I doubt very much whether any engine, working year in and year out, can do it.

Mr. Stiness—The results at the Conant Thread Works were 2¼ pounds of coal per horse power per hour for a year's work, and Mr. Corliss questions whether it can be done with less than 2½ pounds. Of course, that makes your figures so much better.

Mr. Vanderpool—A very great advance in the utilization of power may come from the better utilization of fuel under the boiler. There has been a great improvement in boilers in the last year or two, so that there is a great saving in boilers' fuel by gas furnaces. They are bringing it down so that instead of getting an evaporation of 7 or 8 pounds per pound of coal, they get 10 or 11, which will make a great difference in the power.

Mr. Scott—I have here the result of some experiments with a Corliss compound pumping engine. We made four experiments. The result was 1.88 pounds of coal the first day, 1.78 the second, 1.68 the third, and 1.66 the fourth. I would state that Mr. Corliss has a contract for one of his engines guaranteed to run 48 hours two to four pounds per horse power per hour.

Mr. Goodwin—There is one other remark that I would like to make, and that is in relation to the variation in the quality of coal gas—that is to say, in illuminating and heating power—examples of which I have here. For instance, gas of 26 candles, for illuminating purposes, is 76 per cent. better than ordinary 16-candle gas. Experiments show, however, that for heating purposes it is but 23 per cent. better.

Mr. Vanderpool—Upon that point I would say that that comes in the weight. That is taken by weight, not by volume. Taken by volume, it would be 2 to 1. That is, supposing the specific gravity to be 500, it would give about 1200 heat units per cubic foot; whereas 16 candles would give about 600, and 32 candles would give about 684, both by calculation and experiment. It makes a difference which way you take it. We do not sell gas by specific gravity, but by the cubic foot.

Mr. Goodwin—I merely want to put it into candle power; 33-candle gas is 120 per cent. better than 15-candle gas for illuminating purposes, but only 50 per cent. better for heating purposes.

I would like to make one other remark, in reference to a little incident that happened in reference to gas cooking stoves. Two ladies called at our office some time ago, and wanted to know if we had any gas stoves. They wanted to use one in a school for cooking that they were about to start in Philadelphia. They said, "We are from Boston, and we have ordered a range from there [I don't remember the name of it, but it was a very elegant looking one] that beats anything in the world." I said, "Ladies, I propose to beat your Boston range."

"You can't beat anything that comes from Boston."

"Will you give me an opportunity to try?"

"Certainly, sir."

I had a No. 9 stove put up, and I didn't go near it until one day a certain gentleman called, the forepart of whose name is "Major," and who conducts a gas light journal; but it went on to call my names here. He called at my office, and I went with him and introduced him to these Boston ladies, and asked them to say anything they could against that stove; and I appeal to the Major if they did not say, "Mr. Goodwin, there is a loaf of bread cooked in that stove, and any man or woman who wants to eat a better loaf of bread than that don't deserve to have any"—or words to that effect. I did not go near them again until the other day I took a gentleman there and asked them to say the worst they could against the stove, and their reply was, "We could not get along without it; we cannot say a word against it."

Mr. Thomas—The matter of the introduction of gas stoves as a means of increasing the consumption of gas, has been worked up pretty carefully in the city of Brooklyn by a course of lectures given there by a lady who may have been imported by Mr. Goodwin; but I don't say she was. (Laughter.) The stove that was used during the lecture was, at my rate, Mr. Goodwin's, and was a No. 9 stove. There was not a good opportunity for getting gas there without bringing it down from the side lights; but we a hole in the floor and made a connection under the floor with an ordinary ¾-pipe. When the lady first came in the room I noticed the stove was lighted, but after heating some water and showing how quickly it could be done, the gas was turned off for a short time. There was some considerable description of the stove before she commenced her lessons on cookery, showing how the gas was turned on and off, and how the stove was operated. Then she commenced making different things and cooking them on the stove. She cooked some three or four different dishes and handed them to the audience to let them see how they liked them. The lecture occupied about an hour. After she was through the stove was kept lighted for, I suppose, half an hour longer, and the consumption for the entire time, as near as we could fix it on the meter, was about 100 feet.

Now I think it is a great mistake (and I found it so myself) to attach an ordinary gas stove used by a family to one of the side burners. I had a little one in my house, and I just ran a ¾-pipe from the cellar and brought it up to the gas stove, and I never had a particle of trouble. In fact it was such a pleasure to my wife to use it that I was afraid I would be cooked out. (Laughter.) As far as the things that were cooked on it were concerned, especially meats, as Mr. Goodwin says, if a man has never eaten a steak cooked on a gas stove he don't know what good steak is. The loss in cooking is brought down as low as 10 per cent., I think. I am confident the loss will not, in my event, exceed 12 per cent., while the loss on articles cooked over a fire is at least 30 per cent.

These stoves are very readily managed, and are very economical. All you have to do when you want heat is to turn the gas on, and you have it. When I first introduced the stove at my home, I found that my wife had too many burners on it, and it made the oven too hot; but since that time we have had no trouble whatever. It is a stove that I got a number of years ago. I was on one occasion invited to a dinner where all the preparations were made with that stove. The party consisted of eighteen persons, and the cost of cooking was 25 cents. You can do the ordinary family cooking for at least 15 or 16 cents. The ladies were perfectly delighted with this stove and its operation, and a great many inquiries are made of my wife every day; and I have no doubt but that there will be a large trade in gas stoves in the future.

Mr. Neal—Has your stove a funnel leading into the chimney?

Mr. Thomas—No, sir; it just sets out in the laundry.

Mr. Neal—Has it a water-back?

Mr. Thomas—It has a water-slide on one end.

Mr. Neal—Can you heat water for bathing purposes?

Mr. Thomas—No, it does not heat enough water for that. It heats enough for cooking purposes, but not for bathing purposes.

The President—We have disposed of our order of business, and it is now for the Association to determine whether the present session shall be longer continued.

Mr. Neal—There is no other business upon the Secretary's table.

Mr. Harbison—Before we adjourn I would like to ask if there is any gentlemen present who will state what their experience has been in the use of scrubbers in place of condensers? The impression is that everybody knows all about it; but I am so unfortunate as to know very little about it.

The President—That would open a large field for discussion, and the time for adjournment is very near.

Mr. Neal—I would state that there are several of the members who are anxious to get away, and to try the sense of the meeting I move that we adjourn *sine die* at a quarter past twelve to-day.

Carried.

The President—Before we adjourn I would again urge on the members of the Association the desirability of bringing to our next meeting as exact statements as possible. Keep them in some portable shape, put them in your pockets and bring them along. Our friend Mr. Cabot has set us an example in this respect which I hope we will all follow. When we refer to our experiments, it is certainly much more satisfactory, both to ourselves and the Association, to be able to give exact information, than it is merely to make a general statement from memory. Such a statement does not carry with it the weight that a direct reference to our figures does. I hope you will all try, in your experiments this year, to keep an exact record of the results, and give us those exact records, and not a statement from general recollection; and I think we shall all be pleased with the enhanced interest that such a course, if adopted, will give to our meetings in the future. (Applause.)

Mr. Wood—There is one little matter that has occurred to me that I would like to speak of before we separate, which perhaps may be of some

[From London "Journal of Gas Lighting."]

Experiments in Improved Street Lighting at Birmingham.

On Wednesday last, at the invitation of Mr. Charles Hunt, Engineer of the Birmingham Corporation Gas Department, a number of gas engineers, principally from the Midland Counties, and others interested in the subject of improved street lighting by means of gas, assembled at the Winsley Street works of the Corporation, for the purpose of viewing a collection of lanterns and burners of large power which had been got together by Mr. Hunt for the purposes of comparative trials of their efficiency. Among those who were present were Messrs. J. Annan, Wolverhampton; T. Arnold, Borough Surveyor's Office, Birmingham; J. C. Bent, Birmingham; G. Bray, Leeds; T. Collett, Dudley; W. Cross, Leamington; W. Davis, Hereford; J. Denkes, Worcester; A. Dougall, Kidderminster; H. Hack, Saltley; T. Jackson, Birmingham; Wm. King, Liverpool; T. Layton, Redditch; J. Mealie, Burton-on-Trent; W. North, Stourbridge; G. Parker, Oakengates; R. O. Paterson, Cheltenham; J. Peaty, Burslem; H. S. Pike, Hinckley; T. Proud, Birmingham; J. S. Reeves, Bilston; J. Reid, Derby; T. Roberts, Sheffield; P. Simpson, Rugby; S. T. Stonebridge, Saltley; J. Slocombe, Birmingham; E. Smith, Secretary of the Corporation Gas Department; J. Stone, Stafford; W. Sugg, London; C. Taylor, Derby; J. Tindall, Walsall; W. Whatoley, Newcastle-under-Lyne; H. Woodall, Leeds; J. Wright, Birmingham, etc., etc.

The burners and lanterns were arranged in different parts of the works, the more important ones being placed at distances of about sixty yards from one another on a large tract of unoccupied land to be eventually used for extensions. By this means the effectiveness of the burners was easy of comparison, and much satisfaction was expressed at the completeness of the trials. Appended is a list of the burners and lanterns used, showing the consumption of gas by each burner, the illuminating power afforded (when tested in the photometer room) and the illuminating power obtained per foot of gas consumed.

After a long inspection of the various lanterns and burners, tests were made by a shadow meter between Sugg's 200-candle Argand (No. 9) Bray's 200-candle Quadruple Batswing (No. 10), and the burner and lantern as used by the Paris Gas Company in the Rue du Quatre Septembre (No. 12), with the results shown on the diagram. These appear to agree pretty nearly with the photometrical results obtained from each burner, as shown in the preceding table.

On Thursday evening another trial was made between the burners Nos. 9 and 10 on the diagram. The consumption of gas in each was raised to exactly 46.75 feet per hour; and the lights were shown to be equal when the shadow meter was 73 ft. 2 in. from Bray's Quadruple Batswing, and 76 ft. 10 in. from Sugg's Argand.

It should here be mentioned that the Superintendent of the works, Mr. Alfred Colson, rendered very efficient service in conducting these tests; in fact, to his able assistance Mr. Hunt is considerably indebted for the success which has attended the experiments all through.

The lamp-columns adopted by the Gas Committee to be erected in various parts of the town, which have been specially designed and made for the Corporation by Messrs. Hart, Son, and Peard, of London and Birmingham, were much admired for their substantial yet ornamental and effective appearance.

At the close of the inspection refreshments were served, after which

Mr. Henry Woodall proposed a vote of thanks to Mr. Hunt for affording those present an opportunity of witnessing the interesting experiments that had been carried through so successfully, remarking on the careful and judicious arrangements that had been made for a fair and equitable comparison to be instituted between the various systems for public gas illumination now before the public.

Mr. R. O. Paterson seconded the proposal, which was carried by acclamation.

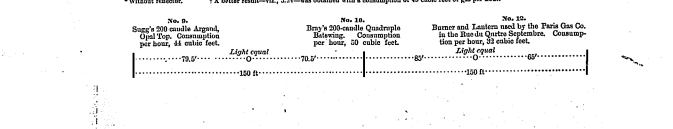
Mr. Hunt, in returning thanks, expressed the pleasure he felt at seeing so many present. It might, he said, be desirable that he should offer a word or two of explanation as to the circumstances under which the exhibition had been brought about. These experiments were initiated some fourteen months ago by the Chairman of the Gas Committee (Alderman Chamberlain, M. P.), who was desirous of showing in Birmingham what could be done with gas in the way of street lighting, as compared with electricity. His (Mr. Hunt's) instructions were comprehensive and, he might say, liberal. He was to procure not only the most suitable burner, but also a lantern capable of diffusing the light to the greatest possible extent, and, at the same time, one that should, with the column, contribute rather to the ornamentation of the street than otherwise. As they all knew, the question of the burner involved considerations apart from the illuminating power obtained; but his experience was that the proper form of lantern was a far more difficult matter. He might take this opportunity of acknowledging his obligation to the Gas Committee for the indulgence they had shown him with regard to the length of time the experiments had taken. It was not contemplated by anyone that they would last so long; but he felt, with the Committee, that they should, as far as possible under the circumstances, impress the character of permanence upon their work. How far they had succeeded in their aims was seen that night; but their experiments, at all events, proved one thing—that gas could hold its own for effectiveness with the electric or any other light.

The London *Metropolitan* comments as follows upon the results given below:

It would certainly appear from these figures that Mr. Sugg comes off first. We are informed that the tests of the 200 candle burners of the two manu-

No. of Lamp.	Description of Burner.	Description of Lantern.	Consumption of Gas. Cubic Feet per Hour.	Illuminating Power, as Tested with 17 Candle Gas.	Illuminating Power per Foot.	Remarks.
				Candles.		
1	Batswing.....	Kitt's fitted with reflector.....	2.53 each	4.42* each	1.85	In direct line with reflectors, 44.4 candles.
2	"	Gillis's patent "	6.00 burn's	14.00* "	2.33	
3	"	Ordinary street.....	5.0	11.50 "	2.30	
4	Sugg's 80 candle Argand.....	Sugg's Shadowlen.....	22.8	74.03 "	3.25	
5	Bray's 60 " Trip. Batswing	3 Closed globes, 24 in. diameter	20.40 each	45.00 "	2.21	These globes diminish the light by 35 p. ct.
6	" 60 " "	3 Clear " "	20.40 " globe	73.00 "	3.04	
7	Sugg's 180 " Argand.....	3 Opal top " 30 in. "	27.0	101.70 "	3.77	
8	" 80 " "	1 " " 24 in. "	23.4	79.87 "	3.41	
9	" 200 " "	1 " "	45.6	150.50 "	3.35	
10	Bray's 200 " Quad. Batswing.	Bray's shadowlen.....	44.4	134.40 "	3.02	
11	" 60 " Triple Batswing.	" "	21.6	63.00 "	2.92	
12	(Burner and lantern used by the Rue du Quatre Septembre...	the Paris Gas Company in the)	48.0	139.40 "	2.90	
13	Gemble's, Paris.....	Gamble's.....	55.8	153.10 "	2.99	
14	Mallet's "	Mallet's patent "	48.0	141.10 "	2.93	
15	Wigham's.....	Wigham's.....	60.0	180.00 "	2.50	
16	(Sugg's 200-candle, hollow top) (flat flame	Sugg's octagon.....	66.0	201.00 "	3.04†	
17	Sugg's 100-candle Argand.....	Sugg's octagon, new pattern.....	30.60	96.15 "	3.14	
18	Bray's Quadruple.....	24 inch circular.....	Were erected too recently to be tested			
19	" 400 candle.....	Bray's.....				

*Without reflector. † A better result—viz., 3.31—was obtained with a consumption of 43 cubic feet of gas per hour.


No. 9.
Sugg's 200 candle Argand, Opal Top. Consumption per hour, 44 cubic feet.
No. 10.
Bray's 200-candle Quadruple Batswing. Consumption per hour, 50 cubic feet.
No. 12.
Burner and Lantern used by the Paris Gas Co. in the Rue du Quatre Septembre. Consumption per hour, 52 cubic feet.
Light equal
72.5'
70.5'
150 ft.
Light equal
65'
65'
150 ft.

torted by enthusiasts, have certainly never been refuted.

To dispose of sewage at a profit has been tried over and over again with the utmost persistency, and at an enormous cost. The result has been complete failure. In certain isolated cases, where the quantity to be dealt with has been small, or where the conditions have been exceptionally favorable, a small profit has been made either by individuals, companies, or towns; but all attempts to get rid of the sewage of cities, and to realize for those cities even a moderate profit on the cost of the necessary works as well, have been failures. There are two ways in which sewage can be delivered on land. It can be supplied to the agriculturist either in the fluid or the solid form. Even the most warm advocates of irrigation now admit, what we years ago maintained, namely, that fluid sewage possesses very little more value than plain water. In other words, the dry hungry soils, on which fluid sewage has heretofore been used to most advantage, could be made to produce very nearly as good crops if irrigated from a river or spring instead of with the sewage of a town. Granting this, however, the fact remains that very good crops can be grown on land irrigated either with water or sewage and the sewage, consequently, does possess a money value. Solid manure made from sewage is of various values. It has been sold at all prices, from 10s. to £3 per ton; as a rule it is worth probably about £1 10s. per ton. It will be seen, therefore, that those who most earnestly advocate the utilization of sewage have something to go on; unfortunately, for them and for others, they have not enough. The causes of the failure of sewage schemes are very few and very simple. They lie in the difficulty met with in obtaining land adapted for the application of sewage; and the cost of delivery. The first-mentioned obstacle is one of overwhelming magnitude, conflicting interests warring with each other and with sanitary authorities. To find a suitable site for a sewage farm is often a work of great trouble, and the sum demanded for it is invariably very large; nor is there any help for these things. Towns do not as a rule stand on high ground, but in valleys or places close to rivers, and, of course, at the base of the watershed of a district. Thus in most cases the sewage has to be pumped up to a higher possible value as fertilizers. The water has to be driven away from all this mass of mud, and this can only be done at a cost which raises the value of every ton of the manure far above the price which the farmer can afford to pay for it. The bankruptcy of company after company which has attempted to make a saleable dry manure from sewage demonstrates the accuracy of our statements.

To sum up, the manurial value of sewage has been very much over-estimated. The cost of obtaining such valuable constituents as it really does possess in an approximately concentrated form is much too great to enable a profit to be made. Attempts to extract the equivalent of a very inferior guano from sewage find a parallel in the struggle to get a profit out of the crushing and amalgamation of a poor gold-bearing quartz. The rock does not contain gold enough to pay for the labor spent in getting it out. In like manner, sewage does not contain ammonia enough to pay for the cost of getting it in a portable form. Our readers will do well, under the circumstances, to look with the utmost caution at the shares of all companies proposing to make a profit out of the utilization of sewage. We do not assert that it will always be impossible to get an adequate return for money spent on such schemes; but we do assert that it is impossible at present, and under existing conditions. Circumstances may be met with now and then which alter the aspect of the question. For instance, pumping may not be necessary, and land may be had for next to nothing. Then with good management, it is quite probable that a profit may be made on a moderate outlay. Again, the dry system may be in use, and as the cost of getting rid of water is avoided, a profit may be made by converting the contents of pails into *poudrette*. But these are all exceptions to the rule, and any person or company undertaking to deal with sewage must be prepared to get it in the but too familiar liquid form; and to make a profit out of this sewage, manipulate it how we may, is a work which has never yet been accomplished on a large scale. The only chance of making a profit lies in getting the sewage for nothing and suitable land at a very moderate rent—conditions which are very rarely at the disposal of a public company.

[From London "Journal of Gas Lighting."]

Experiments in Improved Street Lighting at Birmingham.

On Wednesday last, at the invitation of Mr. Charles Hunt, Engineer of the Birmingham Corporation Gas Department, a number of gas engineers, ... Alfred Colson, rendered very efficient service in conducting these tests; in fact, to his able assistance Mr. Hunt is considerably indebted for the success which has attended the experiments all through.

The lamp-columns adopted by the Gas Committee to be erected in various parts of the town, which have been specially designed and made for the Corporation by Messrs. Hart, Son, and Peard, of ...

The net dividend on the King's and Adventurers shares was for the year ending Midsummer last £2200—a striking contrast to the dividends in the early days of the Company. The dividend on the new shares was at the rate of £10 3s. 8d. per cent. per annum at the last division. In 1862 the dividend on an original share was £898 1s. 6d. per annum, and, though that was then thought a high sum, it has since advanced by steady annual increments to the amount above quoted, being an addition of about 144 per cent. In 1866 a bonus of £1400 per share was declared on each original share, and in 1874 a bonus was declared of £1008 on each original share. In the same year the bonus in favour of the new shares was at the rate of £4 15s. 6d. per cent. Taking the rate of last year's dividend at, say, £2200 per share on the 72 original shares—allowing 10¼ per cent. as the return on the total amount of new shares, with 4 per cent. on the debentures, the sum of about £260,000 will be absorbed in the payment of dividend, and about £140,000 left to represent the amount of trading expenses, improvement of works, extension of plant, and all other charges; showing that about 66 per cent. of the Company's gross receipts is now available for division as profits among the proprietary. The portion of the Company's gross income available for dividend does not average more than 40 per cent.

The rentals and profits arising out of the estates vested in the Governor and Company of the New River form an additional source of revenue to the Proprietors. These estates include not only the watercourse of the river itself, with its frontages, extensive reservoirs, wharves, &c., embracing in Middlesex and Hertfordshire alone large tracts of land, but more than 70 acres of land in the heart of the Metropolis, called the Myddelton Square Estate, for the most part covered with buildings, and now producing annual ground-rents to a considerable amount. On the expiration of the leases in about 28 years, the rack-rents come into the possession of the Company. It thus enjoys a large independent income irrespective of the emoluments of its enormous trade in water, and should it cease to exist as a water company, would retain great wealth as a land corporation.

After briefly recapitulating the foregoing details, and referring to the advantages offered by the New River Company's stock as a thoroughly safe investment alike for the professional man, the capitalist, and the trustee, Mr. Bousfield proceeded to invite bids for those portions which he had had instructions to offer to the public. The sale then commenced, and the following prices were realized:—

The fifteenth of a share in the King's Moiety was put up in 10 lots, each representing the 150th part of the entire share. Lot 1 realized £610; lots 2 to 7, £620 each; lots, 8 to 10, £635 each—total, £6265, or at the rate of £93,975 per share.

The seventy-fifth of the Adventurers share was offered in two lots, one of which fetched £655, the other £645—total £1300, or at the rate of £97,500 per share.

The 25 new shares were sold—two at £355, eight at £350, and 15 at £345—total, £8685, or at the rate of nearly £350 per share.

The total amount realized by the sale was £16,250.

BATLEY CORPORATION GAS SUPPLY.

From the Statement of Accounts of the Batley Corporation Gas-Works, for the year ended June 30 last, published on Nov. 13, we gather that the amount authorized to be borrowed under the Corporation's Act of 1873 is £220,000, of which sum £159,281 3s. 8d. had been raised on mortgage. On June 30, 1878, the expenditure on capital account was £154,321 8s. 5d.—being £122,989 15s. 3½d. for manufacturing plant, and £31,335 13s. 1½d. for distributing plant; while during the next twelve months additions to the

Gas Lighting Water Supply 4 Dec 2 1879

of the inhabitants. He thought it was too much to give the whole of the balance for public improvements.

Bailie M'Gown said it was quite clear that if they adopted the Chairman's suggestion, they would never have any more public improvements at Paisley. The framers of the Corporation Act of 1859 and Provost Murray, who was a shrewd and sagacious man, would surely not have put in a clause such as the last one, which had been quoted, unless they had some expectation of a limit being set for public improvements. It was unreasonable to speak of giving the £1500 to pay off a portion of the late extension of the works that had an interest to capital. In the year 1869, for instance, there was a surplus from the Gas Trust of £2576, which was positively more than they now spoke about. The interest forward was £23,000, as against £15,000 in 1875, and in 1871 the interest was £19,000, and the price was raised to the same tune. It was said that large consumers of gas were paying for the public improvements. He submitted that this was not the case. He found that generations past had paid very high prices for gas, and it was one of the prizes thus paid that the works were in such a splendid condition. The price now was 3s. 2d. per 1000 feet, and he submitted that they were able to sell at that price in any community in Scotland. He found in Dundee the price was 3s. 6d., in Edinburgh 4s. 6d., Aberdeen and Greenock 3s. 9d. each, Stirling, 4s. 5d., and Kilmarnock, 4s. 7d. The only town where it was 3d. less than they were was Dalkeith, but that gas was only equal to 22 or 23 candles, which was not to be compared to theirs.

Treasurer Russell: There is one other point.

Bailie M'Ewen: Gladstone; but the successors are for its services-pages from the Company's mains. He had no sympathy with the Chairman's views. He thought they were in danger as servants of discovering in the mind that the gas undertaking was the best property connected with the Corporation. Assuming that the £1500 paid for gas-works as a recess session £150,000, while it was admitted that their own works would be worth about annually now not £1000 to redeem the debt, they gave cheap gas at the same time, it seemed to him in accordance with the Corporation Act of 1859, which said that they might supply some of the profits for public purposes. The clause was put by Bailie Clark no doubt said that extensive public improvements were to be carried out for that; but he felt that there was spirit in an Act as well as letter, and he felt that there was spirit in the Act was clearly that if the works were kept up in a thoroughly efficient and if the gas was cheap, they could use the surpluses to some extent for public purposes. In these circumstances he moved that they should carry out the Act of 1859, forward.

Treasurer Russell said the Chairman had raised the price of gas as well as the surplus £1000. He had not told them the facts of the case that the consumers of gas had paid which had gone for the extension of the works and the redemption of stock. Under the joint management, from 1845 to 1870, 598,900 tons of coal were consumers of gas, which went to increase the works and to redeem the debt. Since 1870, when the Corporation obtained the management of the works, they had paid over £17,726, which was made in all £417,626, for interest, and redemption of stock and loans of that interest; and he thought the public ought to know the basis of that interest. If they gave gas at 3s. 2d. per 1000 feet, they would have a surplus of £4000 on that gas at 3s. 2d. per 1000 feet, they would it? He had no objection to the Chairman's proposal, but what were they going to do with moved, but he wished it taken off the charge of gas, thus making it the 6½d. Supposing they did this, they would still have a surplus at the end of the year, which would make £3500; if they did not touch at £1500 towards paying off the debt, they would have still £3000 of a surplus, and he was of opinion that the £1500 be added to it.

Bailie Steven supported Treasurer Russell, as he did not see why they should not give the consumers the benefit of cheap gas.

Mr. Robertson thought the first thing was to say what was to be the price of gas in the future, and then whether there was to be with the present surplus of £1500. He considered the whole amount of the surplus should go back to part payment of the other parties of the works for the time, and finally to surplus went the way indicated. He thought they should not do anything for posterity. Finally, he strongly supported the resolution moved by Bailie M'Ewen, that the £1500 should not be voted for the reduction of the debt incurred in connection with the past extension of the works, but should be set aside. He intended afterwards to give notice of motion that £150 of the surplus be allocated to extinguish the debt on the Feuls Part.

In reply to a question,

The Chairman said his motion was that the £1500 be applied for paying off the debts incurred in extension and maintaining the works as required by section 2 of section 85 of the Corporation's Act of 1859, while Bailie M'Gown's amendment was that the surplus be not dealt with in the meantime.

A motion to delay the further consideration of the matter was then agreed to, Treasurer Russell saying he would, on the debtor balance reduced,

OLDHAM CORPORATION GAS SUPPLY.

From the last annual report of Mr. Herbert Andrew, the Superintendent of the Oldham Corporation Gas Department, it appears that during the twelve months ending March 25, the expenditure on capital account was as follows:—

Higginshaw gas station	£4292 11 7
Hollinwood "	177 9 10
Gas-mains "	1970 15 11
	£6442 0 4

The amount of gross profits was £25,869 19s. 10d., and after paying thereon the annuities, the interest on investments, and £3219 to the sinking-funds, there remained a net profit of £16,650 19s. 7d. From this surplus it has been resolved to pay the sum of £15,000 to the borough fund, leaving a balance of £651 12s. 7d. for disposal.

The price charged for gas was 3s. 2d. per 1000 feet, with discounts, as in Bolton, varying with the consumption "within the meaning of the borough," and "beyond the municipal borough, but within the limits of supply," and "beyond the limits of supply" respectively.

The quantity of gas manufactured was as follows:—

Oldham gas station	125,869,000 cubic feet.
Higginshaw "	10,167,000 "
Hollinwood "	10,190,000 "
Royton "	37,114,000 "
Total	183,335,000 cubic feet.

Against 167,631,000 cubic feet in the preceding year; and the quantity of coal and cannel carbonised in its manufacture was 48,510 tons, the latter being an increase during the year of 1427 tons 12 cwt. The average quantity of gas made per ton of cannel and coal carbonised was 9571 cubic feet. The quantity sold during the period was 157,061,000 cubic feet, against 143,630,000 cubic feet in the previous year, or an increase of 4·707 per cent. The loss from leakage and unaccounted for was 27,170,000 cubic feet, or 7·851 per cent. of the quantity delivered. The maximum quantity delivered in 24 hours was 2,250,000 cubic feet on Dec. 22, and the greatest pressure was 2·875,000 cubic feet. The average illuminating power of the gas was equal to 16·35 candles, the standard in the Corporation Act being 14 candles.

During the past year 1731 new meters were fixed and 1248 consumers' meters were removed, leaving a net increase of 483 meters, and the number of consumers is 30,921. The length of gas-mains, and the number of engagements, and removals was 19,950 yards, and 1000 in extension; and 1,000 yards of public lamps within the district of supply is now 5296, being an increase for the year of 82. There are now 3000 public lamps within the municipal borough, and 771 in the out-townships.

The total amount of capital borrowed on the 25th of March was £230,550, with unexhausted power to borrow £19,450; while £16,950 has been redeemed from the sinking-funds since the Corporation Act of 1853 was passed.

The capital account shows that the sum of £190,000 is debited as the cost of the transfer of the old Company's undertaking on the 31st of July, 1851—viz., the value of the mains, meters, and pipes, as per the Company's books at the time of purchase, £99,153 10s. 8d., and amount paid for goodwill to the Company, on estimating the annuities at 27 years' purchase, £90,901 7s. 4d. To this there has been expended, at the Corporation valuation of the 25th of the 31st, mentioned above, £3219 12s. 8d., £1,000 out of the revenue account was as follows:—

Manufacture Account.

Manufacture of gas—*Extract from Account for the Year ending March 25, 1880.*		
Cannel and coal, including carriage, unloading, &c.	£12,802 17 2	
Lighting and stoking retorts	2,403 19 0	
Repairs of retorts and settings	1,021 13 4	
Rent of retort-house	262 2 6	
Salaries of Manager and indoor-staff of station	87 0 0	
Wages (carbonising)	1,284 7 0	
Oxides and purchase of waste and of gas, &c.	3,096 3 7	
	7,294 3 1	
Distribution of gas—		£25,953 12
Salaries and wages of Officers and Rental Clerks	£1,421 11 7	
Repairs, renewals, and removal of mains and of service-pipes (less old material sold, £302 10s. 10d.)	1,142 12 10	
Inspection of meters	1,241 17 8	
Services, meters, &c.	2,591 17 7	
	6,397 19	
Rents, rates, and taxes		3,371 2
Management—		2,455 1
Salary, Superintendent and Clerks	£707 1	
Do., Collectors	1,000 0	
Proportion of Town Clerk's and Treasurer's salaries	391 2 6	
Stationery, printing, advertising, and stamps	229 17 6	
General establishment charges and incidentals	126 9 4	
	2,454 10 4	
Less expenses, coal-gauge, &c.	1,251 7 9	
Bad debts	1 11 0	
	2,253 1 1	
Balance carried to profit and loss account	27,349 10 10	
	£59,581 7 7	

Gas—Revenue Account.

Sale of gas—		
Gas per meter to private consumers	£56,586 11 3	
Gas for public lamps	1,993 15 11	
	£58,580 7 11	
Less discount	1,000 0 0	
	£57,580 7 11	
Residual products—		£57,580 7 11
Coke (less labour, £727 10s. 6d.)	£1,650 2 11	
Tar and farm sales	511 17 1	
Ammoniacal liquor	3,151 9 1	
	5,313 9 1	
Rent of meters	19,585 3 10	
Fittings, repairs, &c.	1,000 0 0	
Services, rentals, &c.	201 6 11	
	3,877 13 10	
	£29,781 7 7	

In the appendices to the accounts, interesting information is given as to the number of new consumers added, and the sizes of meters fixed, in the different months of the past year; as to the mains laid and taken up during the same period; as to the gas manufactured and consumed from July 31, 1855, to March 25, 1880; and as to the gross profit made, and the sums of its appropriation, from 1855 to the present year.

A Corporation Official convicted of Embezzlement.—At the Manchester Summer Assizes last week, Frederic Hopton, aged 40, late chief clerk and cashier in the Water-Works Department of the Manchester Corporation, was charged with embezzling the sum of £1 10s. 6d., and other sums, various amounts, the money amounting in all to nearly £1000, the property of his employers. After a protracted trial, he was found guilty, and sentenced to ten years penal servitude.

but it is at least final and comprehensive, and we are fast becoming strangers to the multitudinous and very shallow devices in taxation with which our Continental neighbours are yet afflicted. A complex organisation such as a gas undertaking offers a ready field, in the multiplicity of its belongings, for experiments in that kind of taxation which is akin to the method of raising money known to the impecunious as "kite-flying;" but as long as Governments have to provide for vast expenditures without daring to ask the taxpayer openly for the revenue they require, we must expect to see continued manifestations of this peculiar description of misapplied ingenuity.

The Silvertown magistrates have recently had occasion to clear up a doubt which seems to have prevailed in that neighbourhood respecting the liability of carts loaded with refuse gas lime to pay toll on passing over turnpike roads. As it was not disputed that manure of any kind is transit for use in agriculture is exempt, it is difficult to see how such a well-known manure as foul lime could have been considered subject to toll by any one other than an over-officious gatekeeper. An effect was, however, made to show, in defence, that as lime is not always exempted from toll, the particular compound in question lay at least in debatable ground; but this ingenious contention was overruled on the broad commonsense principle that the material was in fact manure, and was only intended for use as such. Therefore the toll-gate keeper will interfere no more with the free transit of farmer's carts as they remove the rejected material of the purifiers of the Silvertown Gas-Works.

The Sutton Town Council have been charged more than once of late with reckless extravagance in respect of certain proceedings to which they have committed themselves, notably in connection with the enclosure of open spaces, making new roads, and similar works, for which, as alleged, they are rendering the present generation of ratepayers fat for the prospective benefit of their descendants. So deeply has the sense of their excessive generosity in those matters sunk into the popular mind, if the local press may be credited, that at the next municipal elections will probably be returned a new set of candidates pledged to "economy and retrenchment." The growing discontent has already found expression in the choice few of the present Councillors to return to trim their sails to this rising gale. Hence, the speaking depu on themselves no little public odium Town Councillors hope to turn at least a portion of their prospective unpopularity to account. The gas undertaking—and endeavour to show, in connection with it, that the present instance the chance of making economy soon revealed itself. The Sutton gas over a district of forty square miles ill-provided with means of conveyance prising that the Engineer, who was a personal supervision over this extens down to his assumed his duties, the ex "and trap." This, however, was denie proving rather costly, the Gas Committ him an allowance for travelling expen choice of conveyance. This is the outlay the economic sensibilities of a few sad Council. An undertaking returning a pr amount to operations conducted over a it is said, leer an expenditure such as t by a parish doctor. And the moment exhibition of cheese-paring is the cause reduction in the price of gas, still leaving anticipated increased profit. And the un endeavoured to show some appreciation o man who is officially responsible for keepi its legs, is to put him on full pay, making

The statistics of the Oldham Corporat which we publish some extracts in anot good margin of profit on the past year's w while if the disposable balance, or a n having been added to the respectable t taken from the gas profits and applied i Much detailed information of a general ch the various accounts and tabular statemen report; but, as is too many compilations form which fails to give them the inter comparison with results obtained elsewh have been secured with very little ext methods of analysis practised by Mr. Fle the accounts of the Metropolitan Gas Co Loss, or even the more exhaustive redu

The members of the Société Technique de l'Industrie du Gaz en France—the French equivalent for our Gas Institute—Association of Gas Managers—have just had their "Congress," which was opened with a very interesting address by the President. M. Jordan, as stated by himself, is connected with the iron industry quite as deeply as with that gas, and by virtue of his semi-independent position he claimed the right of being heard as an unprejudiced observer on the question in view of the competition which at this time, more than ever, is forced upon it by its many rivals. The address, indeed, was chiefly concerned with this important subject, upon which the President's judgment was eminently calculated to reassure his hearers. But besides the vindication of those concerned in the manufacture of gas from the charges which the advocates of rival systems of lighting level against them, in France as elsewhere, there were portions of his address which offer much food for reflection to sympathising and interested outsiders. For instance, in the allusions made to the various devices by which gas undertakings in France we obtain instruction illustrative of the extraordinary propensity of the French bureaucracy for raising, by indirect and roundabout means, money which, by the way, they appear just as willing to expend in a similar manner, if we may judge from the latest proposal to subsidize French steamship owners, with the ulterior object of fostering a native merchant service. It gives one an impression that in following out this general idea of taxation, the French authorities hold the belief that money so raised comes into existence by some special creation, instead of out of the pockets of the people, and that they think the long-suffering trader is in ignorance of the extent to which he is victimized by his rulers, just because he cannot precisely tell how and where the money goes. We are seldom at a loss to comments upon a proposal for levying a tax upon gaslighters, at the rate of 20 centimes per cubic metre consumption, irrespective of the tax payable on the gross value of all plant and utensils, and a separate rate on all mains and pipes which are laid under any public highway. Our own system of valuation for the relief of the poor is frequently oppressive, inefficient in many respects, and obstructive of improvements; but it is not to be compared with the French system, which is based upon the principle that the more a man spends in improving his property the more he shall be taxed for the privilege of doing so. Of course, the proposal is not likely to be carried out in its entirety, but the fact that it has been made at all is significant of the tendency of French financial ideas.

M. Jordan, as stated by himself, is connected with the iron industry quite as deeply as with that gas, and by virtue of his semi-independent position he claimed the right of being heard as an unprejudiced observer on the question in view of the competition which at this time, more than ever, is forced upon it by its many rivals. The address, indeed, was chiefly concerned with this important subject, upon which the President's judgment was eminently calculated to reassure his hearers. But besides the vindication of those concerned in the manufacture of gas from the charges which the advocates of rival systems of lighting level against them, in France as elsewhere, there were portions of his address which offer much food for reflection to sympathising and interested outsiders. For instance, in the allusions made to the various devices by which gas undertakings in France we obtain instruction illustrative of the extraordinary propensity of the French bureaucracy for raising, by indirect and roundabout means, money which, by the way, they appear just as willing to expend in a similar manner, if we may judge from the latest proposal to subsidize French steamship owners, with the ulterior object of fostering a native merchant service. It gives one an impression that in following out this general idea of taxation, the French authorities hold the belief that money so raised comes into existence by some special creation, instead of out of the pockets of the people, and that they think the long-suffering trader is in ignorance of the extent to which he is victimized by his rulers, just because he cannot precisely tell how and where the money goes. We are seldom at a loss to comments upon a proposal for levying a tax upon gaslighters, at the rate of 20 centimes per cubic metre consumption, irrespective of the tax payable on the gross value of all plant and utensils, and a separate rate on all mains and pipes which are laid under any public highway. Our own system of valuation for the relief of the poor is frequently oppressive, inefficient in many respects, and obstructive of improvements; but it is not to be compared with the French system, which is based upon the principle that the more a man spends in improving his property the more he shall be taxed for the privilege of doing so. Of course, the proposal is not likely to be carried out in its entirety, but the fact that it has been made at all is significant of the tendency of French financial ideas.

facts into ratios and abstract data, as may be observed in many of the papers of Continental Gas Companies which we publish from time to time, were more generally copied by the accountants who prepare for publication the reports of our important provincial gas-works, a great benefit would be conferred on the members of the profession at large.

It is with surprise that we learn from some of the American papers that Mr. Edison's incandescent lamps, the wonderful carbon burners of which we have heard so much, have actually been improved upon by another inventor—Mr. John H. Guest, of Brooklyn. There appears to be no room for doubt respecting the reality or value of the improvement, which consists in sealing the connecting wires in mercury at the point where they pass into the exhausted interior of the lamp, and so surmounting the difficulty which has troubled Mr. Edison, of air leaking in through crevices in the glass and destroying the vacuum. This is very satisfactory so far, but how comes it that such a simple expedient was left to an outsider to introduce? This improvement, it is true, is not of such a character as to place the horseshoe lamp at once and for ever on the pinnacle of practical success, to do which, indeed, would require alterations of far greater sweep; but that an improvement, however small, should be possible upon anything emanating from Menlo Park, is another melancholy proof of human imperfection. The lesson is but an old one to us, but it is necessary to be reminded of its truth, after the repeated efforts of newspaper correspondents and other (dis)interested witnesses to demonstrate that it did not apply to the case of the great inventor.

According to Mr. J. S. Sloane, M.I.C.E.I., late Engineer to the Commissioners of Irish Lights, the introduction of gas for the use of lighthouses is seriously hampered by the great disadvantage that has been imposed on them by the authorities who are charged with lighting our coast line of dwelling to burn gas at some of their most important stations, they would have taken care to supplement the special burners constructed for that purpose with suitable lenses, in order that no part of the available illuminating power should be misdirected or lost; but it appears that this was not done, and, as a consequence, Mr. Sloane is of opinion that gas has not in this connection received full justice. No one, however, will be surprised to hear from the same authority that the electric light, when tried for lighthouse purposes, has had every encouragement that science and art can give to make it practically successful, although, after all, Mr. Sloane has only qualified praise to give to it. On the different grounds of reliability, clearness in foggy weather, steadiness, and economy, he contends that gas is infinitely preferable to the electric light for lighthouses, even with the unequal conditions under which the two systems have hitherto existed, while expressing himself as unable to imagine what would be the effect of the largest and most perfect gas-burners, if fitted with properly-prepared lenses. That such observations as these should be possible is anything but creditable to the authorities in question; and we may be absolved from the charge of contending for the interests of gas alone in expressing the hope that in all cases, whatever system may be employed in lighthouses, suitable apparatus for enabling the light to do its duty to the full may not be lacking. Mr. Sloane has described the principle on which he would construct lenses for gas-burners, the possibility of making appliances of this kind to meet any requirements is not disputed; so that, now the evil which has arisen from a perhaps inadvertent application of ellipsoidal lenses to Mr. Wigham's burners has been publicly exposed, we may expect to see it remedied.

Ever since the development of the various manufacturing processes involved in the production of wrought iron, which resulted in the application of that material to the multitudinous uses with which it has been associated in modern times, efforts have been constantly made to remove one of the greatest practical drawbacks to its continuance in strength, utility, and beauty—namely, its tendency to rust. It is too well known that wrought iron is no sooner turned out of the manufacturer's hands than it begins to decay from this cause, and nothing hitherto discovered, by way of preventive treatment, during manufacture or after, has availed to thoroughly preserve it in its pristine state. Galvanising with zinc has for long been a favourite device for protecting a certain class of wrought-iron goods; but its application is limited, it is costly, and not always desirable. Platinising has also been warmly advocated as far preferable to galvanising for the same class of articles. And now the latest device, although one not particularly novel in principle, is that of coating iron with a film of its own magnetic oxide, which has been brought under general notice by Professor Barff and Mr. George Bower, of St. Neots. Although the same end is arrived at by the two systems followed by Professor Barff and Mr. Bower respectively, the means adopted in each are quite different. Barff's may be described in brief as a steam process, the oxidizing agent employed to produce the peculiar action before mentioned on the surface of the iron being superheated steam; while Bower's process consists in subjecting the iron to be coated to carbonic oxide flame, with an excess of hot air. In both cases the result is the formation of a thin film of magnetic oxide of iron, adherent to the wrought-iron articles subjected to treatment, and this film is not susceptible of deterioration or further change in presence of influences which would speedily destroy ordinary metallic coats. With the relative advantages of the two processes named we need not at present concern ourselves, for if the principle can be constantly secured with extended success, the survival of the fittest will be observed in this as in every other contest, and the system which is most reliable and the cheapest will be most successful. We may, however, state a few considerations on the general subject. In the first place, it will be observed that, as with galvanizing, there exists a great class of subjects to which the oxidizing process will not apply. Nothing, in short, that cannot be put into an oven can be treated by either a steam or a dry method of oxidation. The plates and bars for large iron structures may, indeed, be so treated, wherever there is no subsequent manipulation—such as hammering, welding, rivetting, and the like—to be gone through. When any rough usage of this kind is necessary, no method of precious surface treatment will avert rusting. Hence for gasholders, &c., it is to be feared that the paint-brush must still remain the great preserver. But, of course, there is an enormous scope for the peroxide process, even if the hitherto subjects are excluded from its range, and in its proper field it may be found to yield results equal to the highest expectations of its friends.

EXAMINATIONS IN "GAS MANUFACTURE."

The list of the successful candidates in the examinations held throughout the country last May, under the auspices of the City and Guilds of London Institute for the Advancement of Technical Education, has just been published. The following table, in reference to the examination in the "Gas Manufacture" section, is compiled from the pass list:—

	Class of Certificate.	Prizes.	Previous Successes.
Honours Grade.			
Blair, Thomas . . . . . London	First.	First Prize, a Silver Medal and £5 . .	1879. Advanced First, with First Prize of £7.
McIlwaine, Neill . . . . . Houghton-le-Spring	First.	Third Prize, a Bronze Medal	1878. Elementary First, with First Prize of £5.
Hulse, William W. . . . . Burslem	Second.		
Marquis, William Thomas. . Rochester	Second.		
M'Gillivray, Hugh . . . . . Edinburgh	Second.		
Advanced Grade.			
Hall, John Ferguson . . . . Liverpool	First.	First Prize, a Silver Medal and £3 . .	1873. Elementary First.
Heath, William Robert . . . London	First.	Second Prize, a Bronze Medal and £1.	1879. Elementary First.
Hogg, John . . . . . London	First.	Third Prize, a Bronze Medal	1877. Elementary First, with First Prize of £5.
Akroyd, Benjamin . . . . . Halifax	First.		
Axon, Samuel Taylor. . . . Leicester	Second.		
Baines, William T. . . . . London	Second.		
Dransfield, John . . . . . Oldham	Second.		
Plumbe, Hilary E. . . . . London	Second.		
Shellabear, Charles . . . . Houghton-le-Spring	Second.	. . . . .	1879. Elementary Second.
Sheard, John Tomlinson . . . Batley	Second.		
Elementary Grade.			
Lewis, Benjamin A. . . . . London	First.	Second Prize, a Bronze Medal and £3.	
Dempster, Alexander. . . . . Halifax	First.	Third Prize, a Bronze Medal.	
Davies, Francis James . . . . Bilton	Second.		
Jones, Richard Rees . . . . Wolverton	Second.		
Lovatt, George Thomas . . . Wolverton	Second.		
Mellor, John . . . . . Oldham	Second.		
Morris, William Walter . . . Jarrow-on-Tyne . .	Second.		
Plant, Joseph. . . . . Wolverton	Second.	. . . . .	1879. Elementary Second.
Wilkinson, Harry . . . . . London	Second.		

YEOVIL GAS COMPANY.—The annual general meeting of this Company was held yesterday, when the Directors reported that the works were maintained in good order. The profit for the year ended June 30 amounted to £1097, which allowed of a dividend being paid of 10 per cent. This would absorb £1462, leaving £365 to carry forward. During the past year the Company have carbonized 2121 tons of coal and cannel, making 21319 lbs. 2d., and produced 10,841,00 feet of gas, of which 1,247,000 feet were supplied for private lighting, and 1,380,000 for public lighting.

THE GLOBE.—Mr. Walter Morris, "Special Correspondent" of the *Globe*, writing from Sheffield, Warren County, Penn., U.S., says: "The most wonderful part of Sheffield is a natural gas well. The gas from this well is used in the furnaces of the tannery of Horton, Crary, and Co., and runs the machinery; it also lights all the houses in the town, being brought in iron pipes 3 miles from the well. It was discovered in boring for petroleum. Escape-pipes have been run up to a height of some 50 feet, and the huge flames from these pipes flare away day and night, and have done so for the last five years. The daily amount given off is estimated at 3 millions feet. The gas was found at a depth of 1500 feet, and blew all the boring machinery out of the well. The pressure is so great when turned full on that the gas blows itself out. But it is not like the ordinary coal gas, but more like petroleum. There is little doubt that put into use the edge of the whole field, and probably, all the land near is underlaid with oil. The amount has not been found to lessen, nor the pressure diminish in the whole five years. It seems rash waste to see these six or eight escape-pipes flaming away day and night, as they have done for the last five years. How long they will go on no one can tell, but at present it looks as if for ever. At present they have no purchasers, as not utilizes the gas except on the spot. There is, however, a well just successfully sunk at Clifton, 7 miles from Sheffield, and there is little doubt but that others will be found in the neighbourhood."

EXHIBITION OF GAS AND ELECTRICITY.

ARRANGEMENTS are in progress under the auspices of the Philosophical Society of Glasgow, for holding in that city an exhibition of a very interesting character during the four weeks commencing 28th September. In many respects it will be like the Exhibitions of Gas Apparatus that have been held in many towns throughout the kingdom during the past three or four years, but it will be of a much more comprehensive character, inasmuch as it promotes, amongst other things, aim at bringing together in one building thus illustrations of all the most recent developments in the use of electricity as well as of gas for lighting and other purposes, in order that there may be made a most thorough comparison in respect of the efficiency and economy of those two agents, and of the various electrical systems with each other. The Exhibition will be held in a large drill hall and grounds on one of the main tramway lines, and, if necessary, annexes will be erected. The range of subjects to be illustrated by the Exhibition will include apparatus, appliances, models, or drawings that relate to, or illustrate any of the following, namely:—

Coal Gas.—The manufacture, purification, storage, distribution, regulation, measurement, and measurement. Its utilisation in lighting, heating, cooking, ventilating, and as a motive power. Photometrical testing of gas or other sources of light. Residual products of gas manufacture, coke, tar, benzole, aniline dyes, ammonia salts, &c.

II. *Oils, Oil-gases, Candles.*—Their manufacture and use for lighting, heating, cooling, and motive power.

III. *Electricity.*—Its generation and application for lighting, telegraphy, motive power, &c.

IV. *Hydraulic Appliances.*—Meters suitable for comparison with gas-meters, and apparatus for the measurement and regulation of the flow and pressure of water.

V. *Architectural Appliances.*—More especially those which relate to lighting, ventilation, heating, and lightning conduction; and architectural brasswork and sanitary appliances, such as can be exhibited in the open grounds.

VI. *Miscellaneous Appliances.*—Gas-lighted buoys, fog-horns, miners' safety lamps, fire-damp indicators, and apparatus for lighthouse illumination, ventilation of mines, &c.

Awards for merit are to be given in such classes of the Exhibition as the committee and exhibitors may arrange to be tested, and other exhibits as may possess very special merit. There will be a supply of gas and water provided by the committee for the Exhibition through the co-operation of the Corporation gas and water commissioners. The gas has an average illuminating power of twenty-six standard candles, and the water pressure will probably be 56 lb. It is intended to supply sufficient motive power by the gas and other engines that are exhibited in action. Amongst our readers there are doubtless many who may take an interest in this exhibition, the offices of which are at 154, St. Vincent Street, Glasgow.

WESTMORELAND COAL ENRICHED WITH ALBERITE, NEW HAVEN, 1869.

Hydrogen	42.47
Marsh gas	46.16
Carbonic oxide	5.09
Carbonic acid	—
Air	2.66
Hydrocarbons	6.67

BRIDELSBURG GAS.

Hydrogen	46.2
Marsh gas	31.62
Carbonic oxide	8.38
Carbonic acid	3.01
Oxygen	0.65
Nitrogen	2.15
Hydrocarbons	5.09

BOSTON GAS LIGHT COMPANY.

Hydrogen	43.15
Marsh gas	42.97
Carbonic oxide	6.06
Carbonic acid	0.36
Oxygen	0.12
Nitrogen	2.05
Hydrocarbons	5.29

In addition to these ingredients, obscure compounds of sulphur with hydrogen, sulphids of carbon and ammonia salts are found in the gas, and may, in large quantities prove highly objectionable and mischievous. Illuminating gas is therefore composed, first, of a series of non-illuminating but highly combustible gases, which together form a burning fluid whose sole office is the supply of heat; second, a group of hydrocarbon gases, yielding upon combustion more or less light; third, diluents whose influence is deleterious directly proportional to the percentage present; fourth, impurities.

The first group consists of hydrogen, marsh gas, and carbonic oxide, and upon the proportions of these bodies present in the gas depend some important features. They regulate the degree of heat which the gas attains in burning, and they determine its density in a great measure. Hydrogen is the lightest gas known possesses the highest calorific power, and while assists the buoyancy and vitality of the gas, produces upon combustion high temperature which, as we subsequently see, is not favorable to a pure and whitest light. Its gravity compared with air is 0.693, its calorific power 34,462 units, its calorific intensity is 2,746°C., the latter falling as much below the former, since hydrogen in burning unites with the oxygen of the air, which supports its combustion and forms aqueous vapor, and a certain amount of heat is abstracted from the sum total of heat generated in order to raise the temperature of the water produced.

Hydrogen from its calorific power is pre-eminently valuable in gas, and its percentage in normal coal gas should exceed that of any other ingredient. Not that it may not predominate so as to virtually destroy or effectively diminish the luminosity of the gas, but that within reasonable limits it enables the production of illuminating material in the best way possible. The principle underlying this is the much-discussed, some time discredited and recently rehabilitated doctrine of photogeny propounded by Sir Humphrey Davy. This philosopher insisted that the luminosity of a gas flame was due to the presence in infinite numbers, confined to the luminous zone, of solid points of carbon which become incandescent at high heats. So long as gas flames are concerned this is unquestionably true, and the appearance of soot upon a cold object pressed into a flame, the opacity of the flame itself, at least of its light-giving portions, and the ease with which a small luminous flame can be made luminous by the introduction into it of such solid point, and, so far as it is a practical question, establishes the reality of this theory. Granting this position, there is very evidently a proper proportion to be maintained between the heat produced by combustion of a gas flame and the number of carbon points to be raised to whiteness by that heat. This heat may be obtained by the intimate mixture of oxygen with the flame, and by a large proportion of hydrogen and highly heating bodies which upon burning produce the necessary temperature. The significant conclusions to be drawn from this will be shown further on. It only here indicates the indispensable services rendered by hydrogen in the economy of lighting.

Hydrogen, while it thus, *par excellence*, renders the flame a hot one, imparts lightness to the gas, which permits the ingression to use a reduced pressure for its distribution. Hydrogen, as the lightest body known, diffuses with great rapidity, and a change in the constitution of the gas may take place in long transits from its escape through exotics and minute apertures although they suffer transformation, do so in relatively smaller volumes as the density is greater. The well known experiments of Dubereiner and Graham upon the diffusion of gases showed that through the finest cracks in the walls of a vessel, even though pressure was exerted by the confined gas, the gas will escape and air from without penetrate in its turn within the vessel. The injurious dilution of coal gas by atmospheric air may occur in this way in the works, or out of them in the mains, the lightest elements of the coal gas effecting their escape first and with the greatest rapidity.

Although this consideration has a theoretical value, practically it is not of frequent importance, as leakage of gas from mains, etc., is generally a process of effusion, whereby the gas pours out in an almost homogeneous mass. Marsh gas is the second member of the heating gases; its gravity is 0.557, its calorific power 13,053 units, its calorific intensity 2,630°C. It thus presents a marked contrast to its companion, although it is a non luminous gas excepting a few candles of light claimed for it, and assists in raising the temperature similarly as hydrogen. It is, however, its gravity which renders its presence useful in the coal gas type of gases. It gives body to the gas, a definite weight and texture. It is true we could have a gas in which the burning fluid was wholly hydrogen, and the necessary gravity supplied by increased proportions of hydrocarbons, which would likewise overcome its high heating power, but in the actual economy of coal gas manufacture, hydrocarbons are not abundant, and the marsh gas protects them from a too sudden and complete destruction in so hot a flame as we would have were hydrogen substituted for it, while it makes the gas more manageable to the engineers and more serviceable to the consumer. Marsh gas should not exceed the hydrogen, and should, in fact, be regarded rather as a preservative element than a directly useful one in the gas, where, if its presence is excessive, it raises the gravity of the gas, which in turn necessitates increased pressure, and that reduced luminosity unless compensated for by more or richer hydrocarbons. Neither is it desirable to have it sink below thirty per cent, as in the average percentage of hydrocarbons, its replacement by hydrogen would seriously affect the proper combustion of the latter, as well as inducing costly and needless expenditure of gas by the consumer.

Carbonic oxide concludes the list of heating gases. Its gravity is 0.967, its calorific power 2,400 units, and its calorific intensity 1,970°C. It is a heavy and a highly heating gas. Carbonic oxide may be considered as the latest member of coal gas constituents, and essentially is of no service. It is rather a necessary accident of gas making than a desideratum. The engineer must endeavor to reduce its percentages as low as possible, replacing it with hydrocarbons or hydrogen. Were marsh gas absent carbonic oxide would serve its purpose, securing by its gravity just that stability for the gas which it is the office of marsh gas to supply. Further, it skirts the heating power of the hydrogen, and it thus enables the engineer to increase the hydrocarbons and obtain a higher candle power for his gas.

The water gas is actually plays the same part in coal gas as does coke, and the former marsh gas may be regarded as an accidental and undesirable element, just as the presence of carbonic oxide is an undesired deficiency. Its poisonous properties are well understood, and on sanitary grounds its presence is obnoxious. In reality it is the only organic poison in coal gas, the other gases permitting inhalation, though of course detrimental.

In experiments made by the writer upon a gas containing small quantities of carbonic oxide, and upon a fully charged with that body, the result, 10,000 to 10,205. This body, which is virtually pure carbon, added to a hydrogen flame makes the latter luminous, and exactly similar conditions in the flame from which it was abstracted force us to conclude it was the cause of the brilliancy of the latter. In true coal gas the clelant gas exceeds the other hydrocarbons. But heavy tar vapors exist in well purified coal gas along with the hydrocarbon gases in almost imperceptible quantities, but to an extent sufficient under some circumstances to be annoying by their settling and aggregation in meters, elbows, etc. Naphthalin, a solid hydrocarbon, may be extracted from almost any gas by passage through a glass tube under ice, stuffed with thin discs of tin perforated by a sieve of fine holes. Gas which previously may not have been suspected of containing this crystalline substance yields it upon such treatment. The writer has obtained large deposits of naphthalin crystals resembling the holes made in the tin discs. The presence of solid or semi-solid bodies in gas, as a rule, is objectionable; they burn slowly, are indeed apt to fill through the flame, escape incomplete ignition, and they absorb heat, while they disturb the economics of the flame in their sparkling transit; and in one case known to the writer, irritated weak lungs breathing the air they filled. These hydrocarbons are not supposed to be all contained in the coal of distillation, or at least not to remain unchanged. For instance, [illegible] are formed and exist temporarily at moderate heats, but are decomposed at high heats within the retort chamber. Thus [illegible] found in the Paris gas:

Benzine (in vapor), acetylene, ethylene, propylene, allylene, butylene, crotonylene, terene, and their pyrenes, all of which he regards as formed from the four fundamental hydrocarbons, acetylene, ethylene, dimethyl, and marsh gas, mixing with hydrogen.

Hours after Commencement. Specific Gravity.

	1	2	3	4	5	6
Enilmann	0.6	0.52	0.43	0.37	0.37	0.3
Kombaluit	0.416	0.697	0.353	0.292	0.24	

The second group of gases into which we divide coal gas is that of the hydrocarbons, those high compounds of hydrogen and carbon which impart light to the gas flame when properly burnt, viz., not over or under burnt. These gases are olefiant gas, C_2H_4, propylene, C_3H_6, butylene, C_4H_8, acetylene, C_2H_2, allylene, C_3H_4, benzine vapor, C_6H_6. The principle involved in their supply of light is similar to that in the process by which carbon is deposited in the retorts. At a high temperature these carbons become disassisted, they fall apart into marsh gas and vapor of carbon, and this latter forming a veil of minute points as raised to incandescence on a lower heat by the combustion of the other gases and emit light until destroyed and burnt up into carbonic acid.

The necessity indicated above for a high temperature is shown here, first, because it rapidly decomposes the hydrocarbons, and from certain theoretical considerations probably produces a vapor whose carbon particles are more minute than would result from disassociation at a lower temperature; and, secondly, because the intense heat as rapidly brings them into incandescence. A subsidiary benefit is also gained, since the marsh gas which results from the falling apart of the hydrocarbons, as is well known, if withdrawn from air, decomposes into hydrogen and carbon, and this may also partially take place within the gas flame. It is obvious that were a gas so highly charged with hydrocarbons that the flame became overcrowded with carbon vapor so that the heat would be insufficient to raise it to whiteness, then the light would in consequence become orange or red. The importance of this consideration, as to the high heat required in a gas flame for its best and most satisfactory appearance, is based then upon, first, the belief that the light arises from incandescent particles of carbon; second, that high heat more instantly and, so to speak, more diffusely, splits up the hydrocarbons into simpler elements. As a corollary from this last hypothesis we say the illuminating power of two flames is proportional to the number of their radiant particles at a high heat. In other words, light results from collected masses and velocity; the slower supply one, the temperature the other.

Although the reality of this explanation of the luminosity of flames in general has been called in question, not altogether without reason, yet there seems little cause to doubt that in the case of the gas flame it is entirely just. Carbon is certainly separated, and although in a gas flame the soot deposited on a cold surface is not absolutely pure graphite, practically it is so. That collected by Mr. Evans, when a silver vessel sank two to three millimeters, in the flame of a silk burner, gave a trace of a solid yellow body when treated with benzole, while alcohol and alcoholic chloride and diluted sulphuric acid extracted nothing. This soot when washed gave—

Carbon	95.444
Hydrogen	1.021
Ash	3.527
Oxygen	1.038

The oxygen is supposed to arise from water yet clinging to it, removing which, and disregarding the ash, we may very safely call the composition 95.625, 11 0.205. This body, which is virtually pure carbon, added to a hydrogen flame makes the latter luminous, and exactly similar conditions in the flame from which it was abstracted force us to conclude it was the cause of the brilliancy of the latter. In true coal gas the clelant gas exceeds the other hydrocarbons. But heavy tar vapors exist in well purified coal gas along with the hydrocarbon gases in almost imperceptible quantities, but to an extent sufficient under some circumstances to be annoying by their settling and aggregation in meters, elbows, etc. Naphthalin, a solid hydrocarbon, may be extracted from almost any gas by passage through a glass tube under ice, stuffed with thin discs of tin perforated by a sieve of fine holes. Gas which previously may not have been suspected of containing this crystalline substance yields it upon such treatment. The writer has obtained large deposits of naphthalin crystals resembling the holes made in the tin discs. The presence of solid or semi-solid bodies in gas, as a rule, is objectionable; they burn slowly, are indeed apt to fill through the flame, escape incomplete ignition, and they absorb heat, while they disturb the economics of the flame in their sparkling transit; and in one case known to the writer, irritated weak lungs breathing the air they filled. These hydrocarbons are not supposed to be all contained in the coal of distillation, or at least not to remain unchanged. For instance, [illegible] are formed and exist temporarily at moderate heats, but are decomposed at high heats within the retort chamber. Thus [illegible] found in the Paris gas:

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Gas and Gas Making.

By L. P. Gratacap, Ph.B.

THE PROBLEM.

Making gas is a mixture of gases whose separate percentages in the retort by the material used, and the degree of perfection to which the process is chemically incline. We are considering gas made by the destructive distillation of coal, and no modification of this process, as coal gas with oil gas, or any novel practice, as water gas. These are reserved for separate treatment.

The ordinary constituents of coal gas and their quantitative relations are given in the following selected analyses.

Fisher's theoretical composition:

Hydrogen	44 to 48
Marsh gas	34 " 38
Carbonic oxide	6 " 7
Carbonic acid	1 " 3
Air	1 " 3
Vapor, temperature 40° to 60°F.	1 " 3
Hydrocarbons	6 " 10

GASWORKS, CHELSEA.

	Manchester Gas.	Rochdale Gas.	London Gas.
Hydrogen	45.58	53.44	50.94
Marsh gas	34.90	29.87	41.99
Carbonic oxide	6.51	6.89	10.27
Carbonic acid	3.07	—	1.10
Air	—	—	—
Nitrogen	2.46	—	—
Hydrocarbons	6.46	10.83	10.81
Sulphuretted hydrogen	0.29	—	—

BIRMINGHAM, GRACE STREET.

	Manchester Gas.	London Gas.
Hydrogen	48.05	51.35
Marsh gas	32.87	35.38
Carbonic oxide	12.93	7.49
Carbonic acid	0.32	0.38
Oxygen	—	—
Nitrogen	—	—
Hydrocarbons	3.37	3.56

Hydrogen (96.625), 0.205, 3.170.

The second group of gases into which we divide coal gas is that of the hydrocarbons, those high compounds of hydrogen and carbon which impart light to the gas flame when properly burnt, viz., not over or under burnt. These gases are olefiant gas, C_2H_4, propylene, C_3H_6, butylene, C_4H_8, acetylene, C_2H_2, allylene, C_3H_4, benzine vapor, C_6H_6. The principle involved in their supply of light is similar to that in the process by which carbon is deposited in the retorts. At a high temperature these carbons become disassisted, they fall apart into marsh gas and vapor of carbon, and this latter forming a veil of minute points as raised to incandescence on a lower heat by the combustion of the other gases and emit light until destroyed and burnt up into carbonic acid.

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The oxygen is supposed to arise from water yet clinging to it, removing which, and disregarding the ash, we may very safely call the composition 95.625, 11 0.205. This body, which is virtually pure carbon, added to a hydrogen flame makes the latter luminous, and exactly similar conditions in the flame from which it was abstracted force us to conclude it was the cause of the brilliancy of the latter. In true coal gas the clelant gas exceeds the other hydrocarbons. But heavy tar vapors exist in well purified coal gas along with the hydrocarbon gases in almost imperceptible quantities, but to an extent sufficient under some circumstances to be annoying by their settling and aggregation in meters, elbows, etc. Naphthalin, a solid hydrocarbon, may be extracted from almost any gas by passage through a glass tube under ice, stuffed with thin discs of tin perforated by a sieve of fine holes. Gas which previously may not have been suspected of containing this crystalline substance yields it upon such treatment. The writer has obtained large deposits of naphthalin crystals resembling the holes made in the tin discs. The presence of solid or semi-solid bodies in gas, as a rule, is objectionable; they burn slowly, are indeed apt to fill through the flame, escape incomplete ignition, and they absorb heat, while they disturb the economics of the flame in their sparkling transit; and in one case known to the writer, irritated weak lungs breathing the air they filled. These hydrocarbons are not supposed to be all contained in the coal of distillation, or at least not to remain unchanged. For instance, [illegible] are formed and exist temporarily at moderate heats, but are decomposed at high heats within the retort chamber. Thus [illegible] found in the Paris gas:

Benzine (in vapor), acetylene, ethylene, propylene, allylene, butylene, crotonylene, terene, and their pyrenes, all of which he regards as formed from the four fundamental hydrocarbons, acetylene, ethylene, dimethyl, and marsh gas, mixing with hydrogen.

BURNLEY CORPORATION GAS SUPPLY.

The statement of accounts of the Gas Department of the Burnley Corporation for the nine months ended March 31 last, just issued, shows that there was expended during that time, on capital account, a sum of £8319 7s. 9d., making the total to date £129,179 7s. 10d., and leaving a balance of capital in hand of £3995 17s. 2d. The following is a summary by the following "general data," prepared by the Gas Engineer (Mr. Samuel Patty Leather):—

Gas made	143,251,700 cub. ft. = 6215 cub. ft. per ton.
Gas sold	127,497,300 " = 5530 " "
Gas unaccounted for	15,754,400 cub. ft. = 683 cub. ft. per ton, or 11·71 per cent.
Average illuminating power during the nine months	17·23 candles.
Coal and cannel used in the nine months	11,511 0 tons.
Coke made per ton of coal used	1·21 lbs.
Coke used as fuel per ton of coal used	0·22 "
	or 22 p. ct. of coke made.
Tar made per ton	121 lbs.
Ammoniacal liquor made per ton	19 gals.

	Per Ton of Coal Used.	Per 1000 Cubic Feet Sold.
Cost of coal and cannel	16s. 1·05d.	5s. 1·27d.
Value of residuals	7s. 7·08d.	2s. 4·25d.
Net cost of coals, &c.	8s. 11·97d.	2s. 9·02d.
Net working expenses	11s. 8·74d.	3s. 7·15d.
Expenditure for gas	15s. 0·71d.	5s. 7·17d.
Interest and sinking-fund	3s. 10·93d.	0s. 9·16d.
Total cost of gas	18s. 11·64d.	5s. 9·33d.

Dr.—*Revenue Account, for the Nine Months ending March 31, 1886.*

—	—	Cost per Ton of Coal.	Cost per 1000 Cubic Ft. Sold.
	£ s. d.	s. d.	s. d.
To Manufacture of gas—			
Coal and cannel, including carriage, unloading, and all expenses of depositing same in works	7,670 8 1	13 1·25d.	1 1·22d.
Purifying materials and expenses	520 13 7	0 10·72d.	0 1·16d.
Wages of Manufacturing Foreman, &c.	262 5 2	0 5·43d.	0 0·58d.
Wages and pensions at works	2,182 17 2	2 10·51d.	0 2·36d.
Repairs and maintenance of workmen's houses, gas-holders, purifiers, retorts, retort-settings, beds, materials, and labour) less old materials sold,	4,101 17 10	3 5·43d.	0 7·11d.
Purification of gas— Salaries of Meter Inspectors and Assistants	103 11 9	0 2·07d.	0 0·23.
Repairs, maintenance, and renewal of works and service-pipes, including materials, laying, and labour	215 9 5	0 4·17.	0 0·23.
Repairing, renewing, and rebuilding meters	221 6 8	0 3·78d.	0 0·42.
Public lamps—lighting and repairing	525 16 4	0 9·16d.	0 0·56.
Rents, rates, and taxes—			
Rates and taxes	111 15 3	0 1·74d.	0 0·20d.
Rents	254 2 7	0 3·96d.	0 0·27.
Management—			
Salaries of Town Clerk, Accountant, Clerks, &c.	435 5 3	0 6·62d.	0 0·73.
Commission	168 10 6	0 2·61d.	0 0·28.
Stationery and printing	81 17 1	0 1·31d.	0 0·16.
General establishment charges and incidentals	23 14 0	0 0·41d.	0 0·05.
Auditors	15 13 0	0 0·29.	0 0·03.
Total expenditure	17,101 2 3	29 0·27	2 0·04.
Balance carried to profit and loss account	7,690 16 8	13 1·31.	1 1·48.
	24,491 2 1	42 1·58.	3 1·52.

Cr.—*Revenue Account.*

—	—	Per Ton of Coal.	Per 1000 Cubic Ft. Sold.
	£ s. d.	s. d.	s. d.
By Sale of gas—			
125,174,300 cubic feet within the borough, at 2s. 8d. per 1000	16,256 12 1	—	—
231,400 collected outside the borough, at 2s. per 1000	926 17 10	—	—
Public lighting and under contracts	1,659 16 2	—	—
	18,843 6 1	34 1·46d.	2 7·61d.
Rental of meters	1,218 12 9	1 4·74d.	0 1·77.
Residual products—			
Coke, less labour and carriage	1,511 3 9	2 9·64d.	0 2·62d.
Tar	1,911 5 0	3 5·46d.	0 3·33.
Ammoniacal liquor	181 9 9	0 4·32d.	0 0·29.
Sale of old materials, less cost of manufacture, &c.	1,240 3 1	1 10·48d.	0 2·16d.
Sewer fines	61 16 0	0 1·92d.	0 0·11.
Rents	6 16 0	—	—
Profit on fittings, &c.	185 5 11	—	—
Discounts	2 3 0	0 0·42d.	0 0·03d.
Total receipts	24,491 2 1	43 1·53d.	3 7·46d.

Date.	Time from First Observation.	Water-Gauge.	Barometer.
Thursday, July 1, 11.30 a.m.	0 hours.	24	29·63
Do. 4.30 p.m.	5 "	11	29·7
Friday, July 2, 7.30 a.m.	20½ "	7	29·77
Do. 12.30 p.m.	25½ "	6·75	29·78
Saturday, July 3, 8.0 a.m.	44½ "	3	29·7
Monday, July 5, 7.0 a.m.	91½ "	0	29·52

No exact expression for the leakage of the main can be obtained from these data, owing to the small number of observations, and the uncertainty how much of the air escaped to escape through leaks in the main into the soil at the atmospheric pressure, and how much passed through

STRONG'S WATER GAS SYSTEM.

By Mr. Gunson S. Dewar.

[A recommendation—indeed boldness, perhaps, even to the Engineering fact of the following paper.]

Some two years since, the representatives of the Strong process publicly announced that it was possible to convert the best anthracite coal to a gas, which should possess a greater heating value than the fuel from which it was derived, for practical purposes. The objection was at once raised that here was an absurd attempt to extract from a given weight of carbon more heat than it contained! The answer was that it is upon the materials really used that the number of the CO burden the expenditure of a proportion of its heat, and hence the new process is not open to the absolute charge from the old.

Prompt answer was made, admitting this but fact, but explaining that the objection was theoretic and not practical—that the conspicuous moment the between the potential energy of a fuel and that of its gaseous products of combustion was not the measure of the value thereof as thermo-metrical agent. It was shown that the calorific intensity of coals are determined by delicate laboratory methods, which, however correct and valuable, are utterly unattainable by ordinary practice; that the standmakers of Sheffield utilize only 5 per cent. of the value so ascertained; consumers in the domestic industries not over 10 per cent.; while the most economical use of fuel ever attained—namely, in the largest and best-managed gas-works—was but about 15 per cent. The latter result claimed for some boilers was but a fraction of the proportion, on the apparently just ground that, as the generation of steam depended upon the driving of engines, the efficiency of heat should be judged by the power developed rather than the weight of water evaporated, and that, so judged, the loss is as great as in other fuel applications.

Evidence was then offered that in the combustion of the Strong gas it is possible to utilize within 10 to 12 per cent. of its full theoretic value, and

It remained only to make a comparison of results, which was done substantially in the following manner:—One pound of anthracite possesses a potential energy of 14,500 units of heat, of which the actual energy—namely, that realized in practical operations—is, as we have already seen, from 8 to 12 per cent. Therefore, 1 lb. of anthracite is equivalent to the energy of 1740 units. The average product of 1 lb. of anthracite by the Strong system at that time was 22·05 cubic feet × weight 0·03116 = 0·6873 lbs., possessing a potential energy of 0·6873 × 4726 = 3021 units of heat, and an actual energy of from 88 to 90 per cent. thereof, or 2721 to 2690 units.

Assuming for simplicity what is, perhaps, not an unfair assumption, that the labour cost of conversion is compensated by collateral advantages in the reduced labour of using gas fuels, the economist was left to consider the question which, within term of set he would realize the greater number of heat units.

This answer on the parts of the advocates of the new system seemed intelligent and correct; at all events it has never been controverted. Admitting it to be so, we must acknowledge also that the new method of converting carbon into superheated steam, instead of atmospheric air, represents an important advance in the art of combustion.

The practical value of the Strong process, as developed by further experience with the Sheffield furnaces, seems perfectly conceived. The opinion that a great variety of fuels could be utilized by it has been justified by the results, and the startling fact established that all yield nearly identical gases, the variation being not in quality but in volume, which is considerably in proportion to the amount of moisture contained in the fuel. The special excellence of this system in rendering available the heat of bituminous coals is also established. Such coals, when used as suggested, such as cannel, coals, and peat coal, and which were employed in the proportion of 3 lbs. to 1 lb. of the better grade, is now ascertained to have a more important significance than the utilization of clamp material, important as that is.

The facts now to be stated will certainly revive the original objection, that the method is claiming to get more out of the fuel than it contains. But the explanation is found in the following manner. In the ascertainment of the relative values of the above-named materials, as already explained, by a comparison between the theoretic results of the street, it being similarly the potential energies of the fuel and the gas were related in 9092 is to 13,500; that is, that the loss by conversion was 5408 units of heat, equivalent to about 40 per cent. of the theoretical calorific value of the fuel.

Now, it is claimed that this percentage of loss has, by greater skill and experience in applying the principle been actually reduced, till, in some cases, to about 20 per centgrave. In other words, the difference between the crude facts and their gaseous products, as therefore determined by scientists, are approaching so closely as to indicate that the Strong system will yet develop what is now understood to be the maximum theoretical energy of the fuel in the gas. Here are the facts:—

1 lb. of Boghead coal is known in a red heat upon the grate of the Strong furnace, and the heat of the resulting products of combustion is stored in a regenerator. Subsequently, when the ashes and superheated a proper quantum of steam, and this latter is passed directly back to the coal, is be ascertained that the largest yield of gas from the volatile is 27·7 cubic feet.

The potential energy of this gas is as follows:—

27·7 cubic feet × 0·03116 = 0·86 lbs. × 9705 = 9,316 units.

The potential energy of the 1 lb. coke is . . = 12,250 .

This, it will be observed, is 91 per cent. upon the earlier results of 1874 units of heat per pound of fuel, and the loss by conversion is so reduced in 91 per cent. of the potential energy.

If 1 lb. of Boghead coke is treated as before, but the superheated steam is interrupted before coming in contact with the incandescent coke in the lower part of the body of fuel, it is possible to convert a larger weight in that form, and the yield in gas, proportionately to the purity of the dust fuel (free of percentage of carbon), will be greatly increased. Take peat powder of the following composition :—

Water	17·00 %
Combustible gas	39·15
Non-combustible gas	20·05
Carbon	23·97
Ash	10·80
	99·97

When 3 lbs. of this material are used, the total gas product is 101·26 cubic feet. Deducting from this volume the 57·60 cubic feet, which, as already shown, are obtainable from the 2·4 lbs. of carbon per each pound of peat derived from the peat, or 23·85 cubic feet or gas for each pound of peat used.

The total gas product possesses the following potential energy :—

101·26 × 0·03116 = 3·156 × 8798 = 26,916 units. The potential energy of the fuels from which it was derived is :—

3 lbs. peat × 7851 =	23,553
1 lb. coke × =	12,250
	37,112

Showing a loss of potential energy of 124 units of heat only. This is equivalent to a loss of about 19 units of heats for each pound of fuel, as against 1874 when the coke was taken without dust carbon.

If the calorific value of the peat is compared directly and separately with that of its own gas, we meet a surprising result namely:—

7917 cubic feet × 0·03116 = 0·2467 × 8798 = 27,046 units.

1 lb. peat = 7851 units.

Here the gas is found related to the fuel as 7·17 to 1, equivalent to a gain of 3019 units of heat, or 17 per cent. even upon the basis of potential energies! What loudness of title for of loss in conversion? It is not disturbed, but most strikingly illustrated. The seemingly impossible result is not beyond an explanation, and one which appears sufficient a theory advanced by the advocates of the new system, and yet to be generally admitted—namely, that in the conversion of the energy of the fuel sold to the gaseous state there is a temporary increase of the potential energy of the fuel, which is not permanent, but is productive of no other effect, and which has never entered into the balance sheet calculations of values. In other words, that the ultimate maximum potential energy of carbon is greater than the accepted estimate.

Take as example the conversion of the peat just calculated. The heat essential to the act was furnished entirely by the coke, which communicated to the molten of the steam, and hence the carbon of the peat vessel directly and momentarily with the steam, and hence the carbon of the water to form and volumizing 3021 units of heat per pound. When the analyst accepts to determine the calorific energy of the peat, he obtained 7851 units only. The difference of 1170 units, or a considerable proportion thereof, we must infer was expended in the gasification of the crude fuel, which, according to this theory, is not merely a question of reduction, but a principle of it. This theory is based upon the proposition that only the gases contained in fuel materials are combustible, and that the carbon of the fuel during the processes of nature, expended in their substitution from their original gaseous form, must be repaid to restore it and render them available in combustion.

Let us for the moment regard heat units as a merchantable article, like any other commodity of purchase and sale, and, regarding the above facts, consider the commercial bearings, as in what market, or in what shape, we can most advantageously buy them.

Assume that lump anthracite coal or coke is selling at 4 dols. per ton of 2240 lbs., and that dust or peat at 1 dol. per ton is available, and that we have 1 dol. to spend for practical heat units—that is, for such as we actually get the value of in combustion. See accompanying table. It will be noted that the figures are not theoretic precept in case we, but that the relative values are practical ones, and consequently the prices, of course, represent the natural cost of manufacturing an available fuel, but they indicate that the gas maker has a margin for liberal profit without using marmosettes. Naturally the gas purchaser will always determine for himself, as in any other transaction, whether the price charged is in excess of the advantages gained, but will calculate many collateral items as to the convenience, comfort, and reduced labour attending the use of gas fuels, must enter. And he will always have the alternative to his return to crude fuels, if the gas manufacturer becomes exorbitant in his demands :—

	Heat Units.	Cost per Ton of Fuel.	Per Cost, Dollars per Million.
1. If we pay 1 dol. for lump coal, applied as in Sheffield steel-making, we obtain	223,800	0·00110	5
2. The same sum as applied in domestic use gives	756,000	0·00132	30
3. The same in the most perfect blast furnace	5,716,100	0·00095	36
4. One dollar's worth of lump coal converted by the Siemens gas-producer, will yield gas representing theoretically	2,651,971	0·00039	33
5. One dollar for lump coal or coke, converted to water gas, as explained, and heated with 20 per cent. of fuel	1,756,451	0·00021	65
6. The same sum expended for one fourth the lump coal or coke and three-fourths peat, and converted by Strong's system, as explained, yields after allowing 10 per cent. loss	10,633,633	0·00038	95

asked a question as to how much of the available surplus the passenger reductio- of 1Bd. per 1000 cubic feet would absorb. He understood that there was a proposal to reduce the debt on the gas-works with the surplus, to which he objected, on the ground that the present generation, and not future generations, should have the benefit of the immediate profits. Mr. Hay replied that there was a sum of £7000 available for whatever purpose they liked to appropriate it. The Lord Provost said that in reducing the price to 4s. 6d. per 1000 feet—from 5s. 6d. to 4—after which there would still be a surplus of £500. After some discussion it was agreed to remit the matter to the Gas and Water Committee to consider and report upon. While speaking of Inverness gas affairs, it is proper to make a correction in last week's "Notes." The quantity of gas sold in that town during the last financial year should have been stated at 22,000,000 cubic feet, instead of 2,200,000, as still very handsome, if correct; but if last week's figures are right, the business must have increased been 25 per cent. But though it is still up at 10 per cent. it was about 11 per cent. higher some years ago, when the present Manager entered upon his duties.

The following are some of the figures connected with the lighting department under the Glasgow Public Authorities during the year ending 31st May last:—The number of public and private lamps there was extended the sum of 210,997 by the addition of 2,000 and upwards, exclusive of the Corporation and various other items the total amount was £30,390 7s. 6d.; and the receipts to be deducted from that amount for broken lamps, for sundries sold, and for private lamps, &c., amounted to £3076 14s. 5d. In connection with the lighting of common stairs there was incurred a total expenditure of £22,548 5s. 6d., including wages of stair lighters, cost of gas, and oil

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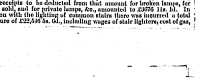

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ASSOCIATION OF GAS MANAGERS.—The Engineer from the presidential address of Mr. J. Robb to the North British Association of Gas Managers shows that some gentlemen connected with gas works view the electric light in the right way. He says:—"In looking over our transactions for several years past, I am astonished at the number of so-called inventions and improvements in gas manufacture, and machinery connected therewith, which have been offered for our acceptance, and been urged upon us with much eloquence and many weighty reasons, and yet you all know that few, if any, of them are ever heard of afterwards. Whether this arises from apathy to the interests of our profession, or from that intrinsic faculty which it is said we Scotchmen possess in a remarkable degree—I will not say of "seeing through a millstone," but rather of seeing at a glance the real value of anything that is placed before us, I will leave someone else to determine. There is one thing, however, which we cannot set aside, and that is the bold flight of our modern gas engineers in an upward direction. We have seen scrubbers towering above all other buildings in gasworks, and we shall shortly have an opportunity of beholding a gasholder, when filled with gas, rising to the amazing height of 160 feet. We may well ask—What next? Some one will say, "The electric light;" but, gentlemen, I think we are far from seeing the realisation of the hopes of those persons who have embarked their fortunes in the production thereof. Yet we need not shut our eyes to the fact that an intense and brilliant light can be produced, which may be used to great advantage in some situations; and although I believe that the time is far distant when it will take the place of coal gas in domestic illumination, yet I am convinced that when the necessity arises for its adoption, science will be able to overcome the difficulties with which the subject is now surrounded. Within the past two or three years it has struck me forcibly that, as gas managers, we have been losing sight of the primary object of our profession, viz., the production of illuminating gas, and have been drifting away in the direction of becoming manufacturers of the secondary or residual products thereof. I am led to this conclusion from the prominence which is given to this subject at all the meetings of our Associations, and from the multiplicity of machinery which has of late years been patented for the purpose of enabling us to enter into the trade. Almost daily we have our attention called to some washer or scrubber newer and more efficient than any other which has preceded it, and if the benefits resulting from the use of these improved appliances are really as great as they are represented to be I do not see how anyone can reasonably delay their adoption. Ammonia is becoming such a valuable article of commerce it may become a question with gas managers how far the amount of this substance contained in a coal should enter into their calculations when making a contract for their yearly supply. The quantity of ammoniacal liquor and its strength have not hitherto formed items in the results obtained from a ton of coal in the analyses sent to us (with the exception of a very few), but I expect it will take a more prominent place in all future analyses. My only fear is that coal merchants will not be slow to take advantage of the additional value conferred on the article in which they deal, and add to the price of the coal according to the quantity of ammonia contained therein. As showing the difference in the quantity of ammoniacal liquor contained in a ton of coal the following is a sample:—Muirkirk 14·00 gallons, Stanrig 9·00 gallons, Foulshiels 29·12 gallons, Shotts 9·00 gallons, Pondegh 31·00 gallons. Allow me to apologise, gentlemen, for trespassing so much on your time and patience. It only now remains for me to call your attention to the very interesting list of papers and communications the titles of which you will find in the programme."

This report was presented to the Chemical Section, and referred to the best means for the development of light from coal-gas. The report pointed out that great fluctuations of pressure occurred in the mains, and that being so it was necessary to have complete control over the pressure of gas supplied to the burners, in order that burners might be used to the best advantage. It suggested that the pressure so supplied to the burners could be regulated by the taps in the burners or at the meter, but in many situations where the pressure altered much in the course of a single night this was very troublesome to attend to, and in most cases would be neglected. The Committee therefore [illegible] which choose to leave [illegible] which acted automatically to the pressure of the gas.

Science in Elementary Education.

Dr. Gladstone brought up the report on this question. The committee nominated at Sheffield for the purpose of considering whether it is important that her Majesty's Inspectors of Science and Art Schools should be appointed with reference to their scientific acquirements, and whether candidates of the said establishments for inspectorships have received a considerable amount of evidence upon the subject, and beg to report as follows:—

"1. It has come to their knowledge that the teaching of the scientific specific subjects is materially discouraged by the incapacity of many of her Majesty's inspectors to examine in them. This incapacity is explained by the fact that the inspectors are not generally acquainted with the subjects which they are required to examine in, and as on account of their high attainments, on through political patronage. 2. In the opinion of the committee there might be no examinable duty for her Majesty's inspectors composed of those of the most experienced of the present Science Inspective Association, with a few members of the Council of the Association, added for the occasion. 3. The committee would be thereby upon the examinatory teachers, and the candidates ought to be tested in the practical work of examination in one of the central laboratory schools in London. 4. The committee believe that the opening of the inspectorship to the Science Association generally would tend to the improvement of many of the professions and improve the character of both inspector and teacher. 5. The committee are further of opinion that while a University degree may be accepted as a test of scholarship, it is not a test of the particular scientific knowledge required of inspectors, and is not sufficient in itself to guarantee the holder thereof a worthy the position of inspector. There appears to be no means why experienced laborers should be made an indispensable condition of appointment. 6. The committee recommend that a memorial be presented to the Lords of the Committee of Privy Council on Education, embodying the above conclusions."

In presenting the report Dr. Gladstone spoke of the necessity of the Legislature with reference to the teaching of the rudiments of science in elementary schools. The new code of this year extends the facilities for teaching science as a class subject, but still limits the choice of the teacher to two class subjects. Lord Norton obtained a majority in the House of Commons against the proposal to remove the restriction that the instruction must generally were opposed to it; but both the last and the present Educational Blue-book showed that, while some would positively discourage science teaching, many favoured object lessons and the knowledge of common things, while others would even extend the present schedule.

A long and animated discussion followed the reading of the report, and ultimately the committee was reappointed.

English Mechanic Sept. 3 1880

THE IMPURITIES IN GAS, AND THE MEANS OF ELIMINATING THEM.

It would be idle in me to occupy even the least portion of your valuable time in apologies for the introduction of a subject which must be to you, as it is to me, a matter of grave concern to all of us. We are known as gas engineers and we have to deal with a manufacture of illuminating gas, which, in its commercial distribution, is only equalled by the amount of interest which is now being largely felt by a considerable portion of the intelligent public and by consumers. May we not be permitted to approach our subject by way of the suggestion that these inquiries were likely existence in our gas to (1) the use of indifferent or ill-adapted material; (2) defective plant in the manufactory; (3) unskilful or careless management; or (4) all these causes?

I do not know that we may arrive at a proper estimate of the difficulties which would be involved in any attempt at the supply of "pure gas," even if this were desirable, we may profitably pay some little preliminary attention to the material which we use in its manufacture. And here we must be at once struck with the number and various qualities of the coals presented to our notice when a good average gas coal, however, we may be allowed to state in opposition as follows:—

Carbon	. . . 76·0	Coal gas	31·57
Hydrogen	. . . 5·2	Ammoniacal water	
Nitrogen	. . . 1·6	Tar	6·73
Sulphur	. . . 0·7	Coke	
Water	. . . 11·3		
Ash	. . . 2·2		

I believe you fervently take it, that the best gas coal is that which, while yielding the highest percentage of illuminating gas, gives best sulphur and tar.

I have a predeterm fear of overweighing you with details in a paper which is necessarily of a discursive character; but nothing is more enlightening than the numerous diversities in the qualities, and hence in the nature of the products of distillation, of these "gas coals." I append a table to which you will find examples illustrating this in a extraordinary degree.

Let us now consider the general products of distillation, and may conveniently classify them as follows:—1. Illuminating gas. 2. Tar. 3. Ammoniacal liquor. 4. Coke.

1. Illuminating gas, consisting of

a. Light - yielding constituents	Gases, e.g.	Acetylene	} Hydrocarbons
		Ethyl	
	Vapours	Benzol	
		Naphthaline	
b. Light heaters		Hydrogen.	
		Carbon dioxide.	
		Carbonic dioxide.	
c. Impurities.		Ammonia.	
		Glycerine, and its sulphates.	
		Carbon disulphide.	
		Carbon disulphide.	
		Unpolymerised hydrocarbons.	
		Nitrogen.	

2. Tar, consisting of

a. Hydrocarbons which are liquid, as	Benzol,	
	Cumol.	
	Butyl.	
" " solid, as	Naphthaline.	
	Anthracene.	
	Pyren.	
b. Acids	Carbolic.	
	Cresylic (cresol).	
	Benzic.	
	Creosote.	
c. Bases	Aniline.	
	Picoline.	
	Lyridine.	
Asphaltine compounds.	Anthracene.	
	Pyridine.	
	Carbon.	

3. Ammoniacal liquor, consisting mainly of

Ammonia carbonate.	
" sulphide.	
" chloride.	
" sulphate.	
" sulphocyanide.	

4. Coke, consisting of . . . . Carbon . . 95 . . 95
Iron salts . 11 . . 4
Ash . . . 4

This table will exhibit the variety of the by-products with which the gas engineer has to deal, and which are to be found in the paper.

The carbonaceous matter is now seen as forming over 95 per cent. of the product of distillation is partly pre-existent in the coal, and is partly formed by syntheses in the process. The ammoniacal liquor is mainly a combination of this water with the nitrogenous and other volatile compounds. The numerous hydrocarbons alike form the tar, and these, together with the water, are supposed to be essential from the gas by the condensers; for with the highly-fatty condensations or lutrepuration can possibly take place in the lighter and more valuable hydrocarbons.

The condenser is too well known to require any description. Its forms are numerous; but the principleand object of all is the lowering of the temperature of the crude gas as it passes from the hydraulic main, so that it may have deposit much of its watery matters. It is probable that too much has been made here made of the importance of this process. It is certainly not the only one in connection it must then hold effected by thorough condensation. And this is not the case, as the results are as follows:—The gas passing from the retorts has a temperature of about 60° to 80° C.; when however the fundamentals may be effected, it should never be carried beyond a temperature of 10° to 15° C. When this is the case, either by accident or design, the gas is deprived of certain variable quantities of valuable hydrocarbons, and its illuminating power suffers in the same ratio. Besides, these hydrocarbons, so deposited, are a constant source of trouble and annoyance. Not only should the temperature be maintained as low as possible, but the gas should be constantly forced through as rapidly as possible, and a liberal allowance of area in the condensers will always more most economical. The writer has recently found this area as low as 10 square feet of tube-surface allowed for 1000 cubic feet gas passing. It is believed this should never be under 20 to 100 square feet per 1000 feet of gas.

Coal naphtha is obtained by the distillation of coal tar. The tabulation has shown that the naphthaline is present in the gas. Its illuminating power of our gas, while a disappearance of the liquid hydrocarbon takes place—in fact, 0·25 grammes of naphtha used in carburetting gas has given an increase of illuminating power equal to from 18 to 20 per cent.; but free and rapid condensation removes the greater part of this vapour, and the richest gas suffers most in this way.

It is not deemed necessary that we should pause in consideration of the acids and bases of coal tar, which may be said to comprise all their ascertained purification can effect.

With the purifiers we have the first stage of chemical purification; and this purification may be dealt with under two main heads—viz., that effected by "lime," and that effected by "oxide of iron." The ordinary arrangements for purification by these reagents are familiar. The useful and extent, however, to which they do their work is probably less well known. Lime, as we all know, removes carbonic acid, sulphuretted hydrogen, and carbonic acid; and hence, while the purifiers are in efficient working order, we should have no trace of these impurities present in the gas. But this extent of purification is rarely obtained, as will be seen from the tables appended. Oxide of iron then steps in to perform a function for which the lime is not adapted; and hence arises the advantage of the two purifying materials. Oxide of iron removes the last traces of sulphuretted hydrogen, and it also removes cyanogen.

The action appears to be something like the following:—The gas having deposited much of its tar and ammoniacal waters in the condensers, scrubbers, and wells, comes into very intimate contact with the lime, when the carbonic dioxide unites with the lime, forming calcic carbonate. The sulphuretted is similar fashion becomes broken up by the affinity of the sulphur and the lime for each other, and a formation of calcium sulphide is the result. But it is found that this calcic sulphide has a strong affinity for the carbon disulphide and other sulphur compounds. The ammoniacal hydrocarbons represent all cyanic sulphide, therefore, passes on, only to be intercepted by the ferric oxide. Hose for and to what an extent this is daily effected will always depend on the state of efficiency and the attention paid to the purifiers and their action. The appended tables are very instructive in this regard.

It may be of interest here to give a tabulated analysis of spent oxide; which will further indicate the direction in which it acts, also exhibits some unusual features:—

Water	12·2
Sulphur	53·3
Aluminous and siliceous matters	9·1
Organic matters and tar	17·1
	100·0

The sulphur particulars of coal gas has an importance which cannot easily be over-estimated; and the question has been so recently investigated and reported upon by the Chemical Section of London as to require little further notice here.

It must, however, be borne in mind that although we may obtain high photometric results, we may also have gas of still very low quality; and that it frequently happens that we have a large excess of sulphur in the illuminating power. It is within the knowledge of the writer that, in consequence of the failure of the supply of a certain coal to a gas-works of considerable capacity, another coal was to be used. Gas of a satisfactory character, other things over 25 grains of sulphur per 100 cubic feet (1). If this were possible, it would not be difficult to absorb the claim of a large and influential "chairman" that he—personally—had, by sundry means, original to himself, increased the income from ammonia sulphate sales by some thousands of pounds. Is it possible that the gas had also benefited by the change? Is it possible that the consumers had benefited? Is it not more consumers likely by desire that a change which may have been from the supply of the gas by so much the purer and more wholesome? We might be pardoned if we were to suggest that a similar improvement—only to a greater extent—would be likely to accrue by a purification of the gas from 25 grains to say 12 grains, which is the result even of "ancient" management.

TABLE No. 1.—*Selected Results of Analyses of Gas Coals.*

Description.	Specific Gravity.	Coke.	Ash.	Sulphur.	Sulphur per Ton.	Ammoniacal Liquor.	Gas per Ton.	Illuminating Power.	Gas per Ton.
		Per Cent.	Per Cent.	Per Cent.	Pounds.	Per Cent.	Cubic Feet.	Candles.	Cubic Feet.
Bridgewater Canal	1·270	68·0	3·0	0·8	17·92	2·0	9,296	15	8·0
Wigan Cannel	1·270	68·0	3·0	0·8	17·92	2·0	9,296	15	8·0
Hindley	1·277	66·0	3·0	0·7	15·68	2·0	9,296	15	8·0
Hindley	1·277	66·0	3·0	0·7	15·68	2·0	9,296	15	8·0
Rowan, Lord Ashtead's	1·265	68·0	3·0	0·7	15·68	2·0	9,296	15	8·0
Rowan, Lord Ashtead's	1·265	68·0	3·0	0·7	15·68	2·0	9,296	15	8·0
Bowes Collieries

these machines may be in use, and at number three not more than two or three of them. In all cases, however, the smoothness and regularity with which the engine works is noticeable, there being no sensible diminution or acceleration of speed as the different machines are put in or out of action.

The attendance required is very slight.

The engine can be started in a minute's time, and the lubricating being done by an ingenious self-acting arrangement, no further attention is needed till the engine requires to be stopped, which is done instantly by slanting off the gas. The only other labor needed is to examine the slide valves once a week to see that the passages to the cylinder are clear, and this does not take more than from 15 to 20 minutes.

There is a water cistern in connection with the cylinder jacket, for keeping the cylinder cool, but I have found that the amount of water required after the first filling of the cistern is practically *nil*, as the temperature of the water has never risen so much as to require a stream of fresh water run in; the rest during meal hours and at night being sufficient for cooling the water down to the atmospheric temperature. Were the engine working continuously, however, as in driving an exhauster, a small stream of water would be necessary, and would have to be taken into account in estimating the expense of an engine for such a purpose.

The cost of the engine for the year from May 15, 1879, to May 15, 1880, working 37 hours per week, has been—

Gas for engine and slide lights, 19,000 c. ft., at 3s. 2d. per 1000 feet	£29	12	6
16 gallons of sperm oil for lubrication, at 2s. 6d. per gallon	2	16	0
Attendance, estimated at 1 hour per day, at 1d. per hour	5	4	0
Making total of working expenses	£38	12	6
The first cost of engine and cistern complete was £170, and the annual wear and tear may be taken at the rate of 7½ per cent., equal to	£11	18	0
Depreciation, the same	11	18	0
Making together	£23	16	0
Add to this working expenses as above	38	12	6
The total charge for year will be	£62	8	6

The amount of the working expenses would necessarily vary with the varying price of gas in different localities. What is given above was the selling price in Edinburgh and Leith last year, but of course the actual expense, where it is used in a gas works, will be not the selling, but the cost price of the gas. With regard to the percentages charged for wear and tear and depreciation, these are, I am sure, ample, looking to the well finished and substantial style in which these engines are got up, the absence of complicated working parts, and the large bearing surfaces of the parts liable to be worn out.

The amount of power derived from the above expenditure has been on the average at least two-horse power. As explained before, the use of wet coal of the machines is intermittent, but it takes about 1½-horse power to drive those that are constantly in use, and the addition of 4-horse power to the average, for those that are used occasionally (including as they do a circular saw of large size and a heavy screw-cutting lathe) is a very moderate estimate. This works out to an expenditure of about seventeen cubic feet of gas per indicated horse power per hour, which is much below what is stated to be used when the engine is worked with a full load, and seems to bear out what was stated by Mr. Carr in his paper last year, that, contrary to what might be expected at first sight, the engine works more economically when not used up to its full power.

The cost of a steam engine and boiler of three and a half nominal horse power, and equal in respect to workmanship to the Otto gas engine, would be about £210; and the usual allowances for wear and tear and for depreciation would be 10 per cent. per annum for each on an engine and boiler of this size. This, relatively to 7½ for the gas engine, is not at all excessive, as of course the boiler involves more wear and tear and depreciation.

The working expenses would be—

To fuel, at 8s. per week for 52 weeks	£20	16	0
Wages of attendant, at 12s. per week	31	4	0
Oil for lubrication (same as gas engine)	2	16	0
Water supply for boiler	2	10	0
Making total working expenses	£57	6	0
Add for wear and tear, 10 per cent. on cost	11	0	0
And depreciation, 10 per cent. on cost	11	0	0
Making total charge for year	£79	6	0

It will be borne in mind that the cost of fuel will be more or less than that given above, according to locality; but it is a fair estimate, checked by actual experience of the working of a small steam engine and boiler in our works, and in comparison with what it costs various users of similar engines in the neighborhood. The wages of an attendant I have taken at 16s. per week, and I have allowed 4s. off that, on the supposition (which in many cases, however, could not be realized) that the man could devote so much of his time to other work.

The general results, then, are as follows:

Working expenses of gas engine	£38	12	6
Working expenses of steam engine	57	6	0

And, taking wear and tear and depreciation into account, the total annual charge would be—

For gas engine	£62	8	6
For steam engine	79	6	0

The advantage is therefore largely in favor of the gas engine, and I venture to think that if I have erred at all in the comparison it is in under, not over, estimating the cost of the steam engine. I have also to point out that our engine is constantly going during working hours. There are, however, an infinite number of cases where power is needed only at intervals, and in such cases the comparison would be still more in favor of the gas engine.

In all cases where we have supplied gas for these engines the testimony of the users has been highly in their favor, and not long ago one gentleman gave me his experience as being that—"When he had a steam engine it cost him 18s. a week for wages to an attendant, and from 10s. to 12s. a week for fuel; but that now his cost was from 4s. to 5s. a week for gas, and no attendant needed."

In addition to the saving in cost, however, the gas engine has other advantages. It occupies small space; is always ready at a moment's notice; does away with the risk and danger of explosion, thereby reducing the cost of insurance to be effected in places where, with a steam engine and boiler, the companies would not undertake it. It also needs no special building, or chimney, and does not make the premises where it is used uncomfortable with heat, dust, and cinders.

One drawback it has, not as regards those who use it, but as giving trouble occasionally to gas managers, namely, that the action of the engine causes an oscillation of the lights taken from services immediately adjoining that of the engine, when the main pipe is small—say under 4 inches diameter. The supply should therefore always be taken from a large main where practicable, at any rate, where the main is less than 4 inches diameter no other service should be taken off in close proximity to that for the engine.

I had lately a correspondence with Messrs. Crossley about this, and they promised to send me a governor which is used on the Continent to prevent this oscillation, but it has not yet come to hand.

I may also note that the pressure in the main must be at least equal to that of seven-tenths of an inch of water.

That gas engines will ere long come into extensive use I think certain; not only as supplanters to some extent of steam engines, but also as affording a cheap and efficient motive power in a great number of places where the use of steam is difficult or impossible.

over

Dr. Anthony Nesbit has fed rabbits for weeks together upon food contain-
ing most of the dyes I have mentioned to-night, and, strange to say, if one
may judge from their appetite and condition, their general health was not
in to least impaired. It is true that some pigments—that is, paints, not
dyes—like cuprimol and emerald green, contain large quantities of arsenic.
Orpiment should never be used, as it gradually fades, and the deplorable
way in which Sir Joshua Reynolds's pictures have deteriorated is partly due
to the use of orpiment and carmine; this last color, although perfectly
harmless, becoming grey in the course of time.

Future of Gas Fire.—Permit me, in conclusion, to s a few words on
the Future of Coal Tar. It may confidently be said it : some of the pro-
ducts of eat tar are useless. A well-known chemist, sev al years ago, in a
work which in many respects showed great cleverness, w s unwise enough
to reproach chemists for the enormous labor which they had bestowed on
what he called so useless a substance as aniline. He, however, lived to see
it become one of the most valuable substances in existence. It is true that
the benzoline and pyridine series have not as yet been utilized ; but to doubt
that they would one day yield valuable derivatives would be to neglect all
the teachings of our glorious science. Nothing exists in vain, and the
chemists who, for the sake of pure science, study the physical and chemical
properties of new and as yet useless substances are preparing the way for
the practical men, who will one day be thankful for those pioneers who
have smoothed the road, and made the advance into new realms comparatively
lively easy. Although the benzoline series have not yet been utilized, I
found a quarter of a century ago that its isomer, toluene, by alternate treat-
ment with iodine of methyl and oxide or sulphate of silver, yielded superb
colored rosanilines, and doubtless, by suitable processes, the benzoline series
will be made to afford valuable products.

I found also that dimaline, treated with iodide of amyl, and then with
caustic alkaline, yielded the superb blue coloring matter cyanine. This
color, from its peculiar constitution, forms quite a new departure in organic
chemistry, and recent researches show it to be closely allied to our subject ;
as, from the observations of Dr. Dalla and Prescel, there seems to be little
doubt that chinoline st imes, and perhaps often, accompanies or replaces
benzoline in coal tar.

There are also many other substances which have not yet been utilized,
among which I may mention the solid hydrocarbons chrysene, retene, and
pyrene. It needs no prophetic eye to see that, with the substances already
known, there is room for a considerable development of new combinations,
and the Future of Coal Tar will be far more brilliant than the Past or the
Present.

To me gentlemen, coal tar, though "black," is "comely," and if I have
failed to impart to you some of my enthusiasm for it, the fault lies with
me, and not with the subject, which I feel is worthy of treatment by a
master-hand.

[From the "London Journal of Gas Lighting."]

Experiments on the Thermal Power of Gas Heating Apparatus.

By Mr. T. Thayne, of Cork.

Read at meeting of British Association of Gas Managers, June 8, 1880.

In a paper which I had the privilege of reading before you two years
since, your attention was called to the fact that gas cooking and heating
stoves did not, as a rule, give the full thermal effect practically available
from them. To us this is a matter of importance, as one of the points with
which we have to contend is to demonstrate the economy of gaseous fuel,
wherever circumstances will allow of its being consumed under the most
favorable conditions.

Manufacturers of gas cooking and heating apparatus are succeeding very
well in making them attractive to the eye. Both in style and finish they
render them more popular, attention must be paid to the mode of develop-
ment of the largest amount of heat from the smallest quantity of gas. What I
and it is that additional pressure be put on the stove makers, so as to ob-
able us to speak with more confidence to our consumers.

As a limited case in point, you are aware that some years ago gas burners
that is one did not give the same amount of light per foot of gas as we now
obtain. If the electric light did no other good than to arouse the burner
makers to the sense of injustice they were so long perpetrating on gas
lighting power, it has done good work. In like manner let us spur on
the stove manufacturers to that which will certainly prove to be of mutual
benefit.

In order to be able to recommend to the gas consumers of Cork the best
and most economical apparatus, I made, during last year, some experiments,
and from the results of these I think it will be seen that the apparatus in
general use are capable of such improvements as will lead to better results.

I am fully aware that the effect of any kind of fuel is much greater in
theory than in practice. I have therefore made the experiments on a
plain, practical method, such as may be applied to the doings of every-day
life.

Intimately connected with this subject is that of the thermal power of
gas of various qualities, and I commenced operations by making some tests
under this head. I noticed that the results as not quite in accordance
with some I have seen in the Journals. The apparatus with which I oper-
ated was capable of carrying 30 cwt. of coal per day. I was therefore
able to make a comparative calculation of the cost of the gas from coal of
various qualities. The coal was South coast, Newcastle coal, and coal
from South Wales. The points noted were—

The illuminating power.
The evaporating power of the gas.
The net cost of coal per 1,000 cubic feet.

Coal.	Illuminating Power.	Water Deposited.	Gas Consumed.
Newcastle.....	21.0 candles.	1 gallon.	18.50 cubic feet.
"	22.0 "	1 "	19.75 "
"	20.0 "	1 "	20.30 "
"	19.5 "	1 "	21.75 "
"	14.5 "	1 "	22.90 "
South Wales.....	19.5 "	1 "	22.50 "
South Wales and 20 per cent. caunel.....	14.0 "	1 "	28.00 "

On account of thermal theoretical efficiency of the various descriptions of gas is far greater than the results which are given above.

On the average it will be found by the experiments that 16 lbs. of water were evaporated by 1 lb. of gas. Newcastle coal gas, for example, of sp. gr. .420 has on ava.erating value equal to 2 times its weight. From the figures it will also be seen that the thermal power does not increase in the same ratio as the illuminating power, as some persons suppose. The calculations I have made of the net cost of coal per 1000 feet of gas proves that a very cheap gas of low illuminating power can be produced for heat-
ing purposes, provided we were able permanently to enrich it at the con-
sumers' meters when need for illuminating purposes was determined worthy of the attention of the inventive portion of the community.

Taking gas from Newcastle coal at 16 candles as a standard of the average gas at present supplied, and 750 as the thermal units per foot of gas, I make a series of experiments on the gas stoves from the various makers. I took the stoves as they are delivered in the usual way to purchasers.

No.		Thermal Units per Cubic Foot of Gas.
1.	Cooking stove fitted with a Bunsen burner formed by a ring of 14-inch wrought iron pipe with jet holes 1 inch apart, etc.....	244
2.	Boiling stove, consisting of single burner 9 inches diameter, made of 1-inch pipe, jets 1 inch apart.....	209
3.	Hot-plate, consisting of three rings, each 6 inches diameter, jets 1 inch apart.....	280
4.	Like the above, rings 4 inches diameter.....	310
5.	Cooker, formed of bars of 1-inch wrought iron pipe, jets 1 inch apart.....	338
6.	Cooker in the form of a double row of rings, one inside the other, 6 inches diameter.....	399
7.	Burner, same construction as above, but 4 inches diameter.....	408
8.	Solid flame burner.....	450
9.	Wallace's burner adapted for domestic purposes.....	580

To the construction of these burners does the higher return of work rises from the others. It is on the principle that jets of fluid escaping from an orifice travel on in their original direction of motion a certain distance before they disperse. In this burner the combustion is so long ere it is complete, and in doing so it communicates a sort of gaseous friction to the air. Both these move in the same direction, but with a retarded motion; thus they become mixed in a chamber, from which they escape through a wire gauze, and they burn at a point of exit in the shape of solid flame, varying in diameter according to the size of the burner. Here we have a very powerful con-
centrated heat, developing a very large percentage of the calorific efficiency of the gas.

It is important to ascertain the reason of this. You are aware that in combustion for the purpose of artificial light, we have a very interesting arrangement of matters. The combustion of oxygen with hydrogen causes powerful heat, and consequent expansion. Hence the particles or carbon are scattered freely through the heated hydrogen, and thus they remain for some time before their exit; and from their incandescent, diffused in all directions, we obtain beautiful light. But in the Bunsen burner the case is different. The oxygen is introduced in such quantities that there is not

[From the London "Journal of Gas Lighting."]

Explosive Mixtures of Coal Gas and Air.

By Mr. W. Foster, M.A., etc.

Professor of Chemistry at the Middlesex Hospital.

Numerous cases recently have been recently reported through the ignition
sive mixtures of coal gas and air have excited a considerable amount
sition, and have given rise to much unnecessary anxiety. As an ab-
proposition, the dangerous nature of a mixture of coal gas and air is
nally understood not only by those engaged in the manufacture and
ribution of gas, but by a large section of the educated public. The best
dent method of dealing with such mixtures and of preventing their for-
on is, however, a matter on which much misconception exists; and this
ly arises from an insufficient appreciation of the general properties of
ous bodies. A knowledge of the practical bearing of the laws of diffu-
of gases is not by any means so general as one could wish. The present
ebrus appears a fitting occasion for a few observations on a subject of
greatest importance to all concerned in the manufacture and use of coal

It may appear an idle statement to say that coal gas, in a confined
e, is perfectly harmless; but unfortunately one is continually meeting
persons in all grades of society who do not abuse such a simple opinion.
erefore often becomes a part of the gas manager's duty to instruct his
tomers with reference to the properties of the article which he manufac-

Coal gas, whether cannel or common, is a mixture of several gases with
apors of hydrocarbons of low boiling point. By far the greater portion
any given volume of common gas consists of hydrogen and marsh gas
CH_4), the sum total of these two component varying from 80 to 90 per cent.
the whole. In 1851, Dr. Frankland made an analysis of the common gas
plied by the Chartered Gas Company in London, and in 1876 the same
pany's common gas was analyzed by Mr. Hunyhlge. The results of
se two analysis, so far as the chief components are concerned, are given
the following table—

	1851	1876
Hydrogen.....	54.3	50.6
Marsh gas (CH_4).....	36.2	38.3
Carbonic oxide (CO).....	8.9	9.1
Other gases represented in their equiva-
lents of olefiant gas (C_2H_4).....	7.7	7.8

low each of these components when allowed to escape from a containing
ce into the external atmosphere can be ignited and consumed like any
or combustible material. The oxygen of the air is necessary to carry on
chemical action which is commenced by the application of the ignited
ch, and, in the case of the gases containing carbon, further supply is
cessary for the removal of the carbonic acid gas produced. The high
mperature required to start the combination of the gas is maintained by the
at from the total amount of heat which it may possess. The smallest
ch of brightly incandescent matter, whether solid or gaseous, is sufficient
ignite a jet of coal gas issuing in atmospheric air. An excellent illus-
ation of this phenomenon is afforded by the use of the electric spark. If
wo platinum wires be brought into the position shown in the accompanying
ure, so as to form a gap of about one-eighth of an inch between their ends,
n the hand on the conductor of an electrical machine, sparks may be
wn from his body during the time the machine is put in motion by a
ond individual. If a jet of coal gas be allowed to escape from a metallic
zzle within his reach, on his extending his other hand, and causing one
the sparks to issue from the burner from above, a spark will instantly pass
ith the burner, producing ignition of the gas. [It will be remembered that
is principle was advocated on a limited scale a few years ago when there
as a scarcity of a taper being required in the dwellings of the aristocracy
ingenious but cumbrous.]

the electric spark the particles of gas in the track of the spark are rap-
ly heated by incandescent; and although their mass must be extremely
all, yet they are capable of setting up a similar condition throughout the
ole gas jet. On the other hand, comparatively large masses of solids at
w temperatures are incapable of setting up a similar condition of things,
for instance, a coal cinder at a dull red heat, and devoid of flame, will not
e ignition of a jet of coal gas, nor will the dull red embers of a recently
tinguished deal wood match. It is clearly obvious, therefore, that heat as
ch is capable of being transferred in consequence of the phenomena of ig-
tion. The substance, whether solid or gaseous, must possess those quali-
which enable it to call into play multitudes of a certain order—those which
e particularly abundant at the more refrangible end of the spectrum pro-
uced by a source of white light.

If the composition of a sample of coal gas be given, the amount of oxygen
(and therefore of atmospheric air) required to effect its perfect combustion
is a matter of simple calculation, as the quantities of the gases afforded us by
Dr. Frankland's analysis. As every two volumes of hydrogen require one
volume of oxygen, the 51.8 volumes of hydrogen given in the sample re-
quire 25.9 of oxygen. Every two volumes of marsh gas require four volumes
of oxygen, and therefore 31.5 would require 63.0. Every two volumes of
of carbonic oxide require one of oxygen, and therefore 8.9 require 4.4.
Every two volumes of olefiant gas require six of oxygen, and therefore 7.7
require 23.1. The results of these four independent oxidations are ex-
pressed in chemical symbols, as follows :

$$2H_2 + O = 2H_2O$$
$$CH_4 + 2O = 2H_2O + CO_2$$
$$2CO + O = 2CO_2$$
$$C_2H_4 + 3O_2 = 2H_2O + 2CO_2$$

On adding together those several quantities of oxygen, we find that 100 vol-
umes of such common gas require 115.4 volumes of oxygen for their com-
plete combustion. As every five volumes of air contain one of oxygen, it
follows that the quantity of atmospheric air necessary to completely effect a
like result is 582 volumes. In other words, one volume of gas of the quality
under consideration requires nearly six volumes of air (5.8). I need hardly
say that, in practice, larger volumes of air are necessary to carry on the or-
dinary process of combustion in an efficient manner, the surplus air assist-
ing very materially in removing the products of oxidation from the points
where they are produced. When atmospheric air is mixed with coal gas in
the proportion of 21 volumes of the former to one of the latter, the mixture
can be ignited when issuing from an ordinary burner, and consumed in the
same way as the unmixed coal gas. The character of the flame, however,
differs from that produced by the pure coal gas in that it loses, in a very
marked degree, its light-giving properties. This phenomenon has given
rise to much misunderstanding, and in the result of several influences operating
somewhat differently. Their considerable is certainly one present question.
In the case of a mixture of 21 parts of air with 100 parts of coal gas, we find
that a considerable proportion of oxygen is needed for the complete
combustion of the gas. This additional quantity is derived from the exter-
nal air, as in ordinary cases. If we take 100 parts of gas and air in the
proportions needed for the complete combustion of the gas (and, in the case
of the particular quality we have already considered, we shall require 6 of
air to 1 of gas), and allow them to burn under circumstances
ind in *theoretically*, quite independent of any supply of oxygen from ex-
ternal sources. Such circumstances, for instance, that a
ntle foot of it be confined in a spherical vessel, and that a flame be applied
to a portion of the gaseous mass; rapid combustion of the mixture would
immediately follow with explosive violence. As it could not even sub-
stance the oxygen required to form the ultimate oxidation products, and as
these are gaseous, and produced at an extremely high temperature in-
stantly, they exert on the sides of the
containing vessel a very great. One speaks in general terms of such an ex-
plosion as being instantaneous. Such, however, is not absolutely the case
with the explosion of mixtures now under consideration, as they require a
certain definite time for the completion of the action which
has been commenced by the application of the lighted substance. In other
words, the flame applied to the mixture does not spread at the rate of
many thousand feet per second. The greatest velocity with
which the explosive wave can be propagated for the completion of the action
of the particular quality we have already considered, we shall require 6 of
air to 1 of gas, and therefore 7 volumes of the mixture
ind in *theoretically*, quite independent of any supply of oxygen from ex-
ternal sources. Such circumstances, for instance, that a
ntle foot of it be confined in a spherical vessel, and that a flame be applied
to a portion of the gaseous mass; rapid combustion of the mixture would
immediately follow with explosive violence. As it could not even sub-
stance the oxygen required to form the ultimate oxidation products, and as
these are gaseous, and produced at an extremely high temperature in-
stantly, they exert on the sides of the
containing vessel a very great. One speaks in general terms of such an ex-
plosion as being instantaneous. Such, however, is not absolutely the case
with the explosion of mixtures now under consideration, as they require a
certain definite time for the completion of the action which
has been commenced by the application of the lighted substance. In other
words, the flame applied to the mixture does not spread at the rate of
many thousand feet per second. The greatest velocity with
which the explosive wave can be propagated for the completion of the action
of the particular quality we have already considered, we shall require 6 of
air to 1 of gas, and therefore 7 volumes of the mixture

American Machinist Sept 11 1880

The Electrician states that the following process for utilizing old india-rubber, of which many hundred tons are thrown away as waste substances, has just been patented in Germany. The rubber waste is subjected to the distillation in an iron vessel over a free fire, with the aid of superheated steam. The lighter oils which come over first are rejected, and then the heavier products. The latter, when fildictered and rectified in the usual manner, are found to possess all the good qualities of first-class natural rubber. Sept 11 1880

Journal of Gas Lighting Communicated Article. Sept 11 1880

ON THE AMOUNT OF LIGHT YAIELDIA IN COAL TAR, AND ITS PRACTICAL ILLUMINATIVE VALUE TO THE GAS MANUFACTURER.

By Mr. H. LEICESTER GRUTELLE, F.C.S., &c., Chemist to the Commercial Gas Company.

(*Continued from* p. 325)

In my last article on this subject, a table was given showing the respective quantities of naphthalene in various samples of tar, taken from different portions of gas-works. The mean amount of light naphtha found in ordinary stock tar was, it will be remembered, 2·6 per cent. by volume. Now, if it is assumed that each ton of coal distilled yields 20 gallons of tar and 10,000 cubic feet of gas, the absolute quantity of light naphtha, which is available for transfer to the gas can be easily calculated. I have taken round numbers in expressing the respective yields of tar and gas, in order to facilitate the calculation, the numerical figures being sufficiently near the truth for the purpose in view. Now 2·6 per cent. by volume of naphtha on 10 gallons represents a bulk equal to that which would be occupied by 18,200 grains of water, which amount represents the quantity to be distilled over with each ton of coal gas. The amount of available naphtha per 100 cubic feet is therefore 182 grains measures, or 1·82 grains measure per cubic foot. The equivalent of this quantity in weight is 1·65 grains.

Having ascertained the absolute quantity of light naphtha capable of transfer from the tar to the gas, the next point to determine was the amount of increased light to be derived from the addition of the naphtha in the quantity stated. The following table shows the results obtained in some experiments in this branch of the subject:—

Number of Experiment.	1	2	3	4
Initial lighting power of gas	16·61	16·60	15·8	15·9
Naphtha added, grains per cubic foot	2·36	2·61	2·7	2·61
Lighting power of gas after addition of naphtha	17·86	19·00	17·1	17·2
Total lighting power in candles due to addition of naphtha	1·25	2·40	1·3	1·4

Mean quantity of light naphtha in grains weight required to raise the lighting power of the gas 1 candle . . 2·61
Mean quantity of grains to each cubic foot, 1·4 = 0·768

From the above figures can be calculated the equivalent lighting value of 120 grains of light naphtha as compared with spermaceti. As 2·4 grains of light naphtha were found to afford the light of 1 candle, 120 grains would be equal to 12·7 candles. The result is not widely different to the value assigned by Dr. Knublauch to pure benzole; it will be remembered that this value was 14·16 candles. I may state that the burner used in my experiments was the ordinary standard—viz., Sugg's "London" argand—and that the method I used for impregnating the gas with the light naphtha was by passing it through a small two-necked bottle containing the liquid under the burner. I at first experienced the same difficulty as Dr. Knublauch—viz., that the gas absorbed too large a quantity of light naphtha to be subsequently burned at the rate of 5 feet an hour. I therefore contrived a special apparatus for the purpose of limiting the quantity of light naphtha taken up by the gas, which may be briefly described as follows:—I procured a small bottle of blown glass, to serve as ordinary stock at the top and an outlet in the form of a tube blown

into the side of the bottle, and extending to the horizontal direction as shown in the annexed engraving. The neck of the bottle was fitted with a caoutchouc stopper, through which was passed a glass tube, the lower extremity of which was curved and drawn out so as to form a sort of nozzle. The curved part of the tube was turned in that the nozzle was brought opposite and near to the horizontal outlet. By this arrangement the gas bursting in a jet from the glass nozzle had a tendency to escape at once by the horizontal outlet, simply drawing with it a small quantity of the naphthalised atmosphere in the bottle. I found that with this apparatus I could easily limit the amount of naphtha absorbed by the gas to about 2·6 grains to the cubic foot. If it is desired to impart a larger quantity of naphtha to the gas, it is only necessary to lower the inlet-tube so that the nozzle discharges its jet of gas less in a line with the outlet-pipe; the gas then has an increased tendency to mix with the atmosphere of the bottle before flowing away, and an increased naphthalisation is the result. This apparatus worked well, and with a little care could be easily managed.

With regard to the lighting power which I have obtained from light naphtha, I think the figures may be taken as representing the *highest* obtainable illuminating value with ordinary gas consumed in the standard burner. My reason for forming this opinion is that with a liquid like naphtha, which consists of a mixture of hydrocarbons of different boiling points, those which possessed the lowest boiling points (benzole, &c.) would be the first to evaporate. It would, therefore, that any experiment in which gas was passed over by light naphtha, by the simple evaporation of that liquid at the ordinary temperature, are practically equivalent to carburetting with benzole, and do not fairly represent the lighting value which would be obtained from the bulk of the naphtha. The only method to ascertain the real lighting value of the naphtha by the direct addition of the liquid to gas in a holder, but the results varied considerably with varying quantities of naphtha, and were on the whole altogether inconsistatory. This might arise from two causes—viz., the imperfect volatilisation of the liquid in the holder, or the partial removal of naphtha during the subsequent passage of the gas to the burner, by the combined action of the friction of the gas and the contact with water in the meter. The results were invariably lower than those obtained where the naphtha was added to the gas close to the point of consumption.

Taking the lighting value which my experiments, under the most favourable conditions, may assign to the light naphtha, it was found that an addition of 1·65 grains to the cubic foot of gas produced an increase of illuminating power equal to one candle. As the available quantity of light naphtha derivable from the tar was in the proportion of 1·65 grains to each cubic foot of gas, it will be seen that this amount represents a little less than a candle of increased lighting power.

As the results which have been obtained in practice wherever the Aitken and Young process has been submitted to a fair trial differ materially from those indicated by my experiments, I think there is but one conclusion to form in order to reconcile that which at first sight appears an anomaly. The conclusion is this, that the large increase in the lighting power of the gas which is obtained by the use of the Aitken and Young process is not directly due to the retention of the light naphthas, but is due to naphthalene which is contained in the gas, being prevented from separating out in the solid crystalline form by the increased amount of naphtha vapour which is present. To account for the large increase in lighting power obtained by the use of the naphtha, I think it is not only necessary to assume that the naphthalene which would be normally present in the gas is permanently retained, but that the gas becomes charged with an increased quantity in its passage through the analyser, this increase also being retained permanently.

I am unable to state what amount of naphthalene is capable of retention in gas at ordinary temperatures by reason of the presence of a definite quantity of naphtha vapour. The experimental determination of such a question would be extremely difficult, but this much is known—viz., that naphthalene is a most valuable illuminating constituent of coal gas.

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With regard to the actual lighting value of naphthalene, I made some experiments some time back with the Albo-Carbon light, from which some information may be derived. As my state briefly that the experiments consisted in burning gas, the lighting power of which was known, from a No. 1 Bray's flatted, attached to an apparatus by which the gas became highly charged with naphthaline vapour. It was necessary to use a burner with small holes, on account of the richness of the gas. The initial lighting power of the gas with the standard burner was 16 candles, and the lighting power with the naphthalising apparatus was 24·7 candles, with a gas consumption of 5·6 feet per hour, the consumption of naphthalene being at the rate of 102·6 grains per hour. As the initial lighting value of the gas was 16 candles, 6 feet consumption, the lighting power of 96 feet would be 96 candles. This gives 14·8 candles increase for a consumption of 102·6 grains of naphthalene, or 7 grains per candle. The light value of 120 grains of naphthalene would thus be 17·1 candles. This experiment does not admit of strict comparison with those made with the light naphtha, inasmuch as the burner used in the naphthalising apparatus was not the same as that used to determine the initial value of the gas; at the same time the burner used for the naphthalised gas was, no doubt, well fitted to develop the lighting power from gas of such high illuminating value.

That the use of the Aitken and Young process tends to retain naphthaline in the gas is shown by the letter from Mr. Bell, which appeared in the JOURNAL for Sept. 8, 1870, and that gentleman also testifies to the increase of lighting power obtained by the use of the analyzer, as well as to the increase in the make of gas per ton of coal. With regard to Mr. Bell's figures, however, I quite concur in the remarks made by Mr. Paterson in the last of his series of valuable articles on "The Effects of the Contact of Tar with Coal Gas," published some time back in the JOURNAL. Mr. Paterson says that inasmuch as Mr. Bell introduced an exhauster about the same time that he adopted the Aitken and Young process, it is impossible to say what proportion of the improved results which he obtained were due to the exhauster, and what proportion to the analyzer. More definite testimony as to the effects of the analyzer on the quality and quantity of the gas obtained per ton of coal is to be found in the results of the experiments made by the West of Scotland Association of Gas Managers. Taking a mean of their experiments, the lighting power of the gas was increased by 0·27 candles, the amount of light naphtha transferred to the gas being represented by 2 per cent. on the tar. The increase in the make of gas was in one case 20 cubic feet per ton of coal. What amount of tar was produced from each ton of the coal used is not given, but if taken at 12 gallons, this amount of quantity of light naphtha transferred to the gas may be taken at 10,800 grains measure, and as the make amounted to 7,020 cubic feet, the proportion of naphtha to each cubic foot of gas was 1·64 grains. As particularly with varying quantities of tar, it is obvious that if a given quantity of light naphtha transferred to the gas may be taken at 10,800 grains measure, and as the make amounted to 7,020 cubic feet, the naphtha per cubic foot which I have shown as the available quantity, at ordinary temperatures, can be no less than 0·76 candles, a very considerable amount.

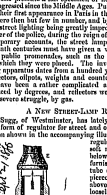
I will conclude with a few general remarks on the separation of tar from gas. If it is admitted that it is desirable to retain all the available light hydrocarbons in the gas, it seems by no means an economical plan to use such means of separating the tar, that a large proportion of light hydrocarbons are also separated at the same time, involving the subsequent treatment of the tar to effect their return to the gas. It is gradually becoming recognised that cooling is not the only agency by which tar can be separated from crude gas; but, on the contrary, cooling alone is not altogether efficient. I look upon it as quite within the bounds of possibility that by the employment of large vessels in which the reduced velocity of the gas would allow time for the heavier particles of tar to settle, and by the subsequent use of some system of straining through a series of sieves of successively fine meshes, the tar will be completely separated, at the same time that the temperature of the gas will be maintained sufficiently high to permit of the almost complete retention of light hydrocarbons. A similar process has already been recommended by Mr. Aitken, and if any mechanical system could be introduced for the separation of tar on the same lines, it would, I believe, be far more perfect than the present method, and altogether more desirable for the purpose of retaining the light hydrocarbons in the gas.

The Lighting of Paris.

The Municipal Authorities of Paris, in unison with the Gas and Lighting Companies, are, says *Builgeonis*, studying all sorts of plans for improving the illuminations of the city. Large contracts are being signed for candelabras in cast-iron and bronze, for *lustres-lampions* (as the clusters of lamps on the street refuges are euphoniously called) and all their appurtenances; and very shortly, no doubt, Paris will be, if it is not already, the best-lighted city in the world. The history of street illumination in the French metropolis presents a fair specimen of how that type of civilization has progressed since the Middle Ages. Public street lamps or lanterns made their first appearance in Paris in the sixteenth century, though they were then but few in number, and by no means perfect in themselves, street lighting being greatly improved by Messrs. Delabrigade, an officer of the police, during the reign of Louis XIV. To judge from contemporary accounts, the street lamps of the seventeenth and eighteenth centuries must have given a very picturesque appearance to the public promenades, such as the Champs-Elysées and quays, along which they were placed. The invention of *réverbères* or reflecting apparatus dates from a hundred years or so back, and with its reflectors, objects, weights and counterweights the first *réverbère* must have been a rather complicated affair. Improvements were introduced by degrees, and reflectors were only dethroned at last, after a severe struggle, by gas.

A New Street-Lamp Regulator.

Mr. Sugg, of Westminster, has lately perfected a compact and simple kind of regulator for street and other gas-lamps, of the same description shown in the accompanying illustration. The body of the regulator, A, is made in brass or steel metal. Gas entering from below enters the chamber, B, furnished at the top with a small tube open at its upper end, and pierced with a small hole just below the bell. The bell, B, is loosely into its seat, and is covered with a metal cap, C, of similar shape, with two holes in the side of it, through which gas is closed at the top. The whole is covered with a glass shade, D, from which a tube, E, leads to the burner. The exact flow of the rents of gas is shown by the screws in the governor, and the steatite bell, which is not liable to stick, is kept in place, as is weighted to the required measure, and when this is exceeded it rises, and so acts as a valve to cut off the outlet tube in the burner. The regulators are of substantial construction, and never vary their purpose minimately at any inlet pressure from 5-10ths to 6 inches, while they are much less costly



because than the diagram street-lamp governors in common use.

Railway Carriage Lighting in Germany.

From reports recently obtained from the various German railway authorities it appears that the present state of the lighting of carriages is as follows:—For lighting material, mineral oil, gas, and, to a considerable extent, even candles, are used. Of some 10,188 carriages adapted for illumination, 10,068 (or 97·6 per cent.) are lit with rape-seed oil, 253 (or 2·47 per cent.) with gas, and 2217 (or 1·6 per cent.) with candles. The gas employed has been in most cases made on some lines with the so-called Möhring oil, which is a mixture of petroleum and rape-seed oil. The gas is partly made in works belonging to the railway, from fat, partially, petroleum, gas oil, or coal tar oil, partly obtained from gas-works. The holders, in which gas can be compressed to 5½ or 6 atmospheres, are fixed under the carriages, and connected with the burners by means of tubes with pressure regulators and valves. The filling of the holders is accomplished either direct from the gas-works by means of caoutchouc tubes, or through transportable reservoirs, which can be filled with 5 or 6 cubic meters of gas pressed to 10 atmospheres, or from small vessels. A single filling of a holder suffices for 20, 30, or even 60 hours burning. The average cost given by the authorities, per frame and hour of burning, varies in the case of gas between 2 and 2·27 pfennige; in the case of oil, between 0·67 and 7·5 pfennige; and in the case of candles, between 1·8 and 6 pfennige.

ashing with gas. They may also give some practical demonstrations of smoke or anti-pollute chemistry.

In another direction the gas companies and water-trusters will form an attractive feature of the Exhibition, as they always do when on view. Some of the best will be engaged in providing for the thorough ventilation of it. Hoff Bell—a matter which is given much notice by Mr. Hermite and his fellow-members of Committee.

Amongst the less attractive but more practical matters will be the Gas Exhibits and such as is now held at Brussels, Paris, and Amsterdam, and which will be represented by Messrs. Clamond, Delmard, &c. There will be urged with all force the claims of the Exhibition to be a success. There will be some dazzling and surprising novelties in electric lighting, without doubt, and more especially that sent by Messrs. Clamon Bros. and Co., Birmingham; and Messrs. Siemens will likewise be represented in a very similar fashion to "Gazelle" of 1876, and a "Jenny" of 1880—together with "Siemens" dynamo machine, and other electrical appliances. The Exhibition is certainly going to be a popular one, and the way to do it is to go to it.

Altogether the Exhibition promises to be an exceedingly important, interesting, and deserving of success.

ON A SYSTEM OF HOT CONDENSATION.

By Mons. C. Jouaust, Engineer.

Paper read at the Meeting of the Société Technique de l'Industrie du Gaz en France, held in Paris, June 18th, 1880.

(*Translated from the Journal des Usines à Gaz.*)

Gentlemen,—Hydraulic condensation has for a long time been very properly held in a system of condensation, having for its object to increase the illuminating power of the gas. This system is, in fact, the most simple and the most generally adopted in the use. The application of this system was not built two years ago in a paper read before a meeting of gas managers in Carlsruh, and published in the *Journal des Usines à Gaz* (Vol. XXIV., p. 305). I was the more struck with the system, because, without being new, it had not, in my opinion, received the attention which it was entitled to from gas engineers. I had, in fact, the double conception of the system, and the practical application; and besides this, in view of the possible competition of the future, I felt that it was to my interest to communicate to my colleagues as soon as it was possible, the results which I had obtained in increasing the illuminating power of gas until by the best response of dividers for or balancing, and therefore I, myself, was obliged to delay to make it so complete as possible.

I will begin by defining its theory, which, it seems to me, has not always been sufficiently elucidated. It rests entirely upon the fact, that when the gas is brought into contact with the water, it takes up from it a certain quantity of vapour, which, in its turn, on leaving the water, is carried off by the gas, and which is in a condition of saturation. This vapour

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At the meeting of the American Science Association, held in Boston in the latter part of August, Professor Love, the Gas Examiner for New York City, read a paper on "The Illuminating Gas of New York City." In the course of his paper the Professor spoke of the different processes by which gas is manufactured in that place. He noticed a change the Mutual Company had made in their process of manufacture, which is of considerable interest. In my first letter (see Vol. XXXV., p. 801), I spoke of this Company's gas being manufactured from naphtha and coal; later on they added wood to the list of their raw materials. Now the wood gas is double in quantity that made from coal, and shortly the latter material will be dispensed with altogether. According to the figures given by the Professor, it appears that the Company pay 5 dols. 22c. (£1 0s. 11d.) per cord, and obtain 47,000 feet. About 80 lbs. of wood are carbonized per charge. The illuminating power of the commercial gas—that is, the mixture of coal, wood, and naphtha gas—averaged for the first six months of this year 27·53 candles, of which the specific gravity is from ·703 to ·808. For 1879, wood gas was first manufactured in September of that year, the sulphur average was 7·28 grains, and the ammonia 0·82 grain per 100 cubic feet. The percentage of carbonic oxide in the gas is 27·19, which exceeds the proportion in the Municipal gas by about 7 per cent. At the same meeting at which Professor Love's paper was read, Mr. Elliot, of Washington, presented a communication on "Electric Lighting as applied to Large Areas." This gentleman called attention to the vast amount of energy which is stored up beneath the earth's surface, and the problem of economically developing this energy. The two processes by which coal can be converted into light are by the manufacture of ordinary coal gas and by electricity. Mr. Elliot claimed that, in the case of large areas, electricity is more economical than gas. Electric lighting he divided into three kinds—the first, by the voltaic arc; the second, by incandescence; and the third, a modification of these two, known as the electric candle. The first he claimed to be the most economical, while the mode by incandescence is more adapted, as far as the electric light is adaptable, to illuminating smaller areas, such as for domestic purposes. He gives the candle power developed by the voltaic arc as ranging from 1200 to 2500 per horse power, while the figure by the incandescent mode is placed at about 170 candles.

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THE GAS APPARATUS AT THE MANCHESTER INDUSTRIAL EXHIBITION.

(FROM OUR OWN CORRESPONDENT.)

The Judges awards in the section of the Manchester Industrial Exhibition devoted to gas appliances were made known on Friday, and the prizes given consist of twelve silver and nineteen bronze medals, eight of the former and nine of the latter being awarded by the Gas Committee of the Manchester Corporation. Some of the more prominent exhibits in gas apparatus, so far as novelty is concerned, have already been noticed, but there are other exhibits also deserving of reference, and these can now be dealt with in a short sketch of some of the prize-winners.

Gas-cooking stoves, as I have already pointed out, have been the chief feature in this section. The exhibits have included all the best known as well as the most recent inventions in gas-stoves, and as no less than five silver medals have been awarded to this particular class of apparatus, this may, perhaps, be taken as an indication of the complete success with which gas is now, amongst manifold other uses, being applied to the purposes of cooking.

Amongst the gas stoves, we have already alluded to Messrs. Greene and Son's exhibit, to which has been awarded a Corporation silver medal, and Messrs. Stark and Co.'s Cox's "Saveall" gas-cooking family stove, to which has been awarded a Corporation bronze medal. Messrs. Greene and Son have also taken a Corporation silver medal for their "Thermogene," or instantaneous water heater, which is a very ingenious apparatus for supplying hot water to baths, kitchens, or for general use. The apparatus is very simple in its construction, and consists of a small copper boiler, which requires no fixing, containing inside a coil of copper piping, which in operation is brought in contact with a number of oxygenic gas-burners, and the water passing direct from the supply-pipe through the copper coil becomes heated at once, without coming in contact with the gas, and thus leaves the apparatus as pure as when it entered. A third silver medal has been awarded to Messrs. Greene and Son for a collection of Brönner's patent burners, and Messrs. Stark have also been awarded a bronze medal for M'Cormack's stocks and dies, wrench, and expanding taps for gas-fitters.

Of the other exhibits which have not yet been noticed, the most prominent are those shown by Messrs. Elliott, Alston, and Olney, of Manchester, who have taken one Corporation silver, and six Corporation bronze medals, and their stand contains perhaps the largest and most varied collection of gas-stoves in the exhibition. Messrs. Wright and Co.'s gas kitchener, for which they have been awarded the silver medal, contains several new improvements. The chief feature—and this is a principle the importance of which is now being generally recognized by gas-stove manufacturers—is that it is cased outside with a non-conducting material, which retains the heat of the stoves much better than where they are simply constructed of the ordinary iron casing, and, consequently, ensures an economical use of gas. The burners for boiling are also so arranged that toasting or grilling is effected by means of a fire-brick, in the place of the ordinary tin deflector. Bronze medals have been awarded to the following five other descriptions of gas stoves exhibited by Messrs. Elliott, Alston, and Olney; Galli and Co.'s combined gas and coal kitchen range with gas oven; Billing and Co.'s £6 and £1 16s. "Sundial" gas cooking stoves; Galli and Co.'s atmospheric gas-cooking stove; and Wright and Co.'s cottager's gas-cooking stove. The same firm have also taken a bronze medal for a high-pressure copper tubular gas boiler, specially designed for heating greenhouses, which is simply a reproduction on a small scale of the ordinary multi-tubular boiler, with the exception that the boiler, instead of being heated by a coal furnace, is heated by means of a terra-cotta gas-burner, perforated with small holes arranged on the atmospheric or Bunsen principle. The boiler is connected with the ordinary heating-pipes, and is sufficiently portable that it can be readily placed in any convenient corner, whilst the flue-pipe is also utilized for heating purposes. An improved application of gas in the place of the ordinary coal fire for dwelling-houses is also exhibited by the same firm. This is termed the asbestos gas-fire, and consists of a row of pipes with atmospheric gas-burners which can be fixed in any ordinary grate, and upon these are placed small blocks of asbestos, which on the gas being lit become red hot without consuming, and thus throw out a considerable heat with all the appearance of a coal fire.

Messrs. H. and C. Davis and Co., of London, have secured two silver and one bronze Corporation medal for gas stoves. The family gas kitchener, the chief feature in which is that it is entirely surrounded—back, front, sides, and top—with an effective non-conductor, and Bellaer's "Auckland" breakfast cooker, with kettle combined—a very handy little stove—have secured the silver medals, and their artizan cottage gas stove has been awarded the bronze medal.

Messrs. Beverley and Wylde, of Leeds, have obtained a silver medal for their "Leeds" patent gas kitchener. This stove is lined with white glazed tiles or fire-bricks, bolted on a plate of iron arranged so as to retain the heat given out by the gas burnt, whilst to prevent radiation the tiles or bricks are backed by a patent non-conductor, known as "slag-wool."

Mr. T. Marsh, of Oldham, has received a silver medal for a useful new invention which he exhibits for the first time. This is termed an "Ærorheometer," or gas-flow measure, and has been designed for testing instantly the quantity of gas passing per hour through burners, governors, &c. The instrument is intended to supersede the ordinary experimental meters, and is a small handy apparatus which can be readily applied wherever it is required. The instrument consists of a glass tube, with a glass rod, holding a perforated disc, running through the centre, and this disc is at once acted upon by the quantity of gas passing through the tube. Above the glass tube is a metal one constructed with great accuracy, and gradually widening out to the top; this contains a second disc, solid, and the higher this disc is forced up the tube the larger is the quantity of gas escaping. The instrument is only constructed to measure up to 12 feet per hour, but the results obtained were highly satisfactory, the quantity of gas passing through being indicated instantly, and there is no doubt it would be found very useful to gas managers for testing the consumption in street-lamps, &c.

Another new and useful invention to which a silver medal has been awarded is Fisher's arrangement for lighting and ventilating public and private buildings by gas, which was exhibited by Mr. James Howarth, of Manchester. This arrangement consists of a sun burner, much of the ordinary description suspended from the ceiling of the room. The outer rim of the burner is perforated with holes communicating with a zinc flue passing through the ceiling and the roof of the building. Inside this flue is a copper tube resting upon the top of the burner or reflector. This tube collects the heat from the burner, and being closed at the top, the hot air is passed out through perforations in the upper portion of the tube into the upper part of the flue, thus creating a strong upward current sufficient to ventilate the building. Several of these ventilators have already been applied with success to public buildings.

Silver medals were also awarded to the Lancashire Gas-Meter Company for their dry metallic governors (Borrodaile's patent) for street-lamps and domestic lights, which are already largly in use; to Mr. J. E. H. Andrew, of Stockport, for the well-known "Bisschop" gas-engine; and to Messrs. W. and B. Cowan, of Edinburgh, Manchester, and London, for Warner and Cowan's wet gas-meter.

Bronze medals were also awarded to the Lancashire Gas-Meter Company, for the "Falcon" gas-meter; to Messrs. J. Stott and Co., for Stott's patent self-acting gas-valve for the use of consumers; to Messrs. J. Wigglesworth and Son, for Gillingham's heat radiator; to Mr. John Busch, for Busch's well-known gas-governors; to Mr. Thomas Heron, for duplex gas-burners, globes, galleries, and coronets, complete; to the Patent Gaslight Company, for duplex gas-burners; to the Lancashire Gas-Meter Company, for the "Falcon" mercurial gas regulator; and to Mr. Thos. C. Marsh, for an equilibrium revolving governor for public lamps and chandeliers.

The Public Lighting of Sidmouth.—The *Western Times*, of Tuesday last, says in reference to this subject: "To the inhabitants of other towns the lighting of the street-lamps would appear a small matter and scarcely worthy of remark, but not so here, for when at the commencement of this week they were lit for the first time for nearly two years, the expressions of pleasure were numerous and emphatic. It will be remembered that at the commencement of last winter the Local Board determined to reject the tender of the Gas Manager, and to adopt a system of lighting by means of 'automatic' lamps, which ultimately proved not only a complete failure, but an annoyance to a large portion of our townspeople. Even when the lamps were burning properly, the light, compared to gas, was exceedingly dim; but that was not all, for generally nearly half the lights were either flickering or completely out before they had been lighted two hours. An increased demand for lanterns was the consequence, and all who did not provide themselves with these—at that time—exceedingly useful articles, were in danger of unpleasantly colliding with any obstruction that might be in the way. This was retrogradation with a vengeance, and the question was often asked, 'Do we live in the nineteenth or the fifteenth century?' and it was really difficult to realize that we were living in such a civilized and enlightened age. After enduring the darkness for some time, the inhabitants raised a protest against it, and petitioned the Local Board to remove the automatic lamps, and again light the town with gas. This petition was laughed at, and the ratepayers had to 'bide their time,' but ere long that time arrived. In March three members of the Board retired, two of whom (both having voted for the automatic lamps) sought to be re-elected. But the ratepayers had not quite forgotten the winter's darkness, and the certificate of the returning officer showed that these 'economizers' of public funds had not the sympathies of those whose suffrages they sought. Three gentlemen were therefore elected who were resolved to make the convenience and safety of the inhabitants their chief aim. The result is that a contract has been entered into with the Gas Manager to light the town for three years; the wooden lamp-posts, which by no means were ornaments to our streets, have been removed, and the lights are welcomed as a boon by the inhabitants, experience having taught them that darkness means inconvenience and danger."

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15 Cheap Gas.—Much attention has, of late been directed to some new processes for producing a cheap gas by the decomposition of water, which, in the form of steam, is brought in contact with incandescent carbon. The reports made by the scientific press state that the experiments in this direction in Sweden and Russia have been attended with good results, and various scientific authorities, some of them government officials, declare that the gas has been employed for welding wrought iron, for smelting in crucibles, both pig iron and steel—the effect being very satisfactory in respect to the heating power of the gas. For illumination, this kind of gas is claimed to possess some peculiar advantages. When used for this latter purpose, the gas is conducted through a vessel filled with cotton moistened with benzine.

Coal Trade Journal Oct-27 1880

—*The Colliery Guardian.* Coal Trade Journal Oct-27 1880

Gas and Electric Exhibition at Glasgow.

15

Great interest is felt among practical men in the exhibition. There no doubt exists in the public mind a prejudice against the employment of gas for cooking purposes, but in all probability the apprehension of accidents from explosions, if not removed, will at least be greatly modified by a visit to the exhibition. A great many different descriptions of gas stoves are exhibited, and as to the merits of these, it need only be remarked that there appears to be a general agreement that the stove patented by Dr. Adam, of Glasgow, which is publicly shown for the first time, is superior to anything of the kind in the market. This stove differs in principle from all others in the details of construction, as well as in the nature and utilization of the heating force. Its outer castings are of a metallic alloy, which practically neutralises or lowers very considerably their power of losing heat by radiation. Dr. Adam contends that from four to twelve times more heat is lost from the customary iron castings of gas-cooking stoves than can possibly escape from his, owing to this outer skin of metallic alloy. This coating is incorporated with the metal by an electro-chemical process, and differs entirely from mould-facing or gilding. Pure radiant heat of powerful force is generated by a peculiar method of burning the gas, while the hot gases are utilized, and may be applied to effect the extra heating of any of the compartments. It is also claimed for the invention that the food does not in any way become contaminated with the gaseous products which result from burned gas. In several of the gas grates asbestos is employed, the appearance of the red-hot balls giving the impression of live coals—an illusion that those who prefer an open fire for heating a room, on account of its comfortable appearance, will not object to.

Passing from this extensive department of the exhibition to that devoted to apparatus for the control of gas pressure and the improvement of burners, a large variety of competing systems are to be seen in operation. To the general public, perhaps nothing has a more personal interest than the adjustment of equitable relations between the gas producer and the gas consumer. It is not denied that the present system is far from perfect, and that improvements are necessary on the common meter, in which the water has a tendency to fall below the proper line through evaporation. In a meter shown by Messrs. W. and B. Cowan, Edinburgh, this fault seems, by a comparatively simple arrangement, to have been overcome, the meter being prevented from registering a larger quantity of gas than is actually required to supply the burner. The same firm also show a dry meter which is likely to take a good place amongst its rivals. In the same line Messrs. D. Bruce Peebles & Co., Tayworks, Edinburgh, exhibit gas governors which, in the opinion of competent authorities, are of a very superior character. The governor entirely prevents the gas flaring up and hissing, and is, consequently, a check upon needless waste. They also show an automatic governor which can be fitted into any bracket. Reference to the burners would be incomplete without a notice of Bray's and Sugg's burners—the former being, perhaps, the largest manufacturer of this article in this country. Both outside and inside the building at night may be seen Bray's patent lanterns and flat flame burners, such as have been adopted by the Birmingham Corporation and by the North British Railway in lighting the new station at Queen street, Glasgow. Sugg competes very keenly in this line with his argand burners. Turning to the purely mechanical exhibits, it may be stated that the collection of these is sufficiently varied and interesting. Mr. James Keith, gas, hydraulic, and hot water engineer, Edinburgh and Arbroath, has a very neat little hot air engine, which can be worked either by gas or coke. The air is heated in one chamber and cooled in the other, returning again to be reheated. The hot air expanding in the one cylinder forces the piston upwards, while the cold air, contracting in the other, draws it down. The arrangement of the machine is very simple; there is no risk of explosion, and it requires no technical knowledge to manage it. Mr. Keith, amongst other things, exhibits a mineral oil gas-work for lighting mansions and other buildings, in places where no regular supply of gas can be obtained in the ordinary way. It is contended that by use of this process gas can be produced at half the cost of coal gas. The apparatus has been adopted by the Commissioners of Northern Lights, to manufacture gas for driving gas engines, working fog signals, &c. In all probability the engine which will attract most attention is the "Otto Silent" of Crossley Brothers. It is 8-horse power nominal, but can be worked up to 15-horse power, and is the largest gas engine at present in use. It is employed for supplying the electricity to the electric light. The gas is mixed with a certain proportion of air in the cylinder, and after the mixture is compressed it is ignited by means of a small flame. This causes the mixed air and gas to expand, forcing the piston of the engine forward. A heavy fly wheel is used to produce a steady motion between the periods of the ignition of the gas. The same firm also exhibit a Bischop engine of small size, which is employed in supplying electricity for a process of electro-plating carried on at an adjoining stall. Another gas engine is in process of erection for driving a printing and several sewing machines. Where light power is required gas engines seem very useful, and they may be expected to come into more general use when their merits are better understood. In another department of the exhibition are a few instruments for the detection of gas in mines—a matter which is at last beginning to receive the amount of attention it deserves. Among these, is the tuning-fork instrument of Professor Forbes, of Glasgow, which is already pretty well-known. Mr. George F. Ansall is another exhibitor of a gas-leakage indicator. It seems a very convenient instrument, not much larger than an ordinary aneroid barometer, and when applied to ordinary gas the dial very readily indicates the quantity which is passing through the apparatus. The dial is marked "non-explosive" at 5 per cent., "explosive" at seven and a half, "most explosive" at ten, and at fifteen "gas burns." The hand on the dial is actuated by an apparatus which is a modification of an aneroid barometer, the action being effected through a small slab of terra-cotta, placed at the back of the mechanism, and through which porous material the mixture of air and gas passes. The only other exhibitor in this department is Mr. William Young, Belfast, who has two indicators—one for detecting gas in the holds of coal-laden vessels, and the other for use in mines. By means of an india-rubber bag, Mr. Young draws the air or gas into a tube, and when liberating it it passes through a chemical preparation. If there be gas in the air, it passes from the tube through this chemical agent in the form of smoke, the quantity of gas being measured by the height the smoke rises in the glass indicator. Of safety lamps for the use of miners there are so many that it would be unsafe to hazard a decided opinion upon their respective merits. The Mueseler lamp, authorized by the Belgian Government, seems to possess some advantages over most of the others.

Communicated Article.

IS A HIGH YIELD OF GAS PER TON OF COAL CARBONIZED AN INFALLIBLE TEST OF GOOD MANAGEMENT?

By Mr. George Livesey,
Secretary and Engineer of the South Metropolitan Gas Company.

The interesting articles by Mr. H. Leicester Greville, on the amount of light naphtha in coal tar and its illuminative value, which were recently published in the JOURNAL, invite attention to a question of some importance to gas managers and to gas companies and corporations owning gas-works. It seems to be assumed that a high make of gas per ton of coal is indisputable evidence of good working, reflecting credit on the manager, and bringing profit to the undertaking. It is, therefore, one of the usual things for the chairman at a meeting of shareholders to make a great flourish of trumpets over a make of, say, 10,000 feet of gas per ton of Newcastle coal carbonized; but he never tells his audience the cost at which this result has been attained—probably supposing, and certainly leading his hearers to suppose, that the increased yield has been obtained without any increase of cost whatever.

If the increased yield is brought about by the prevention of leakage from the retorts, or the removal of the dip, or the prevention of oscillation and the working with a steady level gauge, or by improvements in charging, or more regular heats, while all other conditions remain unchanged, the additional make per ton—provided the illuminating power be not reduced—is a clear gain. Supposing, however, that the additional make is the result of harder firing—which is usually the main element in producing an enlarged make of gas—there is not a clear gain by any means.

It is well known that when the economical maximum is attained, the cost of going beyond that point increases in a very rapid ratio until the gain, however great, is more than counterbalanced by the cost of obtaining it. This is strikingly illustrated in the speed of steamships, and the same principle must apply to gas making.

If an extra 500 feet of gas per ton of coal carbonized is obtained by higher heats, experience shows that the quantity is increased at the expense of the quality. It appears from Mr. Greville's investigations that the quantity of light naphtha found in the tar is very nearly sufficient, if entirely absorbed by the gas—to add one candle to the illuminating power, or to prevent the reduction to that extent. As this, however, does not appear to be the case, it is probable that high heats have but little effect in transferring the light naphthas from the tar to the gas. If they were transferred, a valuable consideration would be taken from the tar, thus reducing its value, and causing a loss on the tar approaching, if not quite equal to the gain on the gas. "You cannot eat your cake and have it."

Seeing that an extra 500 feet per ton is an item that stands out clearly, whilst the items on the other side are to a great extent wrapt in obscurity, and of unknown value, it is not surprising that the one should have been brought prominently forward and the others overlooked or forgotten.

It is very desirable that some attempt should be made to ascertain the economical maximum make of gas per ton, and to this end the following *pros* and *cons* ought to be suggestive, and lead to the necessary experiments that should be undertaken to clear up the doubtful points. It is quite open to any one to set his value on the various items in the annexed statement:—

Statement based on the Comparison of 9800 *Feet of* 15½-*Candle Gas against* 10,300 *Feet per Ton of Newcastle Coal in London.*

Estimated reduction of illuminating power at least half a candle, requiring 3½ per cent. of cannel, producing 30-candle gas, to make up the deficiency of light, the extra cost of the cannel and the diminished value of its coke will add from 10d. to 1s. per ton to the cost of coal, say		
Extra fuel estimated at least 10 per cent.	0s. 10d.	
Less tar produced, estimated 1 gallon	0 2	
Increased wear and tear of retorts and trouble with stopped pipes, say	0 1	
Deduct—	1s. 3d.	
An increase of 5 per cent. in the make per ton is equivalent to a saving of 5 per cent. of carbonizing labour, which, according to Mr. Field, is rather less than	2d.	
5 per cent. less of retort-houses and retorts for the same amount of work effects a saving of plant, which at 10 per cent. interest amounts to	1d.	
	0s. 3d.	
Difference	1s. 0d.	

If this is correct, it appears that the net cost of producing an extra 500 feet of crude gas is 1s., the said gas being not worth more than 6d. in the retort-house.

Can this be even approximately correct? If so, three vaunted high makes per ton, where cannel has to be used to keep up the quality, are a great mistake, and even where the reduction of quality is of no consequence, and cannel is not required, the 6d. worth of gas is not by any means obtained for nothing.

The object of the writer for many years has been to produce, with the smallest amount of cannel, gas of the required quality of 16 candles, being content with a make of 9800 feet per ton. Experiments are about to be made for the purpose of ascertaining the point at which it ceases to be economical to increase the make per ton; and it may be found better to produce only 9000 feet or so without cannel, than any larger quantity with the addition of that expensive article. The result of those experiments shall be placed at your service, and if others will give to your readers the benefit of their experience on this important question, even if it goes to prove that the writer is altogether mistaken, no one will be more pleased than he to see a satisfactory conclusion take the place of the present uncertainty.

London Oct-29-80

I.R.O.N.

GAS-METER RENTS.

A very useful discussion on the subject of gas-meter rents took place at the meeting of Midland gas engineers held last week at Birmingham. A paper was read in which the principle of charging such rents was supported, it being urged that without a charge of the kind the supply of gas would be attended with loss in the case of small consumers, considering the outlay in putting in the service. The instance of Leeds, where 10 per cent. of the consumers pay under ten shillings per annum for their gas, was cited in support of retaining meter rents. In the discussion which followed, it was objected that the arguments used were in favour of a differential rate, but not of the retention of the rents. It was recommended that the charge should be abolished, and that meters should be looked upon simply part of the stock-in-trade of a gas company, just as services and mains and other appliances. Gas managers from various towns took part in the discussion, and the general opinion was strongly in favour of the abolition of meter rents.

Gas Light

Is a High Yield Economical?

We call especial attention to the following article from no distinguished a source as the pen of Mr. George Livesey. The point made is a very important one, as well as a very important one; and we would urge our gas makers to comply at once with Mr. Livesey's request to make an exhaustive set of experiments on this subject and to publish the same. We shall gladly give the largest amount of space to the result of such workings, and trust that the American gas makers may be able and willing to throw some light upon the subject.

[Communicated Article to the London *Journal of Gas Lighting.*]

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Nov. 2, 1880. American Gas Light Journal

[Official Report.]

Eighth Annual Meeting of the American Gas Light Association.

Held at Chicago, Ill., October 13, 14, and 15, 1880.

Morning Session—Oct. 13.

The meeting was called to order at 11 A.M., the President, Mr. W. H. Price, in the Chair.

THE ROLL.

During the meeting the following members were present:

Honorary Member.

G. Warren Dresser, C.E., New York City.

Active Members.

Allen, A. L., Poughkeepsie, N. Y.
Allyn, H. A., Cambridge, Mass.
Battin, Isaac, Albany, N. Y.
Brown, T. R., Philadelphia, Pa.
Butterworth, T., Rockford, Ill.
Bongner, G., Phila., Pa.
Cartwright, W., Oswego, N. Y.
Cabot, G. B., Lawrence, Mass.
Cogswell, H. F., Fitchburg, Mass.
Collins, C., Chicago, Ill.
Clark, Jr., E. W., Phila., Pa.
Dill, M. N., Terre Haute, Ind.
Dwight, G., Springfield, Mass.
Frost, W. H., Plymouth, Mass.
Fuller, H. M., Greenville, Mich.
Gardner, Wm., Pittsburgh, Pa.
Gerould, H. T., Cairo, Ill.
Hickenlooper, A., Cincinnati, O.
Hookey, G. S., Lowell, Mass.
Howard, L. J., St. Louis, Mo.
King, E. J., Jacksonville, Ill.
Loilton, Jr., Brooklyn, N. Y.
Miller, W. H., Cincinnati, O.
Morrifield, P. S., Troy, N. Y.
McDonald, Wm., Albany, N. Y.
Neal, G. B., Charlestown, Mass.
Page, G. S., New York, N. Y.
Pearson, W. H., Toronto, Ont.
Patten, J. C., Rockville, Conn.
Pratt, J. C., Jamaica Plain, Mass.
Reynor, C. H., Adrian, Mich.
Rogers, G. H., Boston, Mass.
Rollins, J. H., Worcester, Mass.
Rice, E. S., Logansport, Ind.
Scott, I. R., Watertown, Mass.
Slatyr, A. B., Providence, R. I.
Summerville, J., Indianapolis, Ind.
Spencer, L., Bordentown, N. J.
Wilde, W. H., Brooklyn, N. Y.
Wood, J. C., Syracuse, N. Y.
Wrenn, G., Manchester, Eng.
H. M. Fuller, Green
E. W. Clark, Jr., Ph
G. Wyner, Philadel
C. Bongner, Philadel
A. Weber, New York

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THE PRE

Gentlemen of the American Ga
in welcoming you to this our fourth annual, I
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Odlorne, F. H., Boston, Mass.
Parrill, W., Bloomington, Ill.
Price, W. H., Cleveland, Ohio.
Pridmit, S., Nashville, Tenn.
Richardson, G., Wilmington, Del.
Hutchison, A. W., N. Adams, Mass.
Root, F. M., Connersville, Ind.
Rumsell, O. G., Vincennes, Ind.
Spear, J. Q. A., Dorchester, Mass.
Starr, J. M., Richmond, Ind.
Smith, M., Wilkesbarre, Pa.
Turner, T., Charleston, S. C.
Watkins, E. T., Chicago, Ill.
Wood, Gideon, New Bedford, Mass.
Weber, A., New York, N. Y.

The President—The first thing in ord

(To be continued.)

GAS LIGHT JOURNAL

Publishing Office No. 42 Pine Street

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

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Collections are similarly made directly from this office, for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

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Death of Samuel P. Parham.—Samuel P. Parham, late Chief Engineer of the Mutual gas company, and formerly Engineer of the Metropolitan gas company, died suddenly of paralysis at his residence in Philadelphia, on Nov. 20th, in the fifty-sixth year of his age.

THE MAXIM ELECTRIC LAMP.

During the past month the attention of the public, and more particularly of inventors, has been called to the Maxim Light, as exhibited by the United States Electric Light Company in the Hale Dayrolk Vaults under the Equitable Building. The good taste and good sense displayed in this exhibition are worthy of commendation. The rooms are elegant in all their appointments, being evidently arranged under the highest advantages of the decorative scenic, being evidently arranged under the highest advantages of the decorative scenic, being evidently arranged under the highest advantages of the decorative scenic

WATER-GAS AS A SUBSTITUTE FOR GAS-COAL GAS.*

Translated for the Engineering and Mining Journal by Dr. Henry Wurts, from the Journal fur Gas-Beleuchtung.

Herr von Quaglio, of Wiesbaden, made a communication, as follows, upon Water-Gas as a Substitute for Gas-Coal Gas:

GENTLEMEN: I feel specially honored that it has fallen to my lot to present to so distinguished a body this exposition of a subject which now occupies the attention of all technologists.

How high a value attaches in America to the verdict of German experts, I may render by quoting the following passage from a letter of one of the most prominent technical chemists of the new world, Dr. Gideon E. Moore, written on hearing that Mr. Dwight and myself had the intention of clearing a path for the restoration of water-gas, even in Germany, by the introduction of the Strong and Pierce processes.

"Nowhere else in the world can you hope to obtain a fairer or more enlightened judgement as to their intrinsic merits, and when submitted to the test of impartial scientific investigation, there can be no diversity of opinion as to result. I consider, as I have said before, that the water-gas manufacture is the most important new thing that has been in the motive of [illegible] for [illegible] and I feel both in respect to engineering and mechanical detail and chemical ethos, your processes will especially the Strong process will unitedly in advance of any that have been subjects tried or suggested."

Since, so to close [illegible] last century, I consider, as a result of his investigations by the combustion of water, obtained the foundation of modern [illegible] as a [illegible] of water and leads to its chemical accomplishment, and [illegible] technically useful, both the constituents of water and leads to its chemical technically useful, both the constituents hydrogen, and the sole supporter of combustion, oxygen. For the sake of brevity, I may be allowed to assume, in accordance with the results up of experts, that all the modern investigations and discoveries up to this time are familiar to you, especially those relating to directly utilized journal presents comprehensive digests thereof, and to anxious few find up to the progress of the age.

Thus I can immediately pass on to my subject. One definition of what is up to day I mean the best process known for the decomposition of water, the "Strong process." This process like nearly all related processes, rests also on the reciprocal decomposition of steam and coal, and the products are the same [illegible] a mixture of hydrogen, carbonic acid, and carbureted hydrogen gases, with carbonic acid, nitrogen, oxygen, with accidental sulphur-compounds, ammonia, and tar-vapor as impurities; such residual being now called by technologists generally "wassergas" (in England and America "water-gas"), a designation which is now adopted by Von Karsmann, Bischoff von Wagner, Hoffman, and others.

But before I enter especially upon a description of the Strong apparatus and its regulations, I must, for clearness, premise with some purely theoretical considerations.

Against the different statements of the results of Strong's process has been brought the objection, especially on the part of pure theorists, that we claim to have obtained from the coal, after its transformation, in a gas, more calories (heat-units) than the coal consumed contains altogether, and that this is a matter of impossibility.

From no substance, however transformed, can we evolve more power (energy) than resides in it, and moreover, we must bring into the account the unavoidable losses during such transformation.

THE PHARE GAS-BURNER.

THE visitor in Paris, standing with his back to the New Opera, has an opportunity of comparing the different systems of lighting three converging streets. In front is the Avenue de l'Opéra, illuminated by the electric light on the Jablochkoff system. To the right, the Rue de la Paix may be taken as the representative of ordinary gas-lighting; but the standards are placed nearer together than in London, and have each three lanterns. To the left is the Rue du Quatre Septembre, illuminated by the Compagnie Parisienne du Gaz, on the Phare system, a new method, intended to demonstrate the power of gas to hold its own against the electric light, and which was briefly noticed in the March last. The Paris municipal authorities determined the cost of lighting a square metre of pavement by the Jablochkoff system, and invited the Compagnie Parisienne—who have the monopoly of supplying gas to the French metropolis—to produce the same effect at the same cost. The Company, accordingly, placed ordinary lamp standards, raised 24 feet on cast-iron bases, about 40 feet apart, and supplied them with their new combination of six burners, consuming together 1400 litres (49·5 cubic feet) per hour, and giving an illuminating power of 140 standard candles. The six burners separately, consuming the same quantity of gas, would only give an illuminating power of 66 candles; and the difference is due to the increased temperature and the superior combustion, caused by the flames impinging on one another and by the currents of air directed by the glasses of the new lamp.

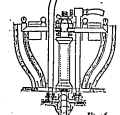

Fig. 1.

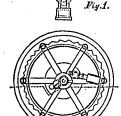

Fig. 2.

In the annexed engravings, fig. 1 shows a vertical section, and fig. 2 a plan of the Phare Gas-Burner. Six burners are arranged equidistantly in a circle of about 6 inches diameter, so that the impingement upon one another of the flames causes additional and perpendicular flames between each, the whole forming a perfect and very steady *corona* of light. Annular currents of air are directed, one inside and the other outside the flame, by the two glasses, the lower one corrugated as shown. Other currents of air, passing both inside and outside the two glasses, serve to reduce the temperature, and prevent the glasses from breaking. Altogether, it is calculated that between one and one cubic feet of air pass through the lamp in an hour. The small horizontal burner, protected by a shield, shows to the right in the engraving, is the *veilleuse*, which always remains lighted, for igniting the jets from the other burners when the gas is turned on to them, so that there is no necessity for opening the lanters. The burner on the left, rising above the others, is for use alone after midnight, when less light is required. The cock is so arranged that, on its being turned in one direction, the gas passes into the single burner, and not into the others, and on its being turned in the other direction, the gas passes into the six other burners, and not into the single one, whilst in the middle position gas only passes to the *veilleuse*. A chronometer is supplied below the cock for equalising the flow of gas.

The lamps, each giving a light of 140 standard candles, are claimed to be superior in illuminating power to the Jablochkoff standards in the Avenue de l'Opéra, which are estimated as equal to only 121 candles each; but a fairer comparison is by area of surface illuminated. The engineers of the gas company put the cost of lighting each square metre of the Rue du Quatre Septembre for six hours at 1·8 centime, while the electric light for the same time and area costs 3 centimes. It is but fair to add that gas is charged to the municipality for public illumination at only 15 c. per cubic metre (35 cubic feet), whereas private consumers pay 30 centimes. This burner has also been adopted by the Brussels Municipality in the Place Royale and outside the Colonies St. Hubert.

THE "ALEXANDRA" MULTITUBULAR GAS BOILER.

FIG. 1.

FIG. 2.

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Death from Gas.

The Board of Coroners was yesterday notified that Sofia Ingenito, twenty-one years old, had been suffocated by inhaling gas, which had escaped from an open burner in her room at the Annex House, No. 76 Spring street.—*N. Y. Herald*, Nov. 1st.

Another case of suffocation from gas has come to light, the victim being a young man named Thomas Jackson, son of a farmer of that name residing on the Dundas road. He came to Toronto quite recently, and engaged with Mr. Wm. Boyd, carriage agent, corner of Mill and Cherry streets. On Monday night he retired to bed in the best of health, and yesterday morning he was found dead by Mr. Boyd who went to call him. He had turned on the gas light, but had not turned off the gas properly, and when his room door was opened the place was full of it. Dr. Riddell was notified of the occurrence, but he saw no occasion for holding an inquest. It appears that Mrs. Boyd spoke to young Jackson previous to his retiring about the way in which he should turn off the gas.—Toronto *Globe*, Nov. 3d.

Bertha Weiss, a servant in the employ of Mr. Isaac Deutsch, at No. 223 Henry street, was suffocated yesterday by inhaling gas from a burner in her bedroom. The girl arrived in this city a few days ago on the steamer Wieland from Germany. She was taught by her mistress how to turn off the gas, but it is supposed that she made a mistake.—*N. Y. Herald*, Nov. 6th.

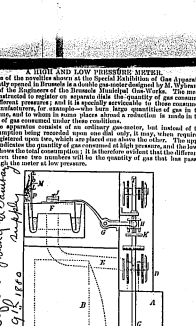
Scranton, Pa., November 6th.—At an early hour this morning Charles Mulrooney, aged twenty-four, residing in Hyde Park, was found in an unconscious condition in a room at the Scranton House, on Lackawanna avenue, instead of turning it off.—*Evening Telegram*, Nov. 8th.

In the broad silk department of W. H. Cogeett & Co.'s silk factory, Nepperhan avenue, Yonkers, on Friday morning, by the escaping gas, about 15 of the employees of that room were prostrated.—Yonkers *Gazette*, Oct. 10.

A HIGH AND LOW PRESSURE METER.

One of the novelties shown at the Special Exhibition of Gas Apparatus recently opened in Brussels is a double gas-meter designed by M. Wybrouw, one of the Engineers of the Brussels Municipal Gas-Works. This meter is constructed to register on separate dials the quantity of gas consumed at different pressures; and it is specially serviceable to those consumers —manufacturers, for example—who have large quantities of gas in the course of their operations, and to whom even a reduction is made in the price of gas consumed under these conditions.

The apparatus consists of an ordinary gas-meter, but instead of the consumption being recorded upon one dial only, it may, when required, be registered upon two, which are placed one above the other. The upper dial indicates the quantity of gas consumed at high pressure, and the lower one shows the total consumption; it is therefore evident that the difference between the two readings represents what will be the quantity of gas that has passed through the meter at low pressure.



The working parts of the apparatus are arranged in a very simple way, as shown by the above diagram. The valve-box, A, is of the ordinary kind. The drum, B, is revolving, communicates a rotatory motion to a vertical shaft, C, which, by means of ordinary meter, sets in motion the hands of the lower dial, D—that indicating the total consumption. A small pipe, E, passes from the upper part of the meter to the regulator, which consists of F, placed at the back part of the meter, and upon the interior of which is suspended the drum. This reservoir is sealed by the vessel which dips into it, and is covered with a leather or India-rubber lid, that falls or rises according as the pressure of the gas is low or high. This lid is attached to a lever, G, which, by the movement of which, it is fixed alone to the centre of the dial box. The extremity of the lever on the other side of the fulcrum ends in a fork, that rests upon the valve-rod, H, which governs the supply of gas at high pressure. The upper vertical rod, I, which constantly corresponds with the lower one, and actuates the dial indicating the consumption of gas at high pressure.

Supposing the gas to be at the usual day pressure, some small weights, J, placed upon the regulator-lid, will cause it to descend a very few inches; consequently, the fork-extremity of the lever being raised, the connection between the two rods is broken, and the valve closed by the action. When the night pressure is passed, and the low pressure of the compensating piece, H, descends, and a small horizontal rod, K, fixed upon the lower vertical rod, is checked by the tooth of the revolving piece, and the two pieces both dials are brought into action.

The apparatus is very ingenious, but has been assumed that the pressure of the gas is high during the evening and low in the daytime; whereas the reverse is sometimes the case. It would be necessary to modify that given in the daytime. The compling arrangement works uninterruptedly, whether on evening or morning, whatever may be the variations in the pressure. The apparatus is constructed to act with a certain fixed day upon it a small weight, L, suppose the rectangular vessel carries water, it does not rest in the notch, M, from the night pressure is on, the lid, N, is pressure down, the notch, M, rises the small weight, L, and the water flows into the vessel, and the lever descends, a second notch, P, which is smaller than the other, causes the panel to fall again into its former position.

The Recent Gas Explosion

On my return after the vacation the experiments on the explosion of gases in tubes were continued.

A tube was constructed by winding narrow strips of paper helically round a glass tube about 8 mm. in diameter; two inches of the width of the paper being glued, it was so wound as to make a tube of about three-quarters of an inch bore. The tube was 1,500 mm. long, and contained 208 joints. At the end—that nearest the gas—a cork stopper, 2 mm. in diameter were fixed, one being perforated to allow the wires in order to indicate the velocity of the flame at the two ends of the tube was 1,260 mm.

The tube was filled with a mixture of 2 volumes of oxygen, to the end of the glass tube—the fine wires also plugged with wet cotton wool, the other tube being closed with an India rubber cap; a spark was then passed. At a distance of 630 mm. from the open end, at which the ignition took place, the outer covering of the tube was split; at a distance of 1,000 mm. from the same point was a hole, at 30-30-300 another split, and at 1365-1100 a third hole. The explosion in each case was blown off the end of the tube. At the split holes the interior coating of the tube was torn and pushed outwards towards the opening, showing that the reflected wave allowed the escape of gas from both directions. Measuring the distances between the holes and the ends of the tube, we have the following numbers:—From end to first split, 630 mm.; from split to first hole, 1250; from first hole to mean of second and third, 1200; from this point to end of tube, 1260.

There seemed to be some doubt as to the uniformity of this tube, so another was made by rolling a strip of paper helically along a glass tube in such a manner that the edges did not overlap. A glued strip was wound over this so as to cover the joint; and a third to cover the joint of the second, the edges not overlapping and yet touching one another throughout. The process was very tedious, and the result showed, not successful. This tube was 975 mm. in diameter, and the glass only 4 %, the total length being 8390 mm. The end of the tube farthest from the wires was firmly closed, after introducing the explosive mixture. When the gas was exploded in the tube 9 holes were made, in some places the tube giving way at joints, but without any great tear of the paper. Starting from the end of the tube the first hole was at 620 mm., the other holes being distant from one another 630, 630, 600, 475, 375, 320, 280, 255, 220, 265, 2115, 365, 85, and the other end 265 from the last hole.

A third tube was next constructed, but on a different principle. A sheet of glazed paper was wound round a brass tube and all once removed; in this way a tube about 275 mm. long and 13 wide, and consisting of about 3 layers of paper was obtained. Thirty-two of these were made, and so as to by gluing narrow strips of paper round the joints. The tube was wound with double strips of paper instead of single, and was 9000 mm. long. The experiment was made in other ways, and it was not found that any additional quantity of water had entered the tube from the gas-holder while introducing the gas. In this case the explosion made no holes, but the joints obviously considerably strengthened the tube in their neighborhood. The distances between the holes were not more regular than in the previous case. From the end to first hole 772 mm.; the other holes being distant 660, 1295, 146, 484, 230, 295, 308, 1325, 585, to end 2615. The end was not spared by the explosion.

Although these experiments have not exhibited the regularity I anticipated, they show that a tube burst by an explosive mixture need not be expected to span along its whole length.

Cooper's Hill, October 25. HERBERT McLEOD

THE USE OF OZONE OR IRON IN GAS PURIFICATION.—Mr. J. Hall, of St. Andrews, N.B., sends us some interesting figures—which have been forwarded to him by Mr. Thomas Hyde, Engineer to the Metropolitan Works of the South Australian Gas Company—showing the advantage gained by using oxide of iron in conjunction with lime for gas purification, in preference to the latter only. These show the following results:—

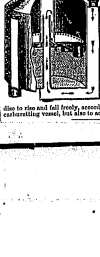
Lime used from May 1, 1877, to Aug. 31, 1878		1,056,000 bushels.
Do. May 1, 1878, to Aug. 31, 1880		1,056 "
Saving effected		77,000 bushels.
Number of purifiers charged during the year 1877-78		1,104
Do. do. do. 1878-79		1,104
Saving effected		Nil
Gas made during the year 1877-78		193,600,000 cubic feet.
Do. second period 1878-79		172,925,000 "
Increase in second period		17,675,000 cubic feet.
Gas purified per bushel of lime during first period, with-out oxide		1,452 cubic feet.
Do. during second period, with oxide of iron		1,452 "
Less gas purified in second period, with oxide of iron		Nil.
Lime per bushel required to purify gas made during first period		0·726 bushels.
Do. do. second period		0·726 "
Actual quantity used		19,231 bushels.
Do. do. do.		4,230 "
Total lime saved		14,831 bushels.
14,831 bushels of lime, at 1Sl.		£311 7 6
Less oxide of iron, ... £276 5 5		
Freight, &c., ... 35 12 5		
		311 13 0
		£394 11 6
Filling 42 purifiers, at £1 6s. 8d., ...		52 16 8
Total saving		£341 19 2
Average quantity of gas purified per bushel of lime (with oxide of iron)		31,351 cubic feet.
Average quantity of gas purified per bushel of lime for 2d period		41,370 "
Note.—The oxide had been in use for 18 months up to Aug. 31, 1880, and had purified 1,163,300,000 cubic feet of gas.		

At Elstree a committee of three of the Board of Supervisors has been appointed to examine into the merits of a "gas saving apparatus" exhibited to the Board. 'There is one way to save gas, and that is not to burn it.' Gas is a luxury—clean, bright, pleasant. Kerosene is cheap, but it explodes, it is troublesome and it smells. Those who use gas, and use it lavishly, must expect to pay for it. No saving apparatus can save, where you want bright light and plenty of it.

THE "IHILIOD" CARBURETTING APPARATUS.

The Universal Carburetting Company, of No. 31, Threadneil Road, E., have introduced a new apparatus for carburetting coal gas, which they style the "Ihiliod"—the invention of Mr. Reuben Trotman, of Yeovil. The patent for the apparatus (No. 3211 of the present year) was taken out on the 18th of July, and the specification states that the invention is for "improvements in Apparatus for Saturating Atmospheric Air or Gases used for Heating or Illuminating Purposes with Liquid Hydrocarbon."

The apparatus—which, by preference, is circular in shape—consists of an



outer and inner chamber, the latter being so constructed as to intercept the gas from the meter or other source of supply. As shown, the gas enters by a pipe, at the bottom, and passes through a perforated diaphragm, which causes it to be thoroughly mixed with the saturating vapour before actually reaching the bottom of the inner chamber. Attached to the bottom of this inner chamber is a cup which the gas enters before it rises to the top; and therefore passes out at the side. This discharge is supported by a float, which rises and falls with the surface of the liquid hydrocarbon in the outer chamber, and which, by means of a valve, regulates the flow of gas from the inverted chamber. The gas, although thoroughly saturated with the vapour of the oil, is not under pressure, and therefore passes out at the top of the apparatus without the aid of any mechanical contrivance. The oil, by the evaporation of the gas, is reduced in volume, and after performing the saturation. At the commencement of the day the inner chamber is reduced a gauge of suitable depth, to prevent the passage of the gas altogether, but as the oil is consumed it gradually rises to the level of the lipsbecause in the outer chamber, and when this is reached the gas passes out freely, according

Gas and Electricity.

GAS ANALYSIS.

Illuminating Power of Gas in New York City.

Week ending	Consolidated Gas Co.	Metropolitan Gas Co.	Mutual Gas Co.	Municipal Gas Co.	Harlem Gas Co.
Dec. 31, 1880.	22.07	19.09	22.98	24.46	23.64	18.80
Jan. 8, 1881.	21.44	19.88	24.01	23.98	24.69	19.69

15 — E. G. LOVE, Ph.D., *Gas Examiner.*

GAS PURIFICATION IN NEW YORK CITY.

The matter of purification is one of general interest to all gas men, and the question often arises how can it be accomplished most effectually and economically. The effectual purification should always be first considered; but in judging from results many give the economical part of the operation more prominence. In many cases, however, a poor gas purification is due more to ignorance as to setting at requirements, value of material, etc., than to any intentional slighting of this part of the manufacture. In this country the thoroughness of purification is left, in the majority of cases, to the engineer of the works, with little or no interference on the part of an official inspector. In England, however, the engineer is fully aware that the gas he sends out will be examined by those appointed in the interests of the public and hence there is added to this check to any carelessness on his part. Gas, like every other article of manufacture should be made to suit the circumstances will permit. Carbonic acid and sulphuretted hydrogen should never be allowed to exist in the gas, if it is possible to remove them. The former injures both manufacturer and consumer, and the second the consumer more than the manufacturer. And this matter has a financial bearing in view of the more extended application of electricity as an illuminating agent.

In England the use of oxide of iron in purification has become very extensive, especially in thickly populated districts, on account of the offensive odors arising from the lime. The lime that is used is for the removal of the carbonic acid, the resulting carbonate being quite inoffensive, while the oxide of iron is depended upon to remove the sulphuretted hydrogen and part of the other sulphur compounds. The spent oxide is often sold at a price sufficient to cover the cost of new oxide. In this country lime is used to a greater extent than the oxide and it must be said that in many cases which have come under our notice where oxide was used the results were far from satisfactory. Practically, the oxide of iron when properly used will remove all the sulphuretted hydrogen, but it has little or no action on the bisulphide of carbon and carbonic acid. Not all oxides of iron are effectual in purification, nor is it possible to say just which oxides will accomplish the purpose, and which will not. It is generally the hydrated sesquioxide which is employed, but sometimes anhydrous oxides will do the work where the hydrated oxides have failed, and none can be relied upon without some practical trial to determine their efficiency. Natural oxides are principally used in England, and of these the Irish oxide seems to furnish the best results. In this country it is more generally the custom to prepare a mixture of a natural oxide with sawdust and some porous material as charcoal or sawdust. Of the New York companies the only one using oxide exclusively is the Harlem. "They employ some such mixture as that already mentioned, and it must be said the results are not entirely satisfactory." The gas frequently shows the presence of sulphuretted hydrogen and carbonic acid. There is no reason why the former should not always be taken out if the oxide employed is suited to the purpose and is made to do its full duty. Sometimes the gas will give an immediate indication of sulphuretted hydrogen, while at other times it shows itself but slightly after a long exposure of the test paper. As to the total sulphur in the gas of this company, it has reached as a maximum 58.57 grains in 100 cubic feet, and 40.24 grains as a minimum, the average for the past three years being 48.10 grains.

We naturally look for more sulphur in the oxide purification on account of the non-removal of the bisulphide of carbon, and doubtless the sulphur in the present case is largely due to this cause. Nor is it surprising that some carbonic acid exists in the gas, if, as we understand, no lime is used to remove it. One per cent. of carbonic acid will diminish the illuminating power 10 cent. seven per cent, and it is a poor policy to add enrichers to counteract the effect of this impurity.

The Manhattan Co. use lime entirely, and the gas is free from sulphuretted hydrogen and carbonic acid. The bisulphide of carbon which forms the larger part of the sulphur compounds present, is best removed by the sulphide of calcium, but it is a matter of some difficulty to maintain the conditions calculated to effect this. The largest amount of total sulphur obtained within the last three years was 72.72 grains per cubic feet, and the lowest 12.8 grains, the average being 20.66 grains.

Ammonia is present in greater or less quantities, the highest being 8.68 grains, and the lowest 2.42 grains, the average, 5.23. The scrubbers remove all the free ammonia, but are not equally effective with the ammonia compounds, which coming in contact with the lime of the purifiers are broken up, the free ammonia passing into the commercial gas.

The water gas as manufactured by the New York and Municipal companies, is free from ammonia and sulphuretted hydrogen, and the nature of the process will insure a tolerable freedom from sulphur compounds. The Municipal company use lime for purifying, and the gas is free from carbonic acid. The New York Company have not adequate purifying capacity, and at present the gas contains carbonic acid. The effect of this may often be roughly traced from day to day, in the varying illuminating power and gravity of the gas. It is no unusual thing for the specific gravity to increase and the illuminating power to decrease at the same time, a condition which can readily be explained on this ground if on no other.

The average total sulphur in the Municipal gas is 3.65 grains per 100 cubic feet, while in the New York gas it is 7.09 grains. When the New York Company was making gas from coal and purifying by oxide of iron the average total sulphur was 27.09 grains.

The Metropolitan Company purify by lime and the gas is free from carbonic acid and sulphuretted hydrogen, but sulphur compounds, other than sulphuretted hydrogen, are present, the average for the past three years being 19.31 grains per one cubic foot of gas. The largest quantity found was 23.89 grains, and the smallest 11.72 grains. The purification of the bisulphide of carbon is an interesting, inasmuch as both lime and oxide of iron are employed and the gas contains both sulphuretted hydrogen and carbonic acid. To understand the case it is necessary to say that the mixture of the coal and wood gas which forms the body of the commercial gas is purified before carbonating, and not afterwards, as with the water gas. With regard to the carbonic acid it is either not entirely removed in the "fixing" of the naphtha vapor in the hot retorts, from some slight admixture of air. In such a case, however, we should not usually expect the lower oxide of carbon, and on the whole it seems probable that the carbonic acid produced in the manufacture of wood gas is not entirely removed.

The sulphuretted hydrogen is found in considerable quantity, at times sufficient to blacken a paper test of moderate exposure. The presence of this impurity may be due not to imperfect purification, but to its subsequent formation by the decomposition of bisulphide of carbon. It is well known that if a mixture of hydrogen and vapor of bisulphide of carbon be passed through hot lime the latter is broken up, the carbon being deposited, and part or all of the sulphur combining with the hydrogen to form sulphuretted hydrogen. This same result is effected by passing the gaseous mixture through a hot retort, as in the process of "fixing" the naphtha vapor, so that in the present case if some bisulphide of carbon still exists in the commercial gas, sulphuretted hydrogen could appear in the commercial gas. It is obvious, that by purifying the gas with oxide of iron only could be avoided, and it may be expected that this impurity will disappear when the improvements of the company make the gas entirely from wood, is carried out. The use of wood in part in the manufacture of the gas has reduced the average total sulphur from 9.15 grains to 5.18 grains per one cubic feet.

"The gas stoves at the stations of the Sixth avenue Elevated Railroad, have been replaced by coal stoves, and in the words of the *Herald*, like faith: evidence of things hoped for and the substance of best not fait."

THE SANITARY ENGINEER.

paratus was placed therein, and since that time has maintained a sufficient moisture, and a temperature of 140°, without a variation of over 2 to 3 degrees. The air is conducted to the burners in the heaters by a flue from the outside, the products of combustion being carried out of the room. A large evaporating pan is placed over the heater, and directions maintained by a considerable quantity of pipe brought into contact with the products of combustion. This water is maintained at a uniform level from the outside by a suitable arrangement designed for the purpose.

Tobacco men tell me that heretofore they have had considerable trouble in maintaining the temperature to within 20 to 30 degrees of what they desired. The object is to color the leaf. Before being placed in the sweating room it is quite light and yellow; after submitting the leaf to this process it comes out a rich brown color, and looks equal to the best Havana leaf. By this means Connecticut and Pennsylvania tobacco is made to rival Havana in appearance. Gas has been called to the aid of the tobacco men, and it has proved a success.

Mr. Littlehales—Have you any idea of the relative cost as compared with the cost of coal that would have been necessary to have accomplished the same result?

Mr. Goodwin—The amount of gas used by the first parties was about 15 feet per hour, until the temperature desired was reached, after which the gas was lowered to probably 8 or 10 feet per hour. In the large room, two burners, of 15 feet each, were placed in the heater, making a total of 30 feet per hour. After the desired temperature was reached, one of the burners was dispensed with, the other being sufficient when lowered to from 10 to 12 feet per hour.

Mr. Littlehales—Was the room specially constructed for the purpose of heating by gas?

Mr. Goodwin—Yes, sir; I told the parties that if they would construct the room in the way I suggested I would undertake the job. I have had the least difficulty in getting the heat up to 150°, which is all they require, and maintaining it at that point constantly.

Mr. Littlehales—I move that a vote of thanks be tendered Mr. Goodwin for the valuable information he has given us. (Carried.)

The President—Our papers have all been read and discussed, and we are about through with our business, with the exception of Mr. Page's address this evening upon the subject of coal tar and its products. But before he begins his address, I believe we have an hour to remain in session for members who died last year. Many of those men were distinguished in their profession, and I suppose some of the members present will desire to say something in reference to them.

Mr. Wood—It has occurred to me that it would be more satisfactory to appoint a suitable committee for the purpose of preparing, on behalf of the Association, a proper expression of our respect for the memories of these deceased members. The report of the committee can be published in our regular proceedings.

Gen. Hickenlooper—In the case of similar proceedings in a society with which I am connected, it has been the custom for a member of years for the president and secretary to constitute a committee to take the course suggested by Mr. Wood. They compile a biographical sketch of the lives of the deceased members, their character and services, and present it at the next meeting.

The Secretary—The very object I had in view in proposing that remarks be made by the members was to avoid the stereotyped, bald and unfeeling business of resolutions. A committee is appointed, and resolutions are prepared which are the merest platitudes. I think we ought to spread upon the record, and transmit to the families of the deceased members, a spontaneous and heartfelt expression of our respect for their memories and regret at their loss. For my own part I would rather have one such tribute paid to my memory from one who knew and loved me than volumes of resolutions. There is another view of the matter that I should like to have passed upon, and that is that when notice of the death of a member reaches the Secretary, he should be empowered to send a brief circular to each member of the Association stating the fact that such a member has departed this life. As it is now, twelve months must elapse before, as an Association, we know that a member has passed away.

Gen. Hickenlooper—The object suggested by the Secretary is accomplished by the course I have suggested. In that way we avoid all this wholesale flattery, and simply make a short biographical statement of the character and services of the deceased members, expressing, at the same time, in fitting language, our appreciation of their character and services. This is preserved in an imperishable form, and can be transmitted to the family and friends of the deceased.

The President—Do you make that motion?

Mr. Wood—I accept the suggestion of General Hickenlooper that a committee, consisting of the President and Secretary, be requested to prepare brief biographies of those deceased members, and agree them to be published in the forthcoming volume, and also that the Secretary notify the Association of the death of members when they occur. (Carried.)

On motion, the Association then adjourned until eight p.m.

EVENING SESSION—OCTOBER 14TH.

The Association met at eight p.m., pursuant to adjournment.

The President introduced Mr. Geo. Shepard Page, of New York, who delivered the following address upon

SECOND PRODUCTS.

Mr. President, Ladies and Gentlemen:

It is needless for me to premise what I have to say by assuring you that I appreciate the honor of standing before you on this occasion. The engineer of the Marquette Gas Light Company sent a small specimen of a substance he had extracted from coal tar, supposing it to be anilline oil. The Association referred it to me to determine what it was. I think he has been, in a small way, distilling his coal tar in order to obtain the light products, and the oil to use again in enriching his gas; (Laughter.) It is evidently the light oil of the coal tar, containing, perhaps, some ammoniacal liquor. Anilline oil is a very different substance. This would be worth, perhaps, ten cents per gallon; but anilline oil, used in making the best aniline dyes, such, for example, as are used in those beautiful fabrics before you, is worth about five dollars per gallon. I think, however, that this engineer located in the wilderness, as we may say, deserves great credit for investigating one of his residual products. I am sure that one beginning thus will steadily advance in the acquisition of knowledge concerning his coal tar products.

I understand, in the announcement was made this afternoon that I would talk to you this evening simply upon the subject of coal tar, its products and their uses. But in the invitation extended to me I was also requested to explain the value of that other residual product—ammoniacal liquor. In this connection, permit me to exhibit to you on the blackboard a drawing of the most complete apparatus for the manufacture of sulphate of ammonia. After you have examined this drawing, I will show you some of the results of this process, and will exhibit to you various ammoniacal products that are found in the market. Most of these products you have seen; I presume most gas engineers have seen ammoniacal liquor. (Laughter). Here is a specimen. Perhaps the ladies would like to test the odor. (Laughter). This was taken from the last gas house we visited yesterday. I have not tested it; but I should judge it to be what is termed "three ounce liquor." It is not beneficial to the manufacturer of sulphate of ammonia to use ammoniacal liquor of much less than eight or ten ounce strength, which is being obtained in some of our large cities by what is termed the "Mann system," or the "Tower scrubber." I presume most of you have seen it; and it is, therefore, needless for me to describe it in detail. The tower is usually filled with coke, boards or lath, scrap tin, various appliances being used to divide the current of gas passing from the lower section to the water passing down. The objection all undoubtedly find to that system is that a portion of the gas passes up the channels generally constructed without coming in contact with the water, so that the ammonia is not all taken from the gas. I presume you will all agree with me that it should be all taken out in order to get the highest illuminating power. The scrubber that is now extensively used in Europe, introduced about three years ago, is what is termed the "standard scrubber." It is a horizontal apparatus of iron, from six to nine feet in height, and four or five to six feet in diameter. A shaft runs through the centre dividing it into sections of from five to ten or eleven each. On the shaft are arms carrying discs of sheet iron—forty of these on each one. Discs are bolted on all over these discs. This shaft revolves four or five times per minute. The gas passes in one way and the water passes in at the opposite end. The water is drawn off at the other end, and the result is unmanufactured liquor of from ten to thirteen ounces. All the free ammonia is taken from the gas, and a large percentage of sulphuretted hydrogen and carbonic acid. Its cost is much less than the tower scrubber. Small works can introduce this one to advantage. I think the question of producing as much ammoniacal liquor as possible will speedily become an important one as companies so that of receipts for coal tar; and my object in bringing this apparatus to your attention is to do what I can in hastening the time when the largest amount of profit is derived from the sale of ammoniacal liquor.

Let me tell you what is done on the other side. About ten years ago I visited Dublin, and I found all the ammoniacal liquor utilized and converted into sulphate of ammonia; and, upon further investigation, I discovered that there was not a single gas company but what utilized that product in one way or another.

The process of manufacturing sulphate of ammonia, which is the chief method of utilizing the ammoniacal liquor, you will see represented on the blackboard, and I can refer readily and more intelligently to it by reading a description of the drawing.

Referring to pipes for securing salty matters, etc., placed in a suitable position above the level of the condenser. B, closed tank containing condensing

Miscellaneous News.

A REVIEW OF THE MANUFACTURING OPERATIONS OF THE PARIS GAS COMPANY IN 1879 AND 1880.

The following is the report of the Commission nominated by the French Minister of the Interior, early in the present year, on "The Gas Supply of Paris," which appeared in the last number of the JOURNAL:—

In the present report the Commission proposes following, step by step, the processes employed by the Paris Gas Company, from the reception into the Company's illuminating gas from the delivery of the manufactured gas through the distributing pipes, down to the consumption of the gas delivered gas through the distributing mains, down to the consumption of the gas delivered. In doing so, it will be convenient to divide the subject into three stages, viz.: (1) the distillation of the coal; (2) the purification of the raw products; (3) the chemical purification and the gasometers of the tar-producers; (3) the chemical purification of the gas; (4) its storage; and (5) the treatment of the residual products—coke, tar, and ammoniacal liquor.

I. *Distillation of the Coal.*

Of the several operations comprised in the manufacture of gas, the distillation of the coal is assuredly the most important, as it is upon the quantity obtained by distillation that the principal return depends. This work the Paris Gas Company have succeeded in making more profitable than it formerly was, and the improvements they have effected from time to time have had an important influence on the quantity of gas obtained from the coal put into the retorts. In order to appreciate correctly the extent of this influence, the Commission applied to the Managing Director of the Company for information from the official returns showing the quantity of gas produced during the last 21 years from each hundredweight of coal carbonized, and the following figures were supplied:—

Year.	Gas Made. Per 100 kilos. Cub. Metres.	Per Ton of Coal. Cub. Feet.
1863	29·05 = 10,088	
1864	29·31 = 10,178	
1865	29·34 = 10,187	
1866	29·53 = 10,421	
1867	29·67 = 10,195	
1868	29·83 = 10,177	
1869	29·77 = 10,546	
1870	29·10 = 9,233	
1871	29·03 = 10,253	
1872	29·13 = 10,293	
1873	29·23 = 10,331	
1874	29·20 = 10,556	

These figures show that the yield of gas, which before the year 1863 rarely exceeded 27 or 28 cubic mètres per 100 kilos. of coal (about 9,500 to 9,900 cubic feet per ton) has gradually increased to 29·20 cubic mètres (about 10,300 cubic feet per ton). This shows an increased yield of very nearly 2 cubic mètres, or about 7 per cent., per 100 kilos. of coal carbonized. This result is one of important fact; but it should be remarked, on the one hand, that it was not obtained all at once, but by successive stages (see table below); on the other hand, that it is simply a maximum result, and not to the introduction of any processes foreign to the system of manufacture employed in 1863, that this increased yield of gas is to be attributed. In fact, several causes have combined to bring about this result. The retorts have been manufactured with greater care; their form and dimensions, combined chimneys, working regularly and at trifling expense, have been studied with more attention; the quality of the coal employed has been carefully selected; more especially soft coal, obtained from Belgium, the north of France, and elsewhere, have been used together, and from this admixture of new material has resulted a more regular and more abundant production of gas than that hitherto yielded by single varieties of coal, or even by mixtures formed less carefully made. However, the influence of these causes has really been only a secondary one; it is in the distillation itself that the chief improvements have been effected. On the one hand, the retorts have been charged with more coal than formerly, and on the other hand, the working has been brought up to this temperature, that must be sought after and attained—the increased yield of gas is which allusion has just been made.

When, some 15 or 18 years ago, gas makers began to substitute, for the comparatively low temperatures previously employed in distillation, the high temperatures at present in use, they found that the quantity of gas obtained from a given weight of coal had to be increased to draw off as quickly as possible the gas produced at this high temperature, and in order to do so the method adopted was to charge the retorts, only two-thirds actually required for the expansion of the coke. It was thus that the Company were gradually led to increase the charges of each retort, which formerly rarely exceeded 60 kilos. (132 lbs.), to 70 kilos. (172 lbs.) in 1863, 80 kilos. (176 lbs.) in 1865, 90 kilos. (198 lbs.) in 1867, 100 kilos. (220 lbs.) in 1868, 120 kilos. (264 lbs.) in 1869, and to the present statement figures at which it now stands—viz., 130 kilos., 286 lbs. It is in this way that the Company have succeeded in obtaining their high yield of gas, which since 1870 have risen to 29·23 cubic mètres per 100 kilos. of coal carbonized (about 10,425 cubic feet per ton), and have only fluctuated to a very slight degree above or below this figure, such fluctuations being in all cases attributable to the quality of the coal employed in the retorts.

In some of the foregoing statements it is possible to recognize processes foreign to the system of manufacture previously employed by the Company. It is simply to some skilful manipulation, and not to the employment of any arrangements answering to the definition of new processes, that is to be attributed the increased yield of gas which the Commission found had been obtained. But even if this were otherwise, the Commission, in the interests of economy, would not recommend the adoption of the Company's concession has been understood to entitle her. But, on the one hand, the economy of combustible which the use of the Siemens furnaces in glass-making, metallurgy, and similar operations, makes possible of realization, is very considerably reduced in the face of the lower temperature suitable for the manufacture of gas, and is moreover largely counterbalanced by the increased expense of first establishment necessitated by their employment; on the other hand, it was at a period considerably anterior to 1855—namely, in 1850—that furnaces constructed at their Vaugirard station, the first four Siemens furnaces set up in France were put in operation. In fact, the results are clearly established in a report presented to the Council of Hygiene of Paris on the 20th of January, 1857, by the present Managing Director, M. Graviss. As another copy of this report has been submitted to the Commission, and it shows that the economy in fuel realized by the employment of these furnaces amounted to 30 per cent., as compared with the distillation of gas in fire-clay retorts, which for all other details of the manufacture were identical with the Siemens furnaces. The saving thus effected was the equivalent to 1,950 fr. (£78) per furnace per annum, while the cost of setting, which for all other settings blows with the Siemens furnaces is increased by 1,950 fr. (£78)

ENGINEERING AND MINING JOURNAL.

JAN. 8, 1881.

...closed as desired by Captain ...

...Railway Company has a sub... to absorb $1,500,000 to be paid ...ernment to commence the ... after a large land grant. In case ...of this railway its obligations to ...ernment are to cease and deter... question would arise as to the ... the duration of the grant is to ... termination of which, we are ... the possession of the line and ... of the road. Captain ... agents, are now in the ... of the Mexican govern... ...ination during its existence ... fee for right to export, free of ... were supplied to Captain ... article of any kind for the use ... are to be bought, free of duty, during ... of the grant, all materials, coal ... any kind required for the con... and operation of the road.

...public favors, however, of this ... it is that which gives to Captain ... hypothecate the revenues of the ... government which he may se... ...ney or guarantee is to be con... to such government, in ... default on the part of the ... such government, the right ... through the courts of Mexico ... been appointed to insure the fulfil... of the revenue in accordance with the ... as agreed upon. No hypothe... can be placed next to the mortg... of the lands, however, can be made ... government without invalidating ...

...s to secure the co-operation of en... is illustrated by the Mexican pre... to the United States the privilege ... with Bucareli in all of the meanings ... of the works, as this is required by ... to Mexico as the American route ... con, and the one in which those two ... are vitally and directly interested. ...on Panama, which is distant 1,500 ...steamships, and 500 in Mexico. Our ...cross rents. Shipstone New York ...are about 1,100 miles from the ... of Tehuantepec instead of by Pana... ...ce is a saving, through the Gulf of ...through the Caribbean Sea, ... of the Mississippi to California ...e is 2,300 miles less than by Pan...

...which Captain Eads is allowed to ...only about three times as great as those ...ed to the Panama Canal by the ...ter. This is the reason for two reasons ...ed 125 miles less in length, as against ...ed Panama; and second, the great ...ifference in favor of Tehuantepec ...ach higher rates of toll. ...ssed Captain Eads, even assuming ...tonnage will be only one-third as ...ntemplated by the Paris convention, ...ges, three such ports as will con... sufficient private capital to con... ...ruct. A canal at Panama, as the ...es that have been made for ...e than double the cost of the ...

...of Mexico expressing a doubt of it, nor have ...heard any doubt expressed by any one in the country. The people seem to accept the survey which has extended the engineering works of Captain Eads as an ample guarantee of his ability to carry out what he proposes, and, while his recognition has been devoid of any theatrical display, the manner in which he has been received and treated by the Mexican government and people has been a source of the liveliest gratification to American residents in Mexico. At his request a costly expedition, comprising about fifty individuals—engineers, assistants, laborers and soldiers—was sent him in making a survey of the isthmus to determine the most practical route for the ship-railway. He has been prepared by the Mexican government and has started for the scene. This commission is under the direction of the eminent civil engineer, Francisco De Garay, who is in charge of the drainage of the Valley of Mexico, and who was commissioned to represent the Mexican government at the Paris Canal Convention. He is directed by the government to assist the engineers of Captain Eads in the instrumental survey of such routes as he may designate. Messrs. Williams and Corthell will direct the survey starting the absence of Captain Eads, who has started with the expedition to the Isthmus to inspect the rivers and harbors, and give the party such instructions regarding the work as he may deem necessary. As an additional evidence of the respect of the government for Captain Eads, he has ordered one of its war vessels, the Independencia, to take him from the Isthmus to the port of New Orleans on his way to Washington.

THE PANAMA CANAL.

(Boston Advertiser (Rep.), Jan. 7.)

There can be no doubt that the financial owners of the Panama Canal, so far as known, are no longer satisfactory than the political elements in which they belong to it. M. de Lesseps has spent all the money he could put into $80,000,000. For this he will undertake to say that a canal is completed the shares holders will get 1 per cent. in annual interest. Some such arrangement is possible at first, but where the unhappy Khedive furnished more laborers and more cash than accessible accounts report. It was possible with the Pacific Railroad which was largely guaranteed by the credit of the United States, and still owns a whole kingdom of fertile lands. The men who bought the shares and bonds of the road received an equivalent, very much as a man who takes a national bank bill receives substantial value. The owners of Panama stock, so far as human eyes can see, receive only the promise of value or possible value—prospective value. There is neither Egypt nor America to fall back on in case of a deficiency. Where, then, is the interest to come from until the canal will be earning money? If it be supposed that the canal is complete in ten years and the $80,000,000 will build it, is it not evident that $30,000,000 have to be paid out in interest alone before the canal will earn anything? Even if the $80,000,000 were signed and paid in, what would be left for building purposes after the annual interest on the shares, and the incidental expenses have been paid? M. de Lesseps surely owes the world some explanation of this remarkable financiering.

...the Gas Trust, paying them $125,000 of six per ...cent. bonds, and $48,000 of five per cent. bonds, ...the stockholders also having the net profits from ...the gas works to that time. The management of ...the works was continued the same as before, however, to protect the bonds thus outstanding. How profitable the manufacture of gas has since proved is shown by the fact that down to Jan. 1, 1879, the sums created for the purpose of developing the gas works have amounted to $6,120,740. Of this amount there was outstanding:

Jan. 1, 1879	$6,300,740.00
Sinking funds	1,555,908.72
Leaving the net outstanding loans Jan. 1, 1879,	$4,744,831.28
for which the city owns bills, at	

...he Trustees, Jan. 1, 1879, estimated the value ...of the works, gross mains, services, meters, ...etc., at cost, at $11,172,380.58
...There has been realized on account as a sinking ...fund for the redemption of loans: 3,256,740.55
...$10,561,139.11
...Sum which deducts the total amount of loans ...and stocks 8,120,740.00
...Leaving the amount paid out of the profits $8,440,300.11
...and interest upon investments 3,120,740.00
...Showing the net value of the works to the city.

With this showing, it is not to be wondered at that the citizens of Philadelphia are clamoring for cheaper gas, and claiming that the exorbitant prices of the past have enabled the Trustees to not only pay the interest upon the capital engaged in manufacturing gas, but to create that capital itself.

The citizens are now agitating the question of taking the workcast of the hands of the present Trustees, but are met by the claims upon the part of the Trustees that no change can be made until the last of their loans expire, which is in 1885, although at the present time there is in hands of the Trust more than double the amount of the loans of 1885.

IMPROVED GAS BURNER.

The accompanying engraving represents a new form of gas burner invented by Dr. Steinberger. It is claimed that it is very economical in burning coal gas, giving a brilliant illuminating power, and is especially adapted to secure perfect combustion, thereby preventing the deposition of lampblack and carbonic acid gas, which vitiates the atmosphere very rapidly. The burner shown in the engraving is so arranged as to increase the formation of poisonous gases, and thus, in time, poisons by smoke and gas, the atmosphere of the room. *Scientific American*, of 50 per cent. according to the second by an increase of illuminating power, and a decrease of consuming the same.

In this burner, which has been named the "force gas burner," the gas, side jets are directed to a point at the center of the flame, thereby throwing heated gas upon the flame. By this means the gas is greatly increased in volume and expanded, and an additional supply of oxygen is conveyed to the flame. The formation of carbonic acid is thus prevented, and the gas being superheated—are reduced to a state to give out the greatest amount of light. This more perfect combustion also checks the production of carbonic acids.

Gas, like steam, admits of expansion by heat to almost any limit. The more the particles are heated and separated, the more perfect combustion is secured, and a larger proportion of light is produced. In the burner in use, a sufficient expansion is given through it to carry the burner to within about two inches of the flame. This is the "force burner" by a novel check, which is very simple and effective. No complicated valves or any kind of apparatus, which are liable to become smutty and fill up, are used.

The inventor gives the following photometric test, made in May last, at Ills. pressure:—A common burner, placed upon the table, gave an average of 22 candles light, light emitted equal to six star candles. The "force burner," with the same amount of gas, light emitted equal to 112 candles. The burners are made by Mr. J. C. G. Pellington, 27, Park-place, New York.

A "NEW GAS" BURNER.

A "new gas" has been introduced for lighting the large engineering and boiler-making works of Messrs. Dunoon, Hawsley, and Co., Glasgow. Col. A. P. Chamberlain, who invented, and the Company manufacture, the thus named gas. In this, Perm's formula, about 95 grains and 5 grains of benzoline are mixed with a small admixture of alcohol. The alcohol is a gaseous nature, about 70 cubic feet of which are required to take three weeks, and through which air is passed, a combination of mineral oil, water, and air, which enter through a small pipe, carried down to the tank to the front of the burner, and the gas finds an exit through a fine slit at the back of the retort. The vapour is carried to the premises, where Messrs. Dunoon, Hawsley, and Co. are on the roof behind the funnel. There it is carried into the gas-holder, and thence through the old pipes in the works to the various machines and benches in the shop, supplying about 1,000 burners. The gas gives a whiter and purer light than that of coal-gas, or something between that of coal-gas and the electric light.

That investors in gas-shares are not alarmed by the progress of the electric light was shown last week, when some additional stock of the South Metropolitan Gas Company was put up and "bids" of wood, cut straight, lapped and ...ed together in the strongest manner, ...ollect very little dirt, are cross-cutted to ...the better with saws, thus forming a ...durable vehicle which may be left out in the ...weather with little harm. Experience and all ...of the gases, dogs, and coal-drivers of the ...roads are readily cleansed by any one of these ...three pails of water I have in use. ...Here is economy of time and trouble in the ...struction of a vehicle made specially for its ...filling purpose in use as long as it lasts, which ...should be longer than the average of light carts, ...even though used for station, market, and trade ...purposes; for the simple reason that decay, the ...prime cause of wear and freshness, is not con... ...cerned between wheels and the ...ground, and the soundness and ...through the centre of the ...ed wheels, which ...being "washed-out," ...heavy "split-cushioned" ...

MR. C. F. Ansell, an Englishman, the inventor of the Breadalbane indicator, has recently applied the principle of that apparatus to the production of a handy little instrument for the detection of gas leaks. The action of Mr. Ansell's breadamp indicator is founded on the fact that different gases have different rates of diffusion through a porous body, the velocities of diffusion being inversely as the square roots of the respective densities of the gases. In the gas leak indicator in question, a small quantity of ...s follows:—A small chamber is provided, having its back formed by a disk of terra cotta, this chamber being described with a small stop-cock, by which communication is established in communication with the outer air. Ill, when this stop-cock inclosed, an indicator be taken into a room where a gas-leakage exists, the gas, in virtue of the above-named law of diffusion, enters the chamber through the terra cotta disk more rapidly than the inclosed air escapes, and the pressure in the chamber is consequently raised. This increase of pressure is indicated to move a fluid in a dial at the front of the instrument, such pressure corresponding to a certain percentage of gas in the atmosphere in which the instrument is set. The dial is graduated, which is done by placing the instrument over, supplied to show what percentage of gas is not explosive. The instrument is extremely sensitive and prompt in its action, and has developed itself as a very useful purpose. The instrument is being introduced by Messrs. J. Macpherson & Co., of the Coal Exchange, London, Eng.

portion of final charges that each thousand feet has to bear; and there is no question but that a lower price, judiciously established, will increase the amount of business, and, consequently, the amount of profits.

That good sixteen candle gas is the best and most economical for both the maker and the consumer cannot be doubted. It can be more perfectly consumed, with less trouble, and more light and better diffusive power can be obtained from it, in proportion to the quantity used, than from a 22 candle gas, simply from the fact that larger flames can be secured without smoking.

The true policy would be to sell the gas as low as possible, and pay ten per cent. on a reasonable capital, and be sure that the gas was uniformly a good, honest sixteen candle gas.

RESIDUAL PRODUCTS.

In our last issue we gave in full the lecture of Mr. Geo. Shepard Page, before the American Gas Light Association at Chicago, upon the subject of the value of residuals. The facts there stated certainly ought to be enough to arouse the managers of works to the importance of looking into this matter in a most thorough and practical manner.

We are aware that aggregates of small amounts sometimes show very largely, and that much labor, expense, and some disappointing experiments have to be endured before the totals given by Mr. Page could be realized in this country; but as long as the possibility exists efforts should not be spared to discover a practical way of obtaining at least a large portion of the benefits that may be derived from the working up more perfectly the by-products of the gas industry.

As in this issue we give two papers read before societies in England and Scotland upon this same subject, with the discussions thereon, which contain many valuable statements as to results actually obtained by numbers of smaller works, as well as an account of the different processes used, those facts are valuable contributions to the literature of the subject, and show, in every case, a clear profit to the Companies. As the price of gas is constantly expected to decline, the reduction in receipts for gas must be made up by increased revenue from residual products.

Paw Paw's Legend

And Paw-kon-wis told them stories—
Stories that were not all fiction;
Told them of his own half-brother,
Gas O Meter*—the great liar,
He whose name would scare the boldest,
He who reads the strong men humble:
He who could deceive the wisest,
He whom ways were past all knowledge
He the most consummate villain,
He the everlasting lyre;
For he sang in every wigwam,
And his voice was low and soothing,
And he lulled all their suspicions—
Then he came down like a wind storm,
Changing them unheard of prices—
Prices that were simply monsous,
Charged them ten times what he should have—
Charged for time he had been singing;
Till at last they had him muzzled—
Brazished with his tongues of fire
To the land of Hocus-Pocus,
"To the land of the Hereafter."

IRA JOYCE.

* The irregularity of the verse is caused by introducing gas into the meter.—*Norristown Herald.*

Lights and Lighting.

The importance of good light, to enable work to be done after dark, is very great, and during the long evenings and when the hours of night encroach upon those of the working day, shops where orders are pressing feel the importances of some method of practical illumination. The first result of poor light is that the work is imperfectly done. The workman is not able to judge of the quality of what he is doing, and so the character of the product falls off, even though he may do his best. The quantity of work produced is also diminished, owing in part to the difficulty of seeing, and in part to the discomforts which are always entailed by an attempt to do anything by an imperfect light. There is always a wear of eyesight, too, which, though it may not be noticed at the moment, contributes to the exertions of the labor. A good light is a necessity in almost every manufacturing operation that can be carried on upon a large or small scale. In many lines indeed, as important is this that the length of the working day in winter is always determined by the hours of daylight, and always ends before artificial light is needed.

In the great cities and most of our manufacturing towns there are at least three methods of artificial illumination which are available for work on a large scale. First in order of intensity is the electric light; second, gas; and last, oil, the latter, with the burners now available, having least power. The electric light, when it can be employed even under ordinary conditions, is very cheap, its cost being practically nominal. When an establishment has power available at night, the amount needed to drive the electric machine is so small that no ordinary establishment would ever miss the quantity needed for the largest light. With the present price for coal, a horse power can hardly be estimated to cost in a large engine more than a cent per hour, and all the other expenses will not more than double that figure. The consumption of carbons is not large, and with an outside estimate for power the total cost of a light of 1000 candle power for six hours would not be more than 40 to 50 cents. To this, if we calculate interest on the plant, we should perhaps add 15 or 16 cents, making a total of about 65 cents for six hours.

The electric light appears to be applicable in all places where power is used and where an abundant and intense light is needed. There are drawbacks, however, to its use, and these are somewhat serious. The light given is not a pure white; it has a strong tinge of red and blue, and is notably wanting in the yellow. This makes the blues and reds, as well as all shades of green, unnaturally brilliant, while the yellows are exceedingly dull. This causes the peculiarly ghastly appearance which is so characteristic of the electric light. Another fault is that the source of light is practically a single point; hence the shadows are as sharp as though the boundaries were marked with a knife. This prevents the possibility of soft shades, and makes every shadow of the deepest black. The tendency of this is to cause all objects to appear flat, even when they are round. Until these objections are removed the utility of the electric light will have well-defined limitations.

Wherever there are gas works an illumination, in some respects greater than that possible from the electric light, may be obtained by the use of large burners, and at a much less cost than is usually deemed possible. Professor Hasy, of London, 700 candle power can be obtained at a cost of about 25 cents per hour, or $1.50 for the six hours. This, it is true, is somewhat greater than that of the electric light, but no power is needed and no supervision required. At the office of the American agents of these burners we have seen much better results than these, but we have taken figures which are entirely within the results obtainable in practice. Gas has the advantage of throwing a diffused light, which is very valuable. The light, although not as white as that produced by the electric lamp, inclines to the yellow instead of toward the blue, and hence is not only more agreeable to the eye, but of more value to the workman.

In many of our country towns the only means for lighting is oil. Unfortunately, no large burners are in the market which are applicable to ordinary 48 candle power. The cost of running these burners for, say, six hours would amount to the expenditure of perhaps a pint of oil. These are much better than a number of small burners consuming the same quantity, and, so far as we know, are the best that can be had in the country. By them my shop may be well lighted, and work carried on with almost the same ease as with gas. The main object is to get light enough.

In all cases a concentration of the sources of light, rather than a dispersion of them, is needed, except in the case of the electric light, when, for the sake of dispersing the dark shadows, it is sometimes necessary to divide the light and use two instead of one. A great loss of light, however, takes place when this is done, either with the electric, gas or oil lights. With oil and gas the burners should be kept as few in number and as close together as possible. One large burner is always better than two small ones, both on account of getting more from the same amount of oil or gas, and because one flame of double power or two flames close together are more effective than two similar flames separated by a considerable distance. The reason for this we cannot here discuss, but it is easily demonstrated.

Whatever light is used, let it be remembered that an abundance pays, not only in the amount of work and its quality, but in a thousand other ways. In the large cities, for example, an abundant light is made to pay for itself in enlarged sales, simply as an advertisement, and for this purpose alone it is also quite valuable in the country.

How much more attractive is the store or shop that is well lighted than the one that is dark and dingy. The subject is well worth the careful attention of our readers from a business point of view alone, independent of the care of the eyesight.

Oils are everywhere so cheap at the present time, and gas, in most places, is so reasonable in cost, that liberality in the matter of lighting cannot be regarded as extravagance by any one. On the contrary, it is true economy.—*Iron Age*, Dec. 30, 1880.

[From the London "Journal of Gas Lighting."]

Southern District Association of Gas Engineers and Managers.

The Quarterly Meeting of this Association was held, at the usual time, at the Guildhall Tavern, London—Mr. James Hunter, the President in the chair.

Mr. D. F. Goddard (Ipswich) read the following paper—

MANUFACTURE OF SULPHATE OF AMMONIA.

In bringing this subject under your notice, I feel I owe you some apology for dealing with matters on which so much has already been written; but it appears to me that there are comparatively few gas managers who, as yet, are working up their ammoniacal liquor, while so many might do so with great advantage. I do not propose to take up your time by going into the question of washing or scrubbing gas, nor to enter upon a minute description of the apparatus used in manufacture—this having been so efficiently done by the late Mr. Esson, of Cheltenham, and Mr. Eldridge, before the British Association of Gas Managers, as also in the article in "King's Treatise on Coal Gas"—but briefly to compare the different methods in use with a view to ascertain the most effective as well as the most economical means of making sulphate of ammonia.

The systems adopted for this purpose are many and varied, but the principles on which these systems work are few and simple. Omitting the most primitive method—namely, that of mixing the acid and the liquor in a lead vessel and evaporating down the resultant liquid to crystallization—as obsolete, on account of its nuisance, danger, and expense, I find there are mainly two, and very often three, operations in every system, viz.:—

1. A means of obtaining the ammonia from the liquor in a gaseous form.
2. An apparatus for fixing the ammonia vapor with sulphuric acid.
3. An evaporating pan to reduce the liquid sulphate of ammonia to the crystallizing point, and sometimes a means of breaking up the fixed salts of ammonia—the spumaline and sulphomyeline—which will not be given off by the simple application of heat.

I think it will simplify the discussion to follow, if I consider each operation *per se*, rather than deal with complete processes.

First, then, the means of obtaining the ammonia in a gaseous form. For this purpose some use an ordinary egg-shaped boiler, or, at all events, a boiler without internal fines, into which the liquor from the works is placed. It is heated either by the direct action of a fire over which it is set, or by the introduction of steam into the liquor; the latter way being decidedly preferable, except on works too small to have a steam boiler. The heat must be applied slowly at first, until the carbonic acid and other noxious vapors are all driven off; the ammonia vapor, as formed, then passes from the boiler through a pipe to the sulphuric acid vessel. When the ammonia is all driven off, some lime is introduced into the boiler to break up any fixed salts of ammonia which may remain in solution.

Others use a column, after the design known as a Coffey still, containing many shelves, over which the liquor, entering at the top, passes, traversing each shelf in succession until it reaches the bottom, where it finds an outlet. The steam enters near the bottom, and passes also over the trays, but in an inverse direction, leaving the liquor, and causing it to give up its volatile ammoniacal vapors, which, with the steam, pass out at the top of the still to the acid chamber. To obtain the best results, the liquor from the still should be passed into another vessel, and heated or stirred up with lime, to ensure no ammonia being lost as fixed salt.

In connecting these two systems, it seems that the former has the one advantage of dealing with the fixed salts of ammonia in the same operation as the volatile salts; while the latter requires another operation for this purpose; but, in my opinion, this does not compensate for the other advantages gained by using the Coffey still—namely, a saving of fuel by not having to heat so large a volume of liquid; less danger of nuisance from the foul gases (these, being given off more regularly and in smaller quantities, may be effectually burned in the boiler furnaces); and from its being almost a continuous process—there being no boiler to empty and refill—more work in a given time.

Secondly, the apparatus for fixing the ammonia vapor with sulphuric acid. This, commonly called the saturator or chamber, is also of two forms, which may be designated the open or crystallizing saturator and the closed saturator. The former is usually of a rectangular form, made of stone timbers lined with 14 lb. lead. Half the top is covered over and divided from the other part by a lead partition, which descends nearly to the bottom. Into the covered portion the pipe from the still enters, and lies along the bottom being perforated with holes for the emission of the ammonia into the acid, while from the cover there rises a pipe to carry off the carbonic acid and sulphuretted hydrogen evolved. Some mother liquor and acid are put into the saturator, sufficient to seal off the covered portion, and the still is started; acid being added constantly as needed, and of such a strength as to produce crystals which are raked out and placed on a drainer. With the boiler arrangement of still this goes on until all the ammonia is driven off; with the Coffey still it may be continued as long as desired.

The closed saturator may be of similar construction, with the simple difference that the top is all covered in and quite tight. A charge of sulphuric acid is put into it, care being taken that the acid is not too strong, or crystals will be formed in the saturator—a result to be particularly avoided. I find acid of from 40° to 50° Twaddel the best strength. When the charge has been neutralized, as is ascertained by testing, it is run off through a regulus cock or lead plug into an open vessel, where any foreign matter or dirt may settle. Thence it is passed on to the evaporating pan, where, by means of steam pipes, it is reduced to its crystallizing point, and the anilinate taken out as formed, and placed on a drainer.

The treatment of the carbonic acid and sulphuretted hydrogen is similar in both forms of saturators. The pipes conveying them may I believe, be advantageously intercepted with another box containing sulphuric acid, to arrest any ammonia that might be taken up with the foul gases; but I cannot speak from experience on this matter. It must then pass through some form of condenser, and the uncondensable gases are carried into the boiler furnace or into the fire of the retort stack.

In comparing these two methods of fixing the ammonia, it would appear that what is done in the open saturator in one vessel requires three vessels when using the closed saturator. The former is therefore undoubtedly the cheaper to erect, and probably the more suitable for small works. Where it is desirable to make white salts, the results are more likely to be satisfactory by using the weak acid saturator and evaporating pan rather than that in which strong acid is used, as this tends to clear and blacken any organic matter that may be present. It will also be more difficult to maintain the highest percentage of ammonia in the salts when these are taken from a strong acid solution, as the salt which hangs to the crystals would increase the weight, besides rendering the sulphate more liable to deliquesce. I may say, however, that I have seen some very excellent white sulphate produced by Mr. Browning, of Colchester, with the open saturator.

To come to the points of most importance to gas managers. Is it better to sell the ammoniacal liquor than to erect plant and manufacture sulphate? I think, with few exceptions, certainly the latter. Where works are so situate as, by water carriage and proximity of manufactures, to command such a price as 1*s.* per ounce per hour, or say 20*s.* per ton of liquid, I should think to wisest to let well alone; but then how few have such offers. The usual price with us is about half the sum I have named, and in all such cases it will be found highly advantageous to manufacture and sell the produce, as the following figures will show; they are based on a fair week's work, although the quantity produced could be increased by working for a greater number of hours—

Three tons of sulphate, at £18 5*s.* per ton.....	£54 15 0
Labor (one man), at 30*s.* per cwt.....	£2 10 0
Fuel (rough breeze) 22 cwt., at 9*s.* per ton.	1 3 5
Acid, 3 tons, at 70*s.* per ton.....	10 10 0 ·
Repairs, etc., 15 per cent. on £500.....	1 8 9
	£15 12 2
Balance of profit.....	£39 3 10

I estimate that it would require 8640 gallons of 10 oz. liquor to produce 3 tons of sulphate—that is 80 butts, at 1*s.* per ounce per butt, £40, showing at that price a slight advantage in favor of selling the liquor.

As to the question of the best apparatus to use, In small works a boiler set over a furnace, with the crystallizing form of saturator, would, no doubt, be cheapest and best; but in works where there is sufficient liquor to keep the apparatus generally in operation, I should recommend the Coffey still and closed saturator, as being most economical, most continuous, and requiring least attention.

I may say, in conclusion, that had I know, when the committee asked me to read a paper on this subject, that Mr. G. E. Stevenson would deal with the same topic before the Midland Association, and that we should have the pleasure of reading the description of his apparatus in the *Journal of Gas Lighting*, I, who was an almost identical form of plant, would have chosen another subject for consideration this afternoon.

Discussion.

The President said he was not a sulphate manufacturer himself, as he was able to get rid of his liquor at something like the price which had been named in the paper, and he was not, therefore, in a position to give a practical opinion on the matter, but no doubt many others present could do so. Mr. Bromley asked Mr. Goddard how he dealt with sulphuretted hydrogen in his apparatus. That point had not come out so fully in the paper as his (Mr. Bromley's) should have liked, for sulphuretted hydrogen was the principal difficulty, especially in small works.

Mr. Goddard said that at one time, after condensing the sulphuretted hydrogen gas as far possible, he passed it into the furnace under the boiler, though he found that it spoiled the boiler. After repairing the boiler they

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it only produced 14 oz. of sulphate of ammonia per gallon, it would represent 21 lbs. of sulphate per ton of coal carbonized, without at all reckoning the liquor which was formed in some hydraulic mains or through the condenser. He, therefore, could see no difficulty whatever in the figures running up to 24 or 25 lbs. per ton of coal. Where some Yorkshire coal was used the figures that were quoted by the late Mr. Esson, of 24 lbs. per ton, might be correct. As to the question whether lime was sufficient to get all the fixed salts from the liquor resulting from the still, he did not think it was, for a moment, but it was easily tested. He had tested it, and found some sulpho-cyanide of ammonium left. Simply by applying a persalt of iron to the liquor, the presence of sulpho-cyanide of ammonium was detected by the deep red precipitate; and he found that really all the sulpho-cyanide of ammonium could not be got rid of. However, a great deal of it could be got rid of—quite enough to make it worth while. As to the waste of steam, which Mr. Gandon complained of in using the Coffey still, he (Mr. Goddard) could not say that he found the difficulty he spoke of, of the steam coming out from the bottom of the still. Probably he did not work in exactly the same way. At Ipswich he did not get the liquid running from the still, but there was a space at the bottom of the still below the shelves, and the liquor accumulated there to perhaps 12 or 18 inches. It was tested from time to time to see that the free ammonia was all extracted from it, and when this was found to be the case it was allowed to be run off, and the cock of the apparatus was shut again. By this means there was no material waste of steam. He need not enter into the question of labor, but his labor was a fixed sum. He paid his one man for the sulphate 10d. per cwt. according to the amount sold. In reply to Mr. Botley, he might say that up to the present time he had not been in the habit of using the lime process at all, but he most firmly believed it was worth while to do so, and was now erecting plant for the purpose of using it. As to putting a large quantity of water into the saturator, as recommended by Mr. Eldridge, he would remind them that the more water they had in the saturator, the more fuel would be required to evaporate it down to the crystallizing point, and that therefore it must be rather more expensive. One gentleman had said that they had used the spent liquor, or fixed salt liquor, as he called it, in the washers, and that was certainly a way of getting rid of the liquor for a time, but he could not see that it did any permanent good to the gas. The fixed salt liquor had simply some sulphide of ammonium and some sulpho-cyanide of ammonium in it, and in course of time the fixed salt in the liquor must be increased, and there would necessarily be greater waste than if it were removed. He, therefore, thought that the better plan was to remove it at once by means of the lime process, rather than use it in the washers. As to Mr. Marshall's question, whether the whole of the ammonia was extracted by steam, he did not think any cyanide of ammonium was extracted by steam, but simply carbonate and sulphate.

Mr. Marshall said the point was whether they were thoroughly extracted by steam.

Mr. Goddard thought that if the sulphide and carbonate of ammonia were not driven off by steam, they would be detected in the liquor by means of a test-paper. He thought, therefore, that these salts of ammonia, which should perhaps be termed the volatile salts, were all driven off, but that the cyanides and sulpho-cyanides were not touched at all. The quotation that 80 butts of 8-oz. liquor would produce a ton of sulphate, was, as near as possible, the same as the figures he had given—80 butts of 10-oz. liquor to produce 3 tons.

Mr. Marshall said this was the amount the London manufacturers were now reckoning upon, so that Mr. Goddard's amounts tallied very correctly with them.

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THE GAS SUPPLY OF PARIS.

GAS matters are just now exciting much attention in Paris. We have, from time to time, noticed the successive phases of the agitation for cheaper gas in that capital, and while fully sympathizing with the popular demand, we have not held the Gas Company responsible for the existing state of things. It is generally known that the lighting of Continental towns is almost invariably made subject to a "concession" by the Municipal Authorities, which has all the force, for practical purposes, of an Act of Parliament with us. Indeed, in some respects a concession generally confers more exclusive powers than a modern Act, but with the great distinction, among others, that it is invariably granted only for a determinate time, at the expiration of which it must either be renewed on terms more or less in the power of the Municipality to dictate, or it may be stipulated at first that the undertaking is to become public property on a certain date. It is evident that under conditions such as these a price for gas must be fixed which will, at least, allow a sufficient margin for the redemption of the capital sunk in the undertaking, and also for making necessary extensions out of revenue, besides paying as high a dividend as may be considered reasonable in view of the risk incurred. But beyond this the Municipal Authorities, when granting a concession, generally insert other provisions with a view to their own profit, such as the rate at which gas is to be supplied to the public lamps, and, in many cases, reserving the right to a share of the undertakers' profits. The more promising the concession, the more exacting are the grantors thereof, as is only natural. In the case of Paris the concession granted to the present Company is particularly stringent in many of its provisions, and by it the Company are compelled to contribute all kinds of taxes, rates, and dues to the Municipality, and also to pay into the public treasury half of their profits over a fixed proportion. Moreover, after a certain time the undertaking becomes the property of the City.

It will therefore be seen that there are no inducements whatever for the Company to voluntarily reduce the price of gas. The price fixed by the last convention with the authorities was 6s. 6d. per 1000 cubic feet—an enormous value for such a consumption as that of Paris. It is indeed provided that the consumers are to participate in any improvements that may be made in the manufacture, if sufficiently important to notably cheapen the cost of production; but this is at best a forlorn hope for the public. No compensation is possible in case of the price of coal and other materials being enhanced, this risk being borne by the Company. Therefore, on an impartial review of the situation, we do not see how the citizens of Paris can obtain cheap gas, or participate in the advantages of any extension of the Gas Company's operations while the present concession remains in force. It has been said to be easier to cause a revolution than to carry out a reform in France, else it would appear that the easiest way out of the difficulty would be for the Municipality to commute their contributions from the Company into a kind of rent-charge; to give the latter additional stability for their property by altering the liability to surrender into the obligation to sell on a fair valuation; and then to leave the Company face to face with their consumers under regulations such as those that have worked so well in this country. The late Municipal Council managed to leave the settlement of the whole question to their successors, who were last Sunday elected; it would be well if the new body were to treat the subject on general principles, and begin by appointing a Commission to inquire into the best conditions under which the gas supply of the capital can be carried on, with special instructions to extend their investigations to contemporary examples in neighbouring countries.

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A NEW DEPARTURE IN GASMAKING.

So far as the manufacture of coal gas in this country is concerned, the stereotyped system of heating the retorts by the use of one furnace for each oven of three, four, or more retorts, rarely, if ever, exceeding seven, is still in force, and solid fuel in the shape of coal or coke, or a mixture of both, is still the heating agent. Little or nothing of any practical importance has been done in the way of adopting the system of using gaseous fuel and the heat regenerative principle in the gas manufacture in any of our large towns—a circumstance which may probably be due to the comparative cheapness of solid fuel in this country. Abroad, however, there is a very different condition of things prevailing as regards the cost of coal; and, accordingly, in Paris and other large cities on the Continent, Dr. C. W. Siemens' heat-regenerative system has been largely brought into use, and with marked benefit in the shape of economic results.

But we are now in a position to announce that a very important step in advance in the same direction is about to be made at home. It may be remembered that a few weeks ago Dr. Siemens had occasion to deliver a discourse of a most interesting and instructive character on "Gas and Electricity as Heating Agents," under the auspices of the Glasgow Science Lectures Association; and when visiting Glasgow to perform that service, Dr. Siemens had, by appointment, a conference with the leading members of the Corporation Gas Committee, who were desirous of learning how far they could apply his system of regenerative gas furnaces to the heating of the retorts at one of their large gas-manufacturing stations. The result of this conference has been that a trial of the system is now to be made.

In the lecture already alluded to Dr. Siemens had first publicly described a gas producer which he deemed to be a great improvement on that already in use, the gas prepared in it being possessed of superior calorific power, owing to the comparatively small quantity of nitrogen contained in it. The raw material charged into the producer through the hopper above will be the coke or char remaining in the retorts after the cannel coal used in the process of gasmaking has undergone complete distillation; and at the bottom of the producer there will be generated a large volume of steam which, in its ascent through the mass of incandescent coke, will yield free hydrogen gas, and with the fixed carbon of the coke, carbonic oxide. The plant to be laid down in the first instance will consist chiefly of one gas producer of the new form, together with such reconstructions as may be necessary in adapting the heat regenerative system to the retort ovens with which the producer is to be connected. Four ovens, each containing seven retorts, are at first to be brought under the new system, the trial of which, by the way, is to be made at the Dalmarnock Gas Works. The necessary plans are already in the hands of Mr. Foulis, the general manager and engineer to the Corporation Gas Committee, who will at once proceed with the work devolving upon him. We need scarcely say that we shall await with considerable interest the results of this "new departure" in actual practice in gasmaking.

METROPOLIS GAS SUPPLY.

The Chief Gas Examiner for the Metropolis (Dr. Williamson, F.R.S.) has just presented his report on the quality of the gas supplied by the Chartered, Equitable, Commercial, and South Metropolitan Gas Companies, during the quarter ending Dec. 31, 1880:—

I. With respect to *Illuminating Power*.—The averages for the quarter at each of the testing stations, in standard sperm candles, were as follows:—

The Gaslight and Coke Company—			
Beckton (common gas)		17·3	
Do. (Incandescent gas)		17·2	Station closed Oct. 8.
Piccadilly Place	"	17·6	" Nov. 5.
Jewry Street	"	17·6	" Nov. 5.
King Street	"	17·6	" Nov. 5.
Horseferry Road	"	17·6	Station opened Nov. 6.
Millbank Street (Carmel gas)	"	17·7	" "
Ladbroke Grove (common gas)	"	17·3	" "
Brook's Road	"	17·3	" "
Bow Common	"	17·6	Station closed for repairs Dec. 11.
Camden Street	"	17·6	" "
Graham Road	"	17·6	" "
Hackney Road	"	17·6	" "
Commercial Gas Company—			
Wellclose Square (common gas)		17·6	Station opened Oct. 23.
Parnell Road		17·3	" "
South Metropolitan Gas Company—			
Vauxhall (common gas)		17·3	" "

From these results it will be seen that the average has been, at each station, above the parliamentary standard, more especially at the two

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Notes.

Another Hot Air Gas-Lamp.

A novel form of gas-lamp has been invented by M. Clamond, of Paris, on the principle of supplying hot air to the flame, in combination with the principle of the lime light. The air necessary for supporting combustion is caused to pass downwards through a tube, which contains cylindrical pieces of refractory material as arranged as to break up the current of air, and cause it to strike repeatedly against the sides of the tube. This tube is in one arrangement heated, from without, by a number of horizontally directed gas-jets, issuing from several specially constructed burners that surround it. By this means the air is brought to a high temperature before it leaves the tube and mingles with the gas supplied to the burner. The flame is thus made intensely hot, and is then directed downwards upon a cylinder of lime or other suitable material, thereupon creating a brilliant white light from the incandescence of the material. Solid carbonaceous matter, such as powdered coal, coke, or charcoal, may also be used for heating the air and supplying gas. In this case the air tube is placed centrally within a funnel-shaped vessel containing the carbonaceous powder, and provided with air-inlet orifices for causing combustion of the powder. The carbonic acid gas produced by the combustion is caused to pass through the mass of intermittent powder, and thus becomes converted into carbonic oxide, which, in its turn, is burnt by the aid of the heated air, and its flame directed upon the lime cylinder, as before described. The inventor also claims an improvement in the formation of the refractory material which he uses in his lamps. Instead of the customary plain block of block of fire-clay, the whole, for convenience of carriage and safety of handling, being enclosed in a pasteboard "cartridge." When required for use this cartridge is placed beneath the flame, and the carriage is thereupon immediately burnt off, the rods being at once rendered incandescent.

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stations of the Commercial Gas Company, and the Camden Street station of The Gaslight and Coke Company.

II. *As regards Purity.*—Sulphuretted hydrogen has not been present in the gas. The average proportions of sulphur in other forms were as follows:—

Grains of Sulphur per 100 Cubic Feet of Gas.	Average.
The Gaslight and Coke Company—	
Beckton	2·1
Do., City of London	2·1
Piccadilly Place	2·1
Jewry Street	2·1
King Street	2·1
Horseferry Road	2·1
Millbank Street	2·1
Ladbroke Grove	2·1
Brook's Road	2·1
Bow Common	2·1
Camden Street	2·1
Graham Road	2·1
Hackney Road	2·1
Commercial Gas Company—	
Wellclose Square	2·1
Parnell Road	2·1
South Metropolitan Gas Company—	
Vauxhall	2·1

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Sale by Auction of Stock of the South Metropolitan Gas Company.

Tyler last, Mr. G. A. Williams offered for sale by auction, at the Mart, Tokenhouse Yard, E.C., £18,000, of ordinary 7l 2½ stock, and £12,000 of ordinary 5l stock of the above-named Company, being the first portion of additional capital authorized to be raised under the Company's Act of 1876 and the Amalgamation with the Phœnix Gas Company confirmed by Order in Council in March last year.

The Chairman (Mr. Alderman Wakley) stated that the Company had found it necessary from time to time to offer for sale what was then unappropriated South Metropolitan, Surrey Consumers, and Phœnix Gas Companies. The total capital of the Company, he said, amounted to £6,000,000, of which £850,000 was untaxed, and of this the £12,000 for which he was then asking was the last. He referred to the great diminution in the fact that the Company worked under the sliding scale, the operation of which was to reduce the price of gas as the dividend rose. With the Midland exception of less than 5½ per cent., which required by the present price of the gas supplied by the Company, would, for the half year ending June 30 next, be at that rate, and if not per cent. respectively.

The biddings were then taken, and the whole of the stock was disposed of at the following prices:—

Stock.			
9 shares at £182 10 realized			£1,642 10
1	"	182	182 0
1	"	181 10	181 10
1	"	181	181 0
1	"	180 10	180 10
45	"	180	8,100 0
113	"	179	20,190 0
173 shares.	Total		£31,645 0
Stock.			
7 shares at £193	realized		£1,351 0
1	"	192 10	192 10
3	"	192	576 0
1	"	191 10	191 10
3	"	191	573 0
1	"	190 10	190 10
3	"	190	570 0
1	"	189 10	189 10
3	"	189	567 0
1	"	188 10	188 10
3	"	188	564 0
1	"	187 10	187 10
3	"	187	561 0
1	"	186 10	186 10
3	"	186	558 0
1	"	185 10	185 10
3	"	185	555 0
1	"	184 10	184 10
3	"	184	552 0
1	"	183 10	183 10
3	"	183	549 0
1	"	182 10	182 10
3	"	182	546 0
1	"	181 10	181 10
3	"	181	543 0
1	"	180 10	180 10
3	"	180	540 0
1	"	179 10	179 10
3	"	179	537 0
130 shares.	Total		£23,998 10
	Add "B" stock, as above		31,645 0
	Total		£55,641 10

There was a very crowded attendance of buyers, and some recent amalgamations of gas and water companies, which, it was stated, recently sought for and also the 144 new "B" shares of a similar character to those

The Gas Explosion in Glasgow.

There is very little to be added to what was reported in last week's Journal in connection with the disastrous gas explosion which occurred in Henderson Street, Glasgow, early on the morning of New Year's Day. All the victims, with one exception—that of Mary Cassidy, who has succumbed to her injuries—are progressing favourably, and it is to be hoped that they will soon be convalescent. Already the effects of the subscription which Provost Sandeman has been so active in getting up are manifesting themselves in what of the sufferers by the explosion, and contributions will be received either by Provost Sandeman, Mr. Alderman Dunlop, or Mr. Cassels, who are connected to act as Honorary Treasurer to the fund. A first list of donations will be found in our pages.

The inquiry into the cause of the disaster before the gas was cut off, it is stated that when the explosion took place a messenger was at once sent to the Gas Office in Dundas Street, and he informed himself on his return that of what had happened, and reported that a man should be sent at once to cut the pipe off. Mr. Alexander Wilson, the manager, was soon to be seen on the premises, assisted by a number of men out to attend to the gas, and by a man not yet in appearance at Henderson Street, a messenger was despatched to summon the attendance of the gas fitter. The officer could not get any gas to answer his knock, and on the latter arriving without the key, he and Mr. Alexander Wilson, the officer were about dispensing with the key, but failed. Then a fireman and a police constable were sent off with positive orders not to return without some one with the key to the gate; but after considerable delay—as it appears, unfortunately—they also failed to gain admittance to the gas premises, and had to return like the others. Then a messenger was despatched and had to return like the others. Then a messenger was despatched to Henderson Street, and the gas-fitter was found out, but not until some three hours had been lost, during which the firemen were comparatively helpless.

Sale by Auction of Stock in the South Metropolitan Gas Company.

On Friday last, Mr. G. A. Williams offered for sale by auction, at the Mart, Tokenhouse Yard, E.C., £18,000, of ordinary 7l 2½ stock, and £12,000 of ordinary 5l stock of the above-named Company, being the first portion of additional capital authorized to be raised under the Company's Act of 1876 and the Amalgamation with the Phœnix Gas Company confirmed by Order in Council in March last year.

The Chairman (Mr. Alderman Wakley) stated that the Company had found it necessary from time to time to offer for sale what was then unappropriated South Metropolitan, Surrey Consumers, and Phœnix Gas Companies. The total capital of the Company, he said, amounted to £6,000,000, of which £850,000 was untaxed, and of this the £12,000 for which he was then asking was the last. He referred to the great diminution in the fact that the Company worked under the sliding scale, the operation of which was to reduce the price of gas as the dividend rose. With the Midland exception of less than 5½ per cent., which required by the present price of the gas supplied by the Company, would, for the half year ending June 30 next, be at that rate, and if not per cent. respectively.

The biddings were then taken, and the whole of the stock was disposed of at the following prices:—

Stock.			
9 shares at £182 10 realized			£1,642 10
1	"	182	182 0
1	"	181 10	181 10
1	"	181	181 0
1	"	180 10	180 10
45	"	180	8,100 0
113	"	179	20,190 0
173 shares.	Total		£31,645 0
Stock.			
7 shares at £193	realized		£1,351 0
1	"	192 10	192 10
3	"	192	576 0
1	"	191 10	191 10
3	"	191	573 0
1	"	190 10	190 10
3	"	190	570 0
1	"	189 10	189 10
3	"	189	567 0
1	"	188 10	188 10
3	"	188	564 0
1	"	187 10	187 10
3	"	187	561 0
1	"	186 10	186 10
3	"	186	558 0
1	"	185 10	185 10
3	"	185	555 0
1	"	184 10	184 10
3	"	184	552 0
1	"	183 10	183 10
3	"	183	549 0
1	"	182 10	182 10
3	"	182	546 0
1	"	181 10	181 10
3	"	181	543 0
1	"	180 10	180 10
3	"	180	540 0
1	"	179 10	179 10
3	"	179	537 0
130 shares.	Total		£23,998 10
	Add "B" stock, as above		31,645 0
	Total		£55,641 10

Journal Gas Lighting Jan 11 1881

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An Examination of the Wrecked Building

An examination of the wrecked building was made on Monday last week by skilled workmen, with the object of reporting on its suitability to the Dean of Guild Court; and afterwards the Lord Provost and the Dean of Guild, accompanied by Mr. White, Assistant Master of Works, made an official inspection. In the afternoon the pavement in front of the houses affected by the explosion was opened with a view to ascertain the condition of the main-pipe at the point where the fracture had occurred. It was found that the pipe was broken right across at that point, and that while the ends of the fracture were close on the top, the lower edges were about 4-inch apart, thus confirming the opinion expressed that the escape of gas was from the main. The Provost-Fiscal has obtained a warrant authorising a skilled person to take possession of the main-pipes, with the view of having them thoroughly examined.

Bilston Gaslight and Coke Company.

The Annual General Meeting of the Company was held on Monday, the 3rd inst., at the Offices, Bilston, Mr. J. Hall in the chair.

The Secretary and Manager (Mr. J. S. Brown) having read the notice convening the meeting, the following report and statement of accounts were submitted:—

The Directors present to the Shareholders their 15th annual report, together with statement of accounts.

The net amount shown is profit of £3239 12s. 6d., which, with £1126 12s. 7d., brought forward from last account, makes a total of £4366 5s. 1d. The Directors propose to appropriate this amount as follows:—

	£ s. d.
Half-year's dividend of 4s. per share, paid Aug. 1, 1880	2400 0 0
" " " payable Feb. 1, 1881	2400 0 0
Subscriber interest	1 5 0
Reserve fund	1000 0 0
Carry to next year's account	565 0 1
Total	£4366 5 1

The Directors have much pleasure in reporting a favourable result for the year to the end of the district, and a satisfactory increase in the sales of gas. It will gratify the shareholders to state that the special attention which has been given to the distributing plant has resulted in a considerable reduction in the amount unaccounted for, which is now 6·4 per cent. of the total make, as against 8·2 per cent. last year. The Directors have determined to allow a discount of 2 per cent. to all gas accounts paid quarterly. This discount will cause a reduction in the receipts from the Public Lamps, and will involve a reduction of nearly 2l. per 100l lost of gas, or about 240l. in the income of the Company, but it is hoped that this will be more than recouped by the saving.

The Directors who retire by rotation are Messrs. Silvester, H. Edwards, W. E. Colmore, and P. Bullock. They are eligible, and offer themselves for re-election. The Auditors also retire, and offer themselves for re-election.

Dr.	*Trade Account for the Year ending Sept. 30, 1880.*	Cr.	
To cost of stock, Sept. 30, 1879		£3,638	0 0
" Coals carbonized	1,211	0	0
" Hire	231	7	2
" Wages	1,031	12	7
" Materials, Repairs, &c., &c.	1,000	0	0
" Rates, Taxes, Water Rents, &c.	421	15	5
" Interest on Mortgages and Debenture Loans and additional purchase money	660	10	4
" Cost of Land	100	0	0
" Law Charges	11	11	0
" Salaries and Directors' fees	211	14	2
" Auditors' fees	21	0	0
" Bad Debts written off	30	0	0
" Law Charges re Bills and Agreements	15	16	9
" Interest on loan of working capital	150	0	0
" Amount required for depreciation	3,235	13	5
" Balance, profit	4,366	5	1
	£16,778	16	3

The Chairman, in moving the adoption of the report, said he thought the Shareholders would agree with him in regarding it as a very satisfactory one. The profit realized had been the largest in the history of the undertaking, and the Directors had been able to recommend a good and steady increase. The heavy expenditure had been incurred in completing the alterations and improvements in the Company's distributing plant, and this expenditure had been judiciously made as contented to think was proved by the fact that the increase in the sales for the year, amounting to upwards of 8 millions cubic feet, had been entirely lost by the saving effected in the unaccounted for gas, which was now 6·4 per cent. against 8·2 per cent. last year. The Directors, however, hoped to effect greater economy in this direction, though in a minimg district like theirs the waste of gas from leakage must necessarily be greater than between two towns, adjoining. During the year the Directors had met a claim for compensation for damage arising out of the explosion of gas at Bilston, but, in consequence of the Company's Act not giving them the liability of the mains, regulating the matter, with a view to determine the liability of the Company, they had resisted the claim, and were practically responsible for the accident, but that it would be difficult to establish their responsibility, and had elected to compromise the matter by paying what they considered a reasonable compensation (£200), rather than involve themselves in costly litigation, the issue of which might be doubtful. As these special items of expenditure would not have to be incurred in the future, they considered the Shareholders to participate in the improved results which, from the advantageous position of the works, and by good management, they were able to secure. The Directors therefore hoped to be able, during the ensuing year, to recommend some addition to the rate of dividend which was then paid.

The report was unanimously adopted, and a resolution passed authorising the payment of a dividend of 8 per cent. for the year.

The retiring Directors and Auditors were then re-elected, and votes of thanks having been accorded to the Directors and Officers of the Company, the proceedings closed.

The Dudley Gas Company and the Corporation.

At the Meeting of the Dudley Town Council on Tuesday last—the Mayor (Alderman Wainwright) in the chair—the subject of the relations existing between the Corporation and the Dudley Gas Company was brought before the Council by the Chairman, who said he had prepared to make a communication to the Council upon the gas question. As for back as the month of June last a case was stated to the Council in the form of a petition, and the greater part of that petition was then signed. The petition was to the effect that the Council should take steps to obtain the powers which would enable the Corporation to become possessed of the gas works. A statement should be made to the Council, and, to the Mayor himself, during the interval which had elapsed, he had carefully read the Company's Bill, and at the first blush it seemed to involve a most tortuous and mysterious piece of business, and a mere matter of arrangement between the Company and the Corporation. The Bill had been framed expressly for the purpose of

MAKING GAS FROM PETROLEUM.

The question "how shall we obtain cheap light" is one of the most important problems of the day. Nature has done her part in solving the question by furnishing us material, in what appears to be an inexhaustible supply, in crude form, for making light. Gas men have known for years that they could make a cheaper and better gas out of oil than coal, and the name of oil gas has been so frequently misused, and applied to so many different compounds that the real oil gas has been almost lost sight of among the numerous claimants to reputation under that name. There is only one true oil gas, and that does not differ from ordinary coal or rosin gas in any essential particular, except in containing a much larger percentage of fixed illuminating, and a much smaller proportion of non-illuminating elements. This difference in amount of light contained, very largely favors the oil gas. Many have found that the transformation of petroleum into something in the form of gas, and remembling it enough to be called gas, is easy, as they could not well fail to produce either gas or vapor. The trouble has been to produce a fixed gas, with regularity and certainty, and to do this well, and so thoroughly, that the great difficulties in the operation, viz.: smoking, condensing, and depositing of tar and other obstructions in the apparatus and its connections, should be avoided, and at the same time keep the apparatus within such simple form as to be within the easy comprehension and power of management of ordinary intelligent labor.

Modern science and ingenuity have perfected an apparatus by which petroleum is made to yield a beautiful illuminating gas, at small cost, and by this process the gas is so thoroughly fixed, as to enable it to be sent through miles of street mains, in all kinds of weather, with but little, if any, condensation or loss of illuminating power. Gradually, but surely, petroleum is taking the place of coal in the manufacture of gas, and with the use of petroleum comes economy in labor and expense and a much greater brilliancy of illuminating power. It is conceded by all well informed gas manufacturers that oil gas works will make a safe, cheap and brilliant light, as free from smoke, and much freer from other impurities than the best coal gas. The gas is perfectly adapted to all kinds of use, either for public or private illumination, and for heating and cooking.

A burner, consuming one foot of oil gas per hour, gives a light equal to sixteen sperm candles. The best coal gas gives but sixteen candles from a burner consuming five feet per hour. In using gas, the maximum of light is obtained by using the proper sized burner. The average medium burner for coal gas is five cubic feet per hour; the medium burner for petroleum gas is one cubic foot per hour. In regard to quality, petroleum gas is pure; it does not contain any sulphur or ammonia, and therefore, requires no purifying. It is also very rich gas, being eighty candle power, while common coal gas is only from twelve to sixteen candle-power. Owing to its higher specific gravity, it burns much more slowly than coal gas, and is, therefore, more economical. The higher the specific gravity of a gas, the more economical it is for the consumer, other things being equal, and the higher the candle-power, the less gas has to be consumed to obtain the same amount of light, so one cubic foot of petroleum gas will give as much light as five feet of coal gas. Oil gas, when well made, is safe and reliable under any circumstances that coal gas is, and under some that coal gas is not. For instance, it requires a larger and more perfect admixture of air to make it explosive; is free from poisonous constituents, and does not deteriorate under extreme cold or pressure, as coal gas does.

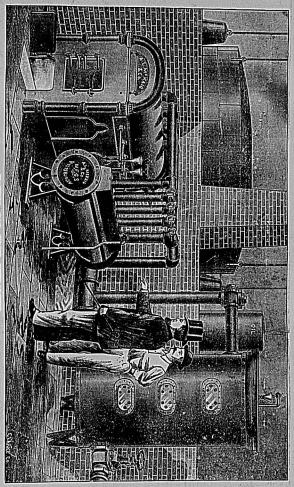
We herewith present an illustration of the National Gas Works, manufactured by A. L. McKaig & Co., of Pittsburg, Pa., with a brief description of their mode of operation.

The petroleum comes from a reservoir extending along the range of the four retorts of the furnace and thence it flows regulated by stop-cocks, into four funnels, each capping an iron supply pipe, which descends vertically and then passes horizontally into a side opening of a retort.

The gas is made in an iron retort kept at an elevated and uniform temperature, and into which petroleum flows in a steady stream.

The retort is made of cast iron, resembling in shape a flattened glass flask, with its upper opening or mouth, for the escape of the gas generated, and with openings on the narrow sides of the retort, towards the bottom, one for the inflow of the petroleum, and the opposite one for the cleaning of the retort.

The retorts are set, upright, side by side, touching only along the edge of two flanges cast on the sides of each retort like the sloping sides of the letter A, and the flanges being about one inch and a quarter wide, making a space of two and a half inches between the retorts. Through this space the current of heated air, rising from the fire below the retorts, is directed by the flanges to the middle of the top of the encasing wall, whence it is deflected sidewards and downwards to the flues in the fire tiles running around the lower sides of the retort casing; and from one end of the united flues it passes into the chimney. Four such retorts are arranged side by side over a single furnace, each retort having its exit gas tube, and the four tubes passing into a single conductor. Around the outside of the upper cylindric opening, or mouth of a retort, is a little cylinder of three inches depth, and the space of half an inch between the two cylinders contains metallic lead, which, when the retorts are in action, is heated above 612 degrees, the melting point. The melted lead acts as a seal to the exit gas pipe, which is thrust into it, excluding the outer air and preventing the escape of the gas within a pressure of over two inches of mercury.



MAKING GAS FROM PETROLEUM.

THE ENCOURAGEMENT OF GAS CONSUMPTION.

SECOND ARTICLE.

We noticed last week, under the above heading, certain causes specially operative at the present time in directing attention to the important question of extending the uses and the consumption of gas. We return to the subject in order to mention some of the ways by which this generally desired object may be attained. Last week the advantages that would accrue to gas makers from the pursuit of the policy advocated were incidentally dealt with; and we may to-day be permitted shortly to revert to this topic.

It may be stated broadly that the profits arising from any growing business will increase in a greater ratio than the gross returns; because, at least in the great majority of instances, it is more economical to manufacture on a large than on a small scale. What is true generally is true in the case with which we are interested; an increased consumption of gas enables a Gas Company to reduce the selling price, and a reciprocating action is set up, the reduced price causing a further increase of consumption. Thus the cause and effect continue to act and react, to the mutual advantage of user and producer. This is the case with old and new Companies alike. With the latter the effect is due partly to the more effective occupation of the plant, and partly to the diminished proportion which many charges of a more or less fixed character bear to the larger rental; with the former the more economical construction of the works required to meet the larger demand is chiefly to be credited with the lessened cost of the additional supply. In such works the advantages of improvements in manufacture, tending to cheaper production, would be equally applicable to old business and to new, and they do account for much of the steady reduction apparent in the cost price of gas. But the new business is not weighted with the heavy capital charges which attach to the old, and for this reason is proportionately more valuable. Let us suppose the case of a town where the price of gas is 3s. 6d. per thousand cubic feet, that price including, say, 1s. 2d. per thousand cubic feet for interest or dividend. This is a proportion not unusual, and most of our readers will be able to supply themselves, from their own experience, with an illustration very near it. Now, such a charge for dividend is no longer necessary with the lessened cost of much of the apparatus employed, more definite knowledge on the part of engineers of exactly what and how much plant they need to provide, and also the reduced charge at which, under the operation of the auction clauses, the necessary money is raised. In most towns of even moderate size, where ordinary maximum dividends are paid, new business can be met by an expenditure of capital which will not involve a greater burden than eight-pence per thousand feet, and sometimes materially less. Here, then, is a difference of sixpence per thousand feet—a saving equal, let us say, to the payment of very nearly the whole of the labour employed in the production of gas and its delivery into the holders. This may be regarded as so much premium to the producers upon new business. In the ordinary case of a consumption doubling in eight or ten years, it alone would effect a reduction in price of threepence per thousand feet over the whole district within the same period.

Such an advantage as this, and others which will suggest themselves—as, for instance, the greater economy of fuel in large as compared with small works, the profit to be derived from the treatment of residual products, &c.—applies to an increase of business obtained on the ordinary lines where the vastly greater proportion of the gas is used for lighting purposes, and its consumption limited to the hours between sunset and midnight. It has with many people become rather the fashion lately to decry the invention of the gas inventor when gas has ceased to be the great illuminating agent—when, in fact, that honourable vocation has been assumed by another, and gas is relegated to the still useful, but much less ornamental purposes of heating, cooking, and the like. Some Chairmen of Gas Companies have contemplated this change "with a light heart," which may have been as real as it looked. It is, however, more from those "good-natured friends" who want to administer a pill and at the same time take credit for a sugar-plum, that we receive most of this kind of encouragement or consolation, as the case may be; and we feel under no oppressive weight of obligation to them in return for it. It will be the commencement of a bad time for gas makers when they have to find other outlets for their chief product, not for the sake of increasing their returns, but to make up for losses sustained in their, at present, most important and useful field.

While we say this with all possible emphasis, we yield to none in the earnestness of our desire to see each of the uses of gas cultivated to the utmost, and our expectation as well as hope is that the percentage of the total quantity of gas made which will in future be used for purposes other than lighting will rapidly increase. We have already referred to the lessened charge upon the gas for dividend on capital required to meet ordinary extension of business, and pointed out that it is by no means trivial. But when considering a development of this kind, where the demand would be chiefly in the daytime, and to that extent would call for barely any increase upon one-half of the capital employed—that sunk in gasholders and distributing plant—the economy in dividend charge is still further augmented. Added to this there would be further saving in leakage and the proportionate charges for distribution, management, collection, &c., all combining to make a day consumption of much more value to a Gas Company than an addition of the same rental value obtained from ordinary lighting sources. It would be palpably erroneous to say that it is more profitable to supply gas in the daytime for working an engine or cooking a dinner than to supply an equal quantity at night for purposes of illumination. Yet at the same time there is much to recommend the idea of charging a lower price for gas used for the former and like purposes. Gas *light* is at present an indispensable necessary in our towns, and consumers have no choice as to those from whom they will buy. Gas-engines, on the other hand, will only meet with acceptance as they are able, in comparison with steam-engines, to develop points of economy or other advantage, and similarly gas stoves as against ranges heated with coal or coke.

We believe we are not over-estimating the advantage of this day consumption "found," as it were, and added on to the work of a Gas Company, at one shilling per thousand feet. If, therefore, the obtaining of this business will enable the Company to produce more cheaply, it is not unreasonable that some inducement should be offered to secure it; and a reduction in price of, say, sixpence per thousand feet would offer such inducement, while leaving a balance to be applied in cheapening the cost of gas for lighting purposes. On this point the experience of the little Danish town of Nakskov, as told in the Journal,* eighteen months ago, is instructive. A differential price has been there instituted, with the result that in 1878 forty-eight per cent. of all the gas sold was for cooking and heating purposes, while in the summer quarters the proportion used for this purpose exceeded rather considerably that for lighting. The laying on of special services to stoves would somewhat reduce the economy in capital expenditure, but it would be amply repaid, and would have further and great advantage on the score of and would have further and great advantage on the score of efficiency. Very much can be done to popularise and extend the use of gas for these subsidiary purposes, without necessarily reducing its price. Gas Companies and Gas Committees should put off, at least in this direction, the monopolist, and put on the trader, taking their wares to the consumer rather than waiting for him to be enlightened, in some accidental or extraneous manner, as to their value, and so come unsolicited to buy. We have offered no slighted praise to those who have sought to do this by opening exhibitions of gas apparatus, and to others, more numerous, who have adopted—some for many years past, others quite recently—the plan of selling or letting on hire stoves for heating and cooking. Good as those efforts have been, they are yet wanting in permanence or completeness. The best model hitherto furnished is that of the Paris Gas Company, which may once more be commended to our readers. The exhibitions should be *permanent*; the consumer should be invited to see the best apparatus for the purpose he needs, and to know, on the authority of the Gas Company, at what cost the work required can be done; and experiments should be made for the purpose of weeding out the unsuitable and inoffensive appliances, which cause dissatisfaction to the consumer, and discredit to the Company, and of bringing into prominence those that are really excellent. Another point of still greater importance is that the stoves or other apparatus, when fixed, should not be lost sight of by the supplier. Not only should the user be instructed how to keep his stove in proper order, but his consumption of gas should be watched, and assistance given to keep it within proper bounds. The excellent stoves read at the last of the Cork Gas Company, in his papers read at the last two meetings of the British Association of Gas Managers, well illustrate the importance and advantage of such attention. The first obligation which has to be met is that of instructing the public as to the great advantages to be derived from gas; and, while we are grateful for such help as is

* See Vol. XXXIII., p. 991.

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THE ACTUAL COST OF MAKING ILLUMINATING GAS.

An investigation is going on in Philadelphia touching the management of the city gas trust, the gas works being owned by the city and operated by official trustees. A recent witness before the investigating committee was Mr. E. S. T. Kennedy, expert of the New York Mutual Gaslight Company. Mr. Kennedy said that this company manufactured last year 721,000,000 cubic feet of gas, 20 per cent of which was from wood, 20 per cent from Youghiogheny coal, and 40 per cent from naphtha. During the year the amount of gas got from a ton of coal (2,240 lb.) was 15,000 cubic feet.

The gas averaged 27 candle power, and the price charged was $2.25 per 1,000 cubic feet.

The present process with coal, wood, and naphtha was introduced in August, 1878. It deposits no lampblack, and no heavy oil beyond about 1 per cent, and that is so heavy that it is used to great advantage as a fuel in the works. To enrich coal gas, Mr. Kennedy said the method was to add a certain percentage of cannel coal to the common coal.

The gas is entirely free from smoke, and does not blacken a ceiling unless within three feet of the flame, when it scorches. With 120 miles of pipe the loss by leakage is about 8 per cent; it is called "unaccounted-for gas," and the amount of it is determined by deducting from the amount registered in the station meter at the works, the gas consumed in the public lamps, in the offices and works, and the amount of gas paid for by consumers. The average power of the gas from coal alone is about 16 candles.

In the Mutual Works there are three separate departments: for coal, wood, and naphtha. In the coal gas department the coal is brought into the retort room, and is charged into the retorts every four hours. That charge will weigh from 215 to 220 pounds. The retorts are set six to a bench, and in drawing the coal one-half of a bench is opened every two hours. As the gas comes off it ascends through a stand pipe to a hydraulic main, which receives a portion of the tarry vapors; the gas then passes off, is cooled, and goes through a double purifying process. It is then measured and stored in the holders. The labor is subdivided, so that there is an average of ninety-one one hundredths of a man to a bench. The average production of coke on a ton of coal is 70 per cent of the original weight of the coal, or a long ton of 2,240 pounds ought to produce 1,600 pounds of coke, or thirty-five bushels. That is the average and ordinary amount produced to-day by the Mutual Gaslight Company.

The average production of gas tar and ammoniacal liquor is 12 or 14 gallons per long ton. The product of ammoniacal liquor varies, some companies producing as low as 15 gallons and others as high as 40; the average would be about 30. The present price of coke is between 8 and 9 cents a bushel; from 2 to 2½ cents a gallon for tar, and about 1 cent a gallon for ammoniacal liquor.

A double system of purification is employed by the Mutual Company. First, with an iron mixture, and afterward with oxyde-shell lime. There are two principal impurities to handle—sulphuretted hydrogen and carbonic acid. The lime is used to remove the latter. After it becomes the roughly charged it is treated to a process of Dr. Wilkinson, the result of which is a lime that does one-third more work than any lime that can be bought, and at one-half the cost of the new lime. The same quantity of lime has been used one hundred and fifty times, and the chemist of the company thinks it will go on forever. There is no depreciation in quantity or quality. They have been using this process for two years without any increase of the lime.

On the following day, after Mr. Kennedy had inspected the plant and processes employed at the Philadelphia gas-works, he took the stand again. In reply to the question: "What does it cost to manufacture gas?" Mr. Kennedy said:

"The average cost of gas per 1,000 cubic feet in the gas-holder is 65 cents; that does not include the cost of distribution. That I consider a fair average price based upon present prices of material and labor. I say 65 cents; it may be a cent or two more or less. I will undertake the management of your gas-works and produce coal gas at the present prices of coal for 65 cents in the holder. My calculation is based upon 16 candle gas."

In reply to the question, "What does it cost your company to put gas in the holders under your processes?" Mr. Kennedy replied: "Less than 50 cents a thousand." The Mutual Company expect eventually, he said further on, to manufacture from wood and naphtha exclusively, when the cost would be from 35 to 40 cents.

Herald. Aug. 4. 1881.

SUFFOCATED BY GAS.

[BY TELEGRAPH TO THE HERALD.]

HARTFORD, CONN., August 3, 1881.

That gas should be turned out and not blown out might well be made an item of public school study in the rural districts. G. A. Thompson, a sixth grader from the little country town of Wilcox Station, was found dead at the McDonough House, Middletown, on Tuesday night. In the morning a strong smell of gas filled the room and corridors and adjoining. The hotel people forced an entrance into the room, and found all the windows closed and the gas burning. The boy was dressed in his clothes, and had probably been dead several hours. There was nothing pointing to suicidal intent, and the coroner's verdict was that the deceased came to his death by the visitation of the ordinary visitation of the gas.

Herald. Aug. 25. 1881.

Gas Cooking Experiment in England.

The experiment of cooking and heating by gas seems to be making more headway in England than in this country. According to an English journal nearly three hundred gas cooking stoves have been placed in operation during the past six months in Birmingham alone, and there is more or less progress in the same direction in other British cities and towns. One reason why the experiment is so much watched with so much success in Birmingham is that the gas there is controlled by the city government and is cheaper than in some other parts of the Kingdom. This probably accounts for the fact that so little is being done in this way here. The price of gas is too high, and many householders cannot afford to use it for lighting, much less for heating purposes. The use of gas in this way is a very practical question in England, particularly in London, with its dense volume of smoke almost constantly overhanging it. The argument is advanced that if gas could be substituted one good result would be to materially improve the atmosphere of the British metropolis.

Aug. 25 1881
Evening Post

LUCK, A NOVEL LIGHT BUOY.

SUCCESSFUL TRIAL OF THE SIGNAL—A STRANGE FLAME IN ALL WEATHERS.

A pleasant crowd, consisting some fifty or sixty gentlemen, went down the bay last night to near Sandy Hook on the fast steamer Sandy Hook for the purpose of seeing one of the new lighted buoys, which is stationed near the old Scotland lightship. The weather was simply delightful. The absence of moonlight served to throw luster into relief the rays of the illuminated buoy, which was found dancing at its number on the surface of as smooth a sea as the eye could wish to behold. The buoy is arranged to serve as a recipient of gas, which is under a pressure of six or seven atmospheres. It is built without rivets, and is surmounted by a diamond lantern, the arrangement of which is such that, while a sufficiency of air is admitted to keep the flame alive or water can enter, the waves are prevented from doing so. The water can, it is claimed, extinguish the light. As the buoy is so constructed that particles of salt will not adhere to it, it is claimed that the mysterious thing the light might be smeared by brinish deposits on it. The surface of the gas which is to illuminate the buoy is 1,000 candles, which is considerably far above or that used for years back on German and English railroads for signaling the passing trains. An attempt to explain the principle of the buoy, or how it works, would be puzzling at the best or how it can burn many days. The buoy light is intended to burn day and night. The buoys used in Europe are made to burn oil, and have to be filled every twenty-four hours. It can be made to burn for the long season of 240 cubic feet daily, such, therefore, the buoy will require to be filled but once in ten days. The buoy also utilizes the sea water. It is refilled at certain intervals by means of a tender. This is accomplished by the use of a hose pipe. The sea water is carried under pressure of the steam, and is forced into the buoy by means of a valve under a flange, all of no more complexity, indeed, than the valves of the tender. For a number of years in Germany, Holland, France, Russia and other countries, has sought where the buoys which will achieve full of attaining success. Some of the buoys in Europe are fitted with a lighthouse, it was found bobbing up and down unpleasant. It was, in effect, a lamp attached to a buoy, or a buoy attached to a lamp. The light was such that which the buoy must always be upward, and as to where the surface of the water as its lighthouse five feet. The light put from the buoy recently for a considerable number of days past. A number of gentlemen interested in popular lines of improvement in lighting apparatus were present, among them an Essex ward Meyers, Superintendent of the Fall River Line, W. H. Tarrant, J. Hall Pleasants, Captain Hall, of the Sandy Hook lighthouse Service, Samuel Wolf known artist and many friends of this science for protecting American waters from disaster. The Sandy Hook reached gas from after eleven o'clock.

THE AMERICAN GAS LIGHT JOURNAL

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Correspondence.—Wishing to make this Journal a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of these subjects a pleasure or a profession.

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[OFFICIAL NOTICE.]

American Gas Light Association.

OFFICE AMERICAN GAS LIGHT ASSOCIATION,
142 CHAMBERS STREET, NEW YORK.

To the Members of the Association:

The Ninth Annual Meeting of the American Gas Light Association will be held in Boston, on Wednesday, Oct. 12th, and continue for three days.

Members of the Association are earnestly requested to prepare papers upon the many topics of general interest, to be read at that meeting. The Secretary counts upon the active co-operation of the members in his efforts to render the meeting of marked value.

WM. HENRY WHITE,
Secretary.

THE CENSUS OF THE GAS INDUSTRY.

Most of the returns from the gas companies have been made, but there is still a number of companies that have not complied with the request of the special agent, and delay sending in their statements. It is consequently impossible to complete the compilation as the few returns due prevent it.

We would, therefore, respectfully and urgently request the companies not yet having attended to this matter to give it early attention.

ASSOCIATIONS FOR THE ADVANCEMENT OF GAS LIGHTING.

It is not many years since it was generally, but not universally, considered one of the fundamental principles of the gas industry to so carry on the operations of a company that no one, outside the management, should know how, or with what results, the manufacture and distribution were conducted. If an improvement was contemplated, or in use, it was for the benefit of the company introducing it, not for others; if others wanted to progress it must be done at their own risk, and from their own experience, assisted, more or less, by the comparatively scant literature referring to the gas lighting of the past. It was not difficult to find the gas manager of the old school who considered that his methods were the only true ones, and that his knowledge included the whole domain of the science and art of the industry. He remained satisfied in his convictions because there was little mutual confidence between manufacturers, and the opportunities for intelligent investigation, comparison and contradiction were few, or impossible.

Wasteful working, extravagant expenditure, ill-designed plant, large losses by leakage, were permitted in those days, when comparative statements of working results could hardly be obtained. Moreover our present great competitor kerosene was then selling at five or six times its present price, and an extra charge to the consumer may, in some cases, have been necessarily made to return dividends that might have been obtained by the savings resulting from improved working.

The need of a change was apparent to the more intelligent and progressive and, on December 15, 1863, twenty-four engineers or managers of gas works met in Manchester, and formed the British Association of Gas Managers. The need of this movement, and its success, are attested by the results, as to-day the number of members of all classes in that Association is upwards of seven hundred, and its influence is most widely extended. Not only so but, largely from the influence and effectiveness of the parent Association, kindred associations, with like objects in view, are vigorously growing in the United Kingdom, America, France and Germany.

It would seem that no question could exist that highly beneficial results have arisen from the association and intercommunication of intelligent men specially interested in the common welfare of a most important industry. Still there are a few who think otherwise, and consider the old times of high profits, when the outsiders and closed doors to have been preferable. Happily, the many do not sympathize with this class, and think it will be a fortunate day when such influences are wiped out. It is undoubtedly true that not all of the improvements made in late years are directly traceable to the influence of the meetings and members of the various associations; but many of them are, and, moreover, many ideas, considered practicable by their imaginers, have been proved otherwise when subjected to the combined intelligence of men who had experimented on similar lines, and their demonstrations have, in many cases, been productive of savings to those intending like experiments.

While the Associations have accomplished, up to the present, excellent results, it would seem that there is still room for great improvements in the methods of conducting the meetings, adding to their interest, compelling the attendance of those hitherto negligent, and to the permanent organization and work of the bodies or committees between meetings. The larger associations meet annually, and are dependent almost entirely upon the good will and interest of a few active members in the possession of power to be

Menlo Park Scrapbook

No. 15A.

This scrapbook is missing. According to the index, it contained material about gas.

Menlo Park Scrapbook, Cat. 1024

No. 16. "Magnetism"

This scrapbook covers the years 1873-1881 and contains clippings about magnetism, including magnetic ore separators. There are 137 numbered pages.

Blank pages not filmed: 1-4, 85-137.

Magnetism of Steel Bars 1024

Compasses

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Sill Journal Oct 16, 74

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Sill Journal Dec 15, 78

Comptes Rendus de l'Académie des Sciences et de l'Académie des Sciences, Vol. lxxix., No. 10. September 7, 1874.

Note on Magnetism (continuation).—By P. M. Gaugain.—Pure. Nov. 24 '78.—" When an armature of soft iron is fitted against the polar faces of a horseshoe magnet, the magnetisation is increased throughout the whole extent of the magnet. This seems to render the theory incompatible that the phenomenon results from magnetic matter which becomes condensed in the neighbourhood of the poles. It may be explained thus, by adopting Ampère's theory:—The action of the magnet is to impress a rotary movement on the molecules of the armature placed near its surface, and causes them (the molecules) to approach more or less the magnetic inclination. The armature, now become a magnet, reacts in its turn upon the horse-shoe, to the increase of the original magnetism. It will be probably impossible to establish, from the actual state of our knowledge, the mathematical law which regulates such mutual actions; but it may be very well conceived how they should augment the magnetisation throughout the whole length of the horse-shoe. Suppose the armature to be composed of bars, applied to the polar faces, to placed at a certain distance from the poles, as *m m*, perpendicular to the branches of the horse-shoe. Then the magnetisation is found to have increased in that part between *m m* and the keel, whilst it is decreased elsewhere. This may be regarded as the consequence of another fact, viz., that if a straight magnet and a bar of soft iron are arranged so that their axes cross at right angles, towards the middle of the iron bar, the latter becomes magnetic, and a consequent point—a double pole—is formed in that portion which is opposite to the pole of the magnet. Reciprocally, if two bar magnets be placed following one another, with their similar poles together, and upon their line of contact a bar of soft iron be placed perpendicularly to the common direction of the magnets, it is very clear that the two magnets will tend to impart the same magnetisation, and that therefore the position will augment the magnetism of the magnets (facts sufficiently attested by *recording* the conditions of the experiment). Each of the branches of the horse-shoe magnet may be considered as formed by the joining of two magnetic bars whose poles of contrary name touch at a point conformably to the line *m m*. And as the bar inclined between this line and the keel is more strongly magnetised than that position between it and the poles, it follows, from what has just been said, that the application of an armature on the line *m m* should increase the magnetisation on the keel side and diminish it on its polar side. On attaching an armature to the polar faces of a strongly magnetised iron horse-shoe magnet, and on plunking it off several times, the magnetisation is diminished throughout the whole length of the magnet; but the decrease is very small, and seems to be solely due to molecular shaking. But when this plunking off of the armature takes place at a distance more or less remote from the poles, then the permanent modifications produced are much more complicated. To illustrate, let the armature be put first on a determined line *o o*; after the armature is wrenched off a diminution of magnetic intensity is noticed throughout the whole length of the magnet; but if the wrenches are continued on the same line a limit of decrease in magnetisation will soon be observed. Then if we place the armature on another line, *n' n'*, situated at a certain distance from the first, a further magnetic decrease may be obtained, subject also to a limit. The same process may be carried on several times, but the decrease will only be continued to a definite limit; for on reaching a certain limit the wrenches effected on a definite line, though they be continue more or less for a week, will not augment between the poles that limit, will not slightly augment the magnetism of the keel. Lastly, it is found that when magnetisation has been reduced to a very low limit, further plunkings off of the armature do not sensibly alter the magnetic condition on either one or the other side of the line."

See "TELEGRAPHIC ARTICLES," vol. ii., p. 250.

Archives des Sciences Physiques et Naturelles.

May 15, 1874.

Some Experiments on the Effects of Magnetism on the Electric Discharge through a rarefied Gas, when it *takes place in the Production of the Light of the Magnet.*—MM. Auguste De la Rive and Edouard Sarasin.—This research (conducted shortly before the death of De la Rive) is a continuation of a previous one, described in the *Archives for 1871* (tome xli.). The authors here employed the electric current in columnar form, causing only one pole to act on the discharge; the tube (Geissler tube or large bell), in which the discharge took place, resting on the top of the column. The effect on the discharge was observed in a portion of the current derived into a galvanometer at some distance, beyond the magnet's influence. A Geissler tube containing nitrogen or hydrogen at low pressure (about 1 m.m.) traversed by the discharge from a Ruhmkorff machine, presents round the negative electrode a beautiful thin sureole extending to the side of the tube; beyond this a long dark interval, and thence to the positive electrode, striæ wide apart. The magnet quite changes this; the negative pole being set opposite the sureole, the latter, of about 2 c.m. length, and complete, the whole tube, is now transformed into a cylinder only 8 or 9 m.m. diameter, very luminous, extending to the positive electrode, across the interval previously occupied by the dark space, and the striated positive jet with a large ball or balloon, the same effect was had; the large spherical sureole was transformed into a narrow thin jet of great brightness. This negative jet is always produced in the continuation of the axis of the electric current, on whose positive electrode is a ring situated in the same horizontal plane as the negative electrode. With higher pressure the negative jet becomes shorter. The magnet notably augments the intensity of the current. The intensity of discharge transmitted by the Geissler tube may even be unaugured by the action of an electro-magnet sufficiently powerful. The effect in hydrogen is more marked than in air; greater in a more (electrically) conductive than in a less conductive tube. The effect is instantaneous, and disappears with the magnet's immediate action; there is scarcely any change in the appearance and intensity of the discharge. If several connected Geissler tubes are placed similarly (with negative poles below) on the top of the magnet, the action on the intensity of the current passing through all of them is simply greater. But if, in place of one or several of the tubes under direct influence of the magnet, three in one semicentre in the circuit quite beyond this influence, the action of the magnet on the intensity of the current is almost wholly annihilated, though the modifications of the light are still distinct. It would thus appear that there is a peculiarly strong resistance presented at the negative electrode, and that this is overcome by the action of the magnet.

Sill Journal May 15, 74

An Investigation with reference to Bar-Magnetism.—H. Hoh.—A number of steel bars were treated thus: (1). Each was heated to redness, and then cooled within a bath; a layer of negative (to the magnetic moment was determined, and they were put in dilute muriatic acid; after remaining in it about twenty-four hours the moment of the bars (now become lighter through solution) was again determined. The bars presented a rough surface, and the dark mass (called by the author carburet of iron) had at the ends an appearance of threads parallel to the length, the iron rises lying round, like a liquid about a solid body. The numerical results are tabulated, and the following are the author's conclusions—(1). The amount of magnetic moment of a steel bar, with reference to its quality, depends on the structure of the iron and the connected structure of the carburet of iron. (2). The magnetic moment for the unit weight (= 1 milligram) increases by removal of magnetised iron, decreases by removal of unmagnetised iron, and by that of the particles of carburet of iron remaining behind after solution of the iron are magnetisable, and receive permanent magnetism. (3). The carbon permanent magnets may be obtained from the remains of dissolved iron masses, if these remaining particles are now magnetised. The author further gives some results of observation as to the magnetic quality of several kinds of mineral graphite.

Ally Journal Dec 1. 75

MAGNETISM OF STEEL.

As Influenced by its Carbon and its Hardness.

For the measurement of the magnetism which different varieties of steel are capable of receiving according to the carbon they contain and their degree of hardness, M. Trève (*Comptes Rendus*, abstracted by Stanislaus Jaquelain) had fifteen steel rods prepared, which he grouped into five sets of three each. Each group had a varying proportion of carbon, viz., A 0·050 per cent.; B 0·130; C 0·290; D 0·636, and E 0·750 per cent. The rods in each group received a different hardening: No. 1 was heated up to 765 deg. C. and hardened in water of 10 deg.; No. 2 was heated to 800 deg., and hardened in water of 100 deg.; No. 3 was heated up to 776 deg., and hardened in oil at 10 deg. The rods were magnetized to saturation, and their magnetism measured. The results of these measurements are given in a table, from which we make the following deductions.

Rod A, with hardening No. 1, gave the highest magnetism, viz., forty-seven; with hardening No. 2, the magnetism measured forty-four; with No. 3, it measured forty-three. A comparison of rods A and E, both at hardness No. 1, show the great influence of the carbon, since, while the magnetism of A was forty-seven, that of E was only thirteen. The influence of the hardening is small when the proportion of carbon is large, but becomes more manifest as the proportion of carbon decreases. The numbers also show with precision the influence of the proportion of the contained carbon; the magnetism rising with it, as shown by the following table:—

A,	47	B,	45	C,	42
A,	44	B,	39	C,	30
A,	43	B,	37	C,	37

D,	33·5	E,	13
D,	22	E,	10
D,	29	E,	12

M. Trève has constructed curves according to these values, showing these results more plainly. A comparison of these curves with the curves of elasticity of these steels shows that as the carbon gives steel its elasticity, it lessens upon it also its magnetic capacity.

Tel Jour Sep 15/76

[illegible] for submarine light.

Researches on Magnetic Rotatory Polarization.—M. H. Becquerel.—Since Faraday's discovery, the phenomenon of magnetic rotatory polarization has been the subject of numerous researches. It has been remarked that bodies strongly refractive have generally also a great magnetic rotatory power; but the exceptions to this rule have hitherto prevented any connection between these two physical attributes from being established. The author finds in his experiments that many bodies which present a regular increase of rotation as the index of refraction augments. The exceptions observed may be attributed either to the effects of lamellar polarization, as in the diamond and garnet; or to the presence of magnetic bodies; or, lastly, to unknown causes.—

EXPERIMENTS UPON THE RAPIDITY OF MAGNETISATION AND DEMAGNETISATION OF IRON AND STEEL.

By M. Dufrêne.

In prosecuting my investigations with electro-magnets and their employment in registering very rapid phenomena, I was led to enquire what was the influence of the nature of the iron in the electro-magnet upon the processes of magnetisation and demagnetisation. With this view, I employed a registering apparatus in which the pieces of iron forming the electro-magnet were movable, all the other parts, such as the coils, armature, pointer, &c., remaining fixed. I then measured the duration of the processes of magnetisation and demagnetisation, by means of the method described in my first memoir, with Jamin upon electric chronographs.

The movable portion of the electro-magnet, which I inverted successively in the apparatus rails, was formed by two cores of 2 millimetres in diameter and 12 millimetres in length. The coils, through which the current was passed, consisted of 14 metres of wire, one-fifth of a millimetre in diameter. The battery used was one Bunsen cell as modified by M. Deleuvier. The different kinds of iron tried were the ordinary iron of commerce, the specially soft telegraphic iron, malleable cast iron, gray cast iron, and, lastly, cast steel drawn and tempered.

The results obtained were entirely unexpected, for the soft iron, the ordinary iron, the malleable cast iron, and *even the tempered steel* gave, very nearly, the same results for the times of magnetisation and demagnetisation, that is to say, duration of demagnetisation, 0·00025; duration of magnetisation (approximately), 0·00150 of a second.

The gray cast iron gave still better results, for the duration of the latter was found to be only 0·00100 of a second instead of 0·00150 of a second. The last result is interesting, for it would allow the greatest possible rapidity to be attained in the transmission of signals.

The final result is, that with my present registering apparatus, which will shortly be described, perfectly clear signals can be obtained, succeeding each other at intervals of one-three-hundred-and-fiftieth of a second, no matter what kind of iron is used for the electro-magnets, and at intervals of one-five-hundredth of a second when gray cast iron is employed. It should be carefully observed that I do not here speak of *signals following each other in regular succession* at intervals of a three-hundredth-and-fiftieth or a five-hundredth of a second, so as to form an equi-distant series. In the latter case a number of signals much greater than 350 or 500 per second could be transmitted.

I am inclined to believe that the superiority of the cast iron is due to its molecular structure, and not to the amount of carbon contained in it. It is therefore my intention, with the new iron and steel *not yet forged*, which I still believe to be more appropriate, to ascertain all that I have hitherto obtained. I propose, further, in a short time to treat, in another communication, of the details of my experiments, and of the application of my registering apparatus to electric chronographs specially arranged in connection with artillery.

It should be particularly noted that the times indicated above are exclusive of the time occupied by the pointer in traversing its course. This time has to be added to that occupied by the magnetisation and demagnetisation to arrive at the three-hundred-and-fiftieth or five-hundredth of a second for the *total* duration of a signal comprising the demagnetisation, the time during which the pointer is falling, the magnetisation, and lastly, the return of the pointer to its original position. These numbers have reference besides to the case where only a single battery element is used, the number of signals per second immediately increases with the intensity of the current.—*Association Scientifique.*

Tel Jour July 15 76
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ON THE CONSTITUTION AND MAGNETISM OF STEEL.

The constitution of steel bars may differ on two accounts—their chemical composition, and the mechanical treatment to which they have been subjected. Chemically, steels vary according to the quantity of carbon they contain; physically, according to the degree of hardness given them, by heating and quick extinction of the heat in cold water, and by the after process of annealing.

In both directions very also the magnetic properties of steel; and numerous researches on its magnetism, as thus determined, have been published. In a recent paper to the Göttingen Society of Sciences, H. Fromme studies the question of the influence of hardening on the permanent magnetism of steel. This has often been discussed, without, however, decisive results. The observers have taken opposite sides, some attributing to hardened steel, others to annealed steel, the greater power of retaining magnetism. Thus, Müller, Plücker, and Wiedemann took the former view; Hansteen and Lamont, the latter; while Coulomb, after numerous observations, considered the question as still open.

After some researches on the magnetism of soft steel bars, M. Fromme was about to proceed to an investigation of the point, when a paper of M. Ruths (an inaugural dissertation in 1872) came into his hands, and it seemed to him of a decisive character.

M. Ruths found that the *dimensions* of the bars must be taken into account. Cylindrical bars in which the relation of the length to the thickness is greater than 30, retain in the hardened state less magnetism than when annealed in the yellow, and in the latter less than when annealed in the blue. In the manner behave also thicker bars, so long as the inducting forces are small; with greater forces the case is different; an that, in general, bars in which the ratio of the length to the thickness is less than 30, have the greater power of retention in the hardened state. "Thus with small magnetizing forces, an annealed bar always retains more magnetism than a hardened one, otherwise similar. But, since the magnetism in the hardened bars increases in greater proportion than in the annealed ones, a value of the magnetizing force is reached, at which the magnetism of the hardened bar reaches that of the annealed, and thereafter exceeds it. The coefficient magnetizing force is smaller, the thicker the bar in comparison to its length. Its value increases with increasing length and decreasing thickness, and, at a certain proportion of these two magnitudes, becomes infinitely great." It is an important confirmation of these results that the contradictions of all previous observers are fully explained, when regard is had to the dimensions of the bars. M. Fromme, however, tested the matter experimentally.

Eight steel bars of 100 mm. length, of which four (I) were 7 mm. thick, the other four (II) 2 mm. thick, were hardened in the same manner. The temperatures to which they were heated varied between 827° and 1067°. Of the bars, I_1 and II_1 were left hard, I_2 and II_2 annealed to the oxidation colour yellow, I_3 and II_3 to blue, I_4 and II_4 to disappearance of all oxidation colours. The bars were magnetized to saturation by touch, and their magnetic moment determined. The following values were obtained, and they are compared with those got from natural bars, with the same kind of magnetization:—

	Natural.		*Natural.*
I. 1.	1982 660	II. 1.	413 232
2.	1282 630	2.	288 234
3.	1218 624	3.	440 265
4.	1051 609	4.	475 257

These numbers fully confirm M. Ruths' result, at least for strong magnetising forces. It further appears, that with thin bars it makes very little difference; with thick bars a considerable difference, whether one magnetizes the steel hardened or annealed. For very small magnetising forces, on the other hand, which in practice do not come into consideration, the magnetisms of the thinner bars present, according to Ruths, greater differences. It will be perceived, however, how very unsatisfactory it is to use natural bars for magnets, for in every case the power of retention increases through the hardening.

M. Fromme seconds to M. Ruths, then, the priority in deciding this question. Quite recently M. Gaugain has communicated to the Paris Academy results which fully agree with those of Ruths.

As to the possible cause of these phenomena, M. Fromme offers the following opinion: "Determining the specific gravity of steel bars of natural, hardened, and annealed steel which I wished to use in further researches, I found no difference of specific gravity of a natural and a hardened bar considerably greater than I had anticipated, or than I found in Lamont's Handbook, and in a table of specific gravities. I therefore, myself made some experiments on bars of different dimensions.

"In hardening of a steel bar, there is an increase of volume, and so a decrease of the specific gravity; the coefficient of dilatation lies between 1/100 and 1/90. In annealing to the oxidation colour yellow, there is a contraction; the coefficient of which is 1/1040 at least; but the specific gravity rises again approximated to that of the natural state to the extent of a half. With further annealing to blue, the bar contracts further, coefficient of contraction about 1/997. It is only after heating till the disappearance of all oxidation colours (gray), that the bar reaches the specific gravity which it had before hardening.

"Hence we infer that with sudden extinction of a glowing steel bar there forms a very hard superficial layer, which cooling more quickly than the interior, restrains the latter in its contraction. Thus the interior is in a tense state, caused by the outer solid crust; the latter is very hard, the former soft. The consequence is the enlargement of volume observed."

Continued over

9

Continued

We may regard a hardened steel bar as consisting of concentric layers, whose hardness quickly diminishes from without inwards, ultimately reaching a soft heart. In slow heating or gradually higher temperatures, the molecules again arrange themselves regularly, and it might be supposed that with the annealing temperature at which the specific gravity before hardening is reached again, the molecular state of bar is also the same again. The magnetic behaviour, however, contradicts this. The much greater magnetism of the grey bars compared with that of the red indicates a crystalline arrangement of the molecules different from that of the natural state.

"Now I have found that steel bars of different thickness, otherwise alike, hardened in the same manner, show a different decrease of the specific gravity, the thin ones a greater, the thick ones a less. It may probably be inferred, that hardened and annealed steel bars of different thickness show a different magnetic behaviour, because the proportion of the outer harder part to the inner softer part is different.

"I conceive the process of magnetisation of a hardened steel bar thus: In each individual layer the separating force excites a remanent magnetism, the amount of which continuously decreases from without inwards. But from the remanent magnetism of each layer is subtracted the opposite induced magnetism which is excited by the remanent of all the other layers, and the amount of which increases from without inwards. The proportion of these two parts to each other is determined for the amount of the resulting magnetism coming outwards; it further determines whether a bar takes more magnetism in the hard or in the annealed state. Thus the greater or less value of the remanent magnetism of a bar also finds its explanation, when we consider not only the laws of the remanent, but also those of the temporary induced magnetism.

"Without proceeding to further establishment of this hypothesis, which I wish to test by further experiments, I will only refer to a result of Holtz's, which, along with another of Jamin's, may serve as verification. Holtz, having dissolved in hydrochloric acid magnetised bars, both hardened and annealed, found that in the removal of the outer layers the magnetic moment of unit weight increased more in the annealed in greater proportion in the hardened than in the annealed bars.

"The explanation is easily furnished, according to my hypothesis, as follows:—In the removal of the outer hard bed, of course, most strongly magnetic layers, a considerable portion of the magnetism is also removed; and one might therefore expect rather a decrease of the magnetic moment of unit weight. That this does not occur is proof that at the same time opposing forces are removed—namely, the opposite induced magnetism. Its influence was given, that even the moment of the unit weight increases; and the increase must be less in annealed bars, because in them the inequalities of the individual layers are in part removed by annealing."

Lec. Jour. Aug 15. 83

Note on Magnetism.—By M. Th. du Moncel.—Replying to M. Gangain's objection as to originalities in certain experiments, M. du Moncel says:—I have shown that magnets have two kinds of action—a *dynamic action*, or in the molecules of iron, and a *static action*, which constitutes the attractive force properly so-called. The two actions, which have a certain connection, may be produced independently one of the other, under certain conditions. The effected results—despite the hypothetical statement of which M. Gangain contests the theoretical value—are positive, and are, consequently, unrelated to dynamic action. It is a kind of reflex action exchanged between the armature and the pole acting on the armature, which has for its effect, not the depleting of the magnetism from the end of the magnet (as interpreted by M. Gangain), but the molecular induction of a greater quantity of magnetism. These result from the effect two consequences. The atomic polarities being excited to excess, the molecular currents possess more energy, and the magnetic solenoid acts with greater intensity. The polarities determining the attraction finding themselves displaced or assailed more or less by the reflex action of the armature, all the atomic polarities in the different parts of the magnet are obliged to displace themselves in the same manner in order to preserve their equilibrium, from which results a general subdivision of the exterior polarities of the magnet. Consequent upon these curious consequences of magnetic molecularities is the retardation which occurs on the current of demagnetisation in a cloud magnetic system, when the voltaic current succeeding the system is interrupted. This effect is analogous to that remarked in electric transmission on submarine cables. In these transmissions there exists a dynamic action, which is related to the current transmitted, and a static action, which is represented by the condensation produced between the insulating envelope of the cable. Now there are actions which exist simultaneously give rise to contrary effects, and these by retrogressive influence retard the rapidity of the electric development which has produced them.

Lec. Jour. Aug 15. 1883

MAGNETISATION OF STEEL TUBES.—According to further researches of M. J. M. Gaugain, when a system of steel jars formed of two parts enclosed with different degrees of coercitive force is submitted to the magnetising action of a feeble electric current, the part which possesses the least coercitive force is always that which takes the strongest magnetisation, whether it take the form of a core or a tube. This result is analogous to those formerly obtained with plain bars, annealed or tempered.

Lec Jour Aug 15-83

On Hardification of the Magnetic Power of Steel by Tempering and Annealing.—By M. Jamin.—Having described the method of measurement, of tempering, and annealing, M. Jamin tabulates his results. The table shows that the magnetic power increases in the following order:—Heated to redness, tempered to yellow, blue, blue-white, annealed.

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Electrical Review, July 8, 1882.

SPECIFIC GRAVITY AND MAGNETISM OF IRON.

By corrosion of magnetised steel bars with nitric acid, and fresh determination of the magnetic moment, M. Holz found that the moment was become greater, per *unit of mass* of the undissolved of the soluble iron; and that, therefore, the insoluble carbonated iron appears to be the bearer of the magnetic coercive force. The closely related question of how pure iron behaves with regard to magnetic properties, forms the subject of a second investigation by M. Holz in a recent number of *Poggendorff's Annalen*.

Perfectly pure iron, free from carbon and all admixtures met with in ordinary iron, M. Holz prepared by electrolysis of an iron salt solution, according to the method described by Klein and Jacobi. He obtained in this way four shining and strong plates of the purest iron, which formed the material of a large series of experiments.

It was necessary, however, first to ascertain what influence gases occluded by the iron in electrolysis might have upon the magnetic moment. M. Holz did so by first magnetising the galvanic iron, then determining the magnetic moment; then keeping the iron in vacuo till no gas bubbles came from it, and then determining the magnetic moment anew. This was found to be only very slightly increased. The collection of the galvanometer rose from 4178·7 to 4179·5, and M. Holz concluded that the occluded gases have no considerable influence on the magnetic moment.

From three plates small bars were now prepared, magnetised to saturation by a coil traversed by the current from several Bunsen elements, and their moment was then determined. Thereupon the bars were annealed and subjected to the same process. These experiments gave approximately to observe the following properties of galvanoplastic iron (which are somewhat divergent from those hitherto known).

On annealing in the gas flame, there was deposited over the bar an envelope of oxide, which could easily be split off, and quickly became separated if the red-hot iron was allowed to fall into water. The iron then appeared brilliantly white, like platinum, and possessed elasticity almost equal to that of steel. The magnetic moment of the bar was not at all diminished by annealing, but, on the contrary, somewhat increased. The specific gravity of the iron was also increased, and that considerably. Before annealing it was 7·8, and after annealing 7·9. The increase in the specific gravity is, therefore, 1·3 per cent. This result is remarkable, as it is known that in the annealing of ordinary iron, which is accompanied by a considerable increase of carbon and its compounds. The change which occurs through annealing of electrolytic iron is accordingly only a change of density and the texture of the metal, considered therewith; and in order to determine this entire molecular change in pure iron with reference to its density, with sufficient accuracy, I have merely to ascertain the specific gravity for each molecular state. The specific gravity of the electrolytic iron before annealing, and the same after annealing, must yield perfectly determinate results as to the molecular expansion and contraction of all particles subjected to the annealing."

M. Holz gives his determination of the magnetic moment and specific gravity of various bars of galvanoplastic iron (see preceding table), and, it is shown that in annealing, the moment increases with increase of density of the iron bars; but the decrease of density is greater than the moments increase. Annealing has this, it reiterates to magnetism, an opposite action on galvanoplastic iron to that it has on steel. Both actions, however, stand in intimate connection with the specific gravity, as appears from the following review of the results:—

The values obtained in the foregoing experiments suffice to prove that through the change of the specific gravity in iron, as in steel bars, the coercive force is considerably altered. The opposite results of pure iron and of steel correspond to like causes.

In Gaugain-Holtz iron regulates, through annealing, a *greater* specific gravity; the molecules are more compressed, the intervals become smaller, and the permanent magnetic moment diminishes about half.

In steel bars, by annealing and hardening, acquire a *less* specific weight; the molecules are further apart (if in addition the mean of all distances of the molecules is not somewhat lessened), the intervals are, in arithmetical mean, greater, and the magnetic moment is considerably increased.

M. Wiedemann has shown, by his extensive experiments upon the influence of magnetisation on torsion, that the permanent magnetism decreases through torsion, the compressing in consequence increases through distortion; and thus twisted iron bars untwist on being magnetised. These facts are explained by the author here found between density and the magnetic force of iron. Torsion causes, in fact, by the distortion of the magnetism, a decrease, owing to the increase of the specific gravity. Through detension, the molecules are separated; the magnetism will, therefore, increase. Hence it follows, that if the magnetism of iron bars by magnetism and, therefore

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Elect. News July 1.'75

Rapidity of Magnetisation and Demagnetisation of Iron, Cast-iron, and Steel.—M. Dupuy.—The tell-tale machine used in researches, of which the following is the results, will be fully described in a later number of this journal.—"The pieces of iron in it composing the electro-magnet are removable; all the other pieces, such as coils, armature, &c., remaining intact, so as to give evidence of the influence of the metal composing the electro-magnet. The metallic rod used in the electro-magnets, which I call the instrument for magnetising bodies, was 12 of two cones 6 m/m. in diameter, and 12 m/m. in length. The exciting coils contained 14 metres of wire #2 m/m. in diameter. The battery used consisted of one Bunsen element modified by M. Dulaurier. Lastly, the varieties of iron experimented upon were the ordinary iron of commerce, the soft iron of telegraphy, malleable and grey cast-iron, and drawn and tempered steel. The results obtained were quite unexpected for soft iron, ordinary iron, malleable cast-iron, and even tempered steel, as they gave almost precisely the same readings, viz.:—

	Second.
Duration of the phase of demagnetisation	0·0003
" " magnetisation (ap-	0·0030
proximately)..	

Grey cast-iron gave still better results, since duration of magnetisation was reduced to about $\frac{1}{1000}$th of a second.' This last metal, therefore, is that which will enable us (according to the author) to attain the greatest possible rapidity in the transmission of signals.

Elect. News July 1.'75

Simple Way of Finding the Pole of a Bar Magnet.—M. F. Müller.—A magnetised sewing needle, between two pieces of cork, is placed horizontally on water, and allowed to place itself in the magnetic meridian. A pointed iron wire is then brought in that position, towards either of the ends of the needle (both ends possessing the constant of all forces goes versâ-vicâ in proportion as the iron wire is more carefully brought closer till it touch the magnet, constant taking place in the beginning of the approximation. To mark that fact point, the point (pencil) is precisely directed in all parts. Any indication of deflection from the point is always found.

Elect News Oct. 15.'74

Notes

M. GAUGAIN has lately undertaken experiments with a view to ascertain the influence of changes of temperature on the magnetisation of steel bars, and has obtained curious results. He found that, when certain bars were magnetised at a high temperature and cooled, their magnetism entirely disappeared and then changed sign; so that if a bar had been magnetised when hot in a certain direction it was found to be magnetised in the opposite direction after returning to the ordinary temperature. When heated afresh the inverse magnetism, which is always very feeble, vanished, and the primitive magnetism reappeared. The same change of sign is reproduced when the bar is again cooled. The specimens of steel with which these experiments were made were all of Sheffield manufacture. With other bars changes of intensity of magnetism were observed, but no changes of sign. M. Gaugain does not give any very satisfactory explanation of these phenomena.

Tel. Journ Nov 15. '74

MAGNETIC PROPERTIES OF NICKEL AND COBALT.—M. Hankel finds that with feeble currents the magnetic power of nickel is equal to that of soft iron; but with strong currents it is comparatively feeble. The magnetic power of cobalt with both strong and feeble currents is much less than that of nickel and soft iron.

MAGNETIC PROPERTY OF HYDROGENIUM.—It is known that palladium is feebly magnetic, and that hydrogenium is feebly diamagnetic, and when the late Professor Graham succeeded in "occluding" hydrogen and palladium, he believed that the resulting alloy would be at least less magnetic than before, but to his surprise, he found it much more magnetic. M. Blondlot has inquired into the matter, and found results in all cases opposed to those of Graham. He finds that palladium charged with hydrogen is much less magnetic that when in the pure state. It is thought that Graham's materials have been impure.

ON THE ACTION OF HEAT IN MAGNETIZATION.

BY L. PAVÉ.

It has long been known that the magnetic state of a steel bar changes with the temperature. Coulomb, Hankel, and other physicists have studied the very complex laws of the dissipation of magnetic intensity; and the most marked consequence resulting from their experiments is, that by raising the temperature of steel to a certain point we cause it to lose definitely the magnetism it has received.

M. Jamin has recently demonstrated "that steel is capable of receiving considerable magnetization at a temperature at which it loses almost entirely that which is received when cold, while the magnetism of a bar magnetized when hot diminishes very rapidly as it is a very short time almost completely disappears.

We have investigated the variations of magnetic intensity by the method of Van Rees, which permits a speedy determination of the total quantity of free magnetism in a bar.

If a helix, formed of a few turns of copper wire wound round the bar, be slid quickly from the middle to a distance at which its influence is no longer sensible, the initial deflection of a galvanometer-needle, produced by the very feeble induced current resulting from the movement, measures sensibly the total quantity of free magnetism of the bar, we are assured that the earth's action is not sufficient to give an induced current that could disturb the result.

We operated on bars previously annealed, and cooled slowly, so that we could regard the changes of state as absolutely temporary, and the variations of temper did not complicate the phenomenon.

The bar to be examined is suspended horizontally to a copper rod, above a tube pierced with a series of apertures forming gas-jets close enough to heat the bar in a manner sensibly uniform throughout its length. This arrangement permits the magnetising-coil to be introduced without the bar ceasing, even when inside, to be under the action

Telegraphic Journal July 29 1875

performed by the engines; but the steam-engine is by no means the only thermic motor employed in the industrial arts. Electro-magnetic engines may also be regarded as thermal machines, deriving their motor force from the heat developed by the solution of the zinc in each cell of the battery, and transmitted to the engine by means of the current. The experiments of Professor Page have shown, in the most satisfactory manner, that it is at the expense of a certain quantity of this heat that an electro-magnetic engine produces mechanical work; and in measuring the work performed upon Gramme's machine, I had no knowledge of Van Rees's labours; they are not mentioned in any French work, and I do not think I am far wrong in saying that M. Blondlot was the first to bring them into notice in this country. From him I am led to understand that the various methods I used had been employed for a long time, which rests of less important modification, by various German physicists—Messrs. Lenz, Jacobi, Van Rees, and Riefsthal. I do not, therefore, claim priority.

The method I employed to determine the curves of magnetic intensities is described in my paper on Gramme's machine,* and consists in marking the bar into equal parts—a centimetre, for instance. I then moved an annular conductor from one extremity of the bar to the other, moving it only over one of the marked portions at a time, and noting the existing corresponding in each spots so traversed. The curve was drawn by taking the measured bar-lengths for the abscissæ, and the corresponding readings for the ordinates. Now, undoubtedly, it is not evident that the intensity measured by this plan is proportional to the ordinary magnetic strength as measured by Coulomb's oscillating method; but I have experimentally proved that this proportionality does exist so long as we leave on one side the parts of the bar bordering on the extremities. As to the statement that I have admitted, between the curve of the intensities and the curve of the demagnetisation, it evidently results from the mode of constructing the two curves. If Van Rees and myself have been led to use the same experimental means, we have been guided by different theoretical considerations. Starting from the same premises, With Van Rees, the induction current represents what he calls the free magnetism, *i.e.* the sum of the molecular elements belonging to the part of the bar upon which the helix is placed. With me, the induction current is that of demagnetisation, *i.e.* the current which would be obtained in the given position of the helix if the magnetism of the bar were destroyed. According to Ampère's views, which I have adopted, this current gives the measure of the solenoidal current. In other words, if we imagine a solenoid of variable strength, which possesses all the properties of the bar, the current of demagnetisation corresponding to a given point of the bar represents the strength of the current which causes the corresponding portion of the equivalent solenoid.

Electrician & Mechanic July 1 1875

Relation of Temporary Magnetism to Magnetising Force, and its Bearings on the Reciprocal Action of Metallic Particles.—M. Blondlot.—The nature of the experiments was briefly this.—Fine powdered masses of the magnetic metals, chemically prepared, and mixed variously with anglicaceous earth, were enclosed in glass tubes, corked at both ends, when brought to a certain density, would float on water, when forced down out of a magnetising spiral. A small steel magnet with mirror, was hung a little way off the end of the coil, and above its level. The deflection by the coil was compensated by a simple circuit on the other side, which received the same current. The deflecting action of the magnetised bars was thus brought into prominence. Each bar was subjected to currents of different strength, and the rendered magnetism examined. *Inter alia*, it appears that by mixing a non-magnetic substance with iron, the magnetic nature of nickel or cobalt may be imparted; and similarly, to nickel, the magnetic nature of cobalt (diffregarding the absolute weight of the metal). The phenomena of temporary magnetism are affected in the same way, when one increases the dimensions in direction of the magnetising force at cost of the other dimensions, as they are when one separates the small particles of the magnet from each other. The metal diluted as described presents more favourable conditions for magnetisation than massive metal. Bars of different density, with corresponding differences of which, however, with increasing magnetisation, and, on saturation, being reached, quite disappear. The entire reciprocal action decreases with increasing magnetisation. In reverse, the course of magnetisation in soft magnetisable metallic bodies depends both on the form and the density of the magnet, and this dependence is to be explained by the reciprocal action of the magnetic molecules.

The Engineering & Mining Journal Oct 23 1875

Magnetic Properties of Nickel and Cobalt.—M. A. Ditlfs, says the *Electrician*, has made some fresh experiments on the magnetic properties of nickel and cobalt, the specimens being obtained by an electro-chemical process, the currents employed being of sufficient intensity to render the metals very hard. Having divided the two into bars of nearly equal dimensions, some of them were left in the hard state, others were annealed, and again some of them were left hard. All of them were magnetized in the same time and by the same way, and measured by means of a set the same time and by the same way, and measured by means of a magnetometer. After being left for 36 and 72 hours, they were again remagnetized. The found the their magnetic properties increase, and consequently, with increasing magnetization, and, on saturation, being reached, quite disappear. The entire reciprocal action decreases with increasing magnetization. In reverse, the course of magnetization in soft magnetisable metallic bodies depends both on the form and the density of the magnet, and this dependence is to be explained by the reciprocal action of the magnetic molecules.

"question, is the coefficient of self-induction of a coil constant, independent of the current, or does it vary with the current? In short, is the coil "electrical" or "magnetical"?

It consists in inserting the magnet between two very short coils of conducting wire united to a galvanometer, and observing the throw when the coil from x to x', and measuring the deflection produced by the induction current. According to Faraday and Lenz, this deflection depends simply on the loss of magnetic force intercepted by the coil, and which are bounded by x and x'; it is thus proportional to the quantity of magnetism comprised between x and x', and is independent of the form of the coil provided the latter be sufficiently tight against the steel. M. Gaugain adopted this plan without modification. Recently M. Blondlot rigorously proved that Van Rees method is only exact for a single case: that in which the magnet is very long, and the coil is rapidly transferred free from the middle line to an extremity, and thence to an infinite distance. In this case the deflection measures M the whole of the magnetism, in its values, M_1, are given in the third column of the table.

On the other hand, let us call A the true value of the ordinate at the commencement; we shall obtain a second valuation of the total magnetism by measuring the expression $y \, d \, x$ *from axis to infinity*: and, as this valuation will not be related to the same unit as the preceding one, we will express it by the product of M with a constant a

$$Ma = \int_0^\infty y \, dx = c \int_x^\infty \frac{A}{x^2} \, dx$$

whence

$$\frac{A}{x} = M \, l \, k$$

The values of $M \log k$ are shown in the fourth column of the table, and are very sensibly constant. Hence it follows that the true value A of the ordinate at the commencement is constant for the same steel, whatever may be its degree of temper. The coefficient A_0, which had been found by the parabolic method, is a function of the conductibility, and its increase by annealing proceeds only from increase of conductibility.

We must now find the relation of A_1 to A or $f(\theta)$. I said that A_1 should be equal to $\frac{A}{\mu}$. Indeed, $\frac{1}{\mu}$ expresses the coefficient of conductibility in a bisted magnet, and $\frac{A}{\mu}$ will represent the superficial coefficient in all the directions around a point on the plane of a magnet; and observed laterally A_1 will be proportional to this coefficient, and consequently equal to $\frac{A}{\mu}$. Whence $A = A_1 \mu$.

I have already found this quantity to be constant, and we now see that it expresses the true ordinate at the extremity of the bar. Whence it follows that the expression for the true ordinate y at any point whatsoever will be

$$y = A_1 k^{\frac{1}{x}} = A \, k^{-x} = A \, l^{-x}$$

that of the observed ordinate being

$$y_1 = A_1 \, k^{-x} = A \, k^{-(x+a)}$$

To classify the steels in a magnetic point of view it will then be necessary to transform them into long plates with a thickness of one millimetre. Let A_1 and k be measured; A_1 will be the true ordinate, and it will represent the magnetic power of the steel; it will depend simply on the chemical composition of the steel; and it cannot be changed, neither by the process of annealing nor by temper.

The second constant k is at the disposition of the constructor; it depends on temper, and diminishes by the process of annealing.

The attractive force developed at the extremity of the bar is proportional to y^2, whence $\left(\frac{A}{\mu}\right)^2$. For the same steel this force increases with the annual, and diminishes with the temper.

The height of the true magnetic curve at the extremity of the bar is invariable and equal to A; but the measured height by "trial of contact" is $\frac{A}{\mu^2}$, and increases with process of annealing.

In proportion as k decreases by anneal the magnetic curve lengthens. The steel used should therefore be longer the more it is annealed; otherwise it cannot contain the whole of the magnetism it is capable of. Such was the case with No. 12 in the table.

The quantity of total magnetism $\frac{A}{l \, k}$ increases with the anneal; the quantity measured by "trial of contact" increases more rapidly still and is $\frac{A}{\mu \, l \, k}$.

The conclusions to be learnt from these experiments and reasonings are that *to make magnets which shall excercise great* CONTACT-ACTIONS *we must use annealed steels of very great lengths; but if we desire* DISTANT-ACTIONS, *we must use short and strongly tempered steels.*

SPECIFIC GRAVITY AND MAGNETISM OF IRON.

By corrosion of magnetised steel bars with nitric acid, and fresh determination of the magnetic moment, M. Holz found that the moment was become greater, per unit of mass, after removal of the soluble iron; and that, therefore, the insoluble carbonised iron appears to be the bearer of the magnetic current. The closely related question of how pure iron behaves in regard to magnetic properties, forms the subject of a second investigation by M. Holz in a recent number of *Poggendorff's Annalen*.

Perfectly pure iron, free from carbon and all admixtures met with in ordinary iron, M. Holz prepared by electrolysis of an iron salt solution, according to the method described by Klein and Jacobi. He obtained in this way four shining and strong plates of the purest iron, which formed the material of a large series of experiments.

It was necessary, however, first to ascertain what influence grains occluded by the iron in electrolysis might have upon the magnetic moment. M. Holz did so by first magnetising the galvanic iron, then determining the magnetic moment; then keeping the iron in vacuo till no gas bubbles came from it, and then determining the magnetic moment anew. This was found to be only very slightly changed. The deflection of the galvanometer rose from 67·75 to 67·85; and M. Holz concluded that the occluded gases have no considerable influence on the magnetic moment.

From these plates small bars were then prepared, magnetised as saturatedly as a coil traversed by the current from several Bunsen elements, and their moment was then determined. Thereafter, the same bars were annealed and subjected to the same process. These experiments gave opportunity to observe the following properties of galvanoplastic iron (which are somewhat divergent from those hitherto known).

On annealing in the gas flame, there was deposited over the bar an envelope of oxide, which could easily be split off, and quickly became separated if the red-hot iron was allowed to fall into water. The iron then appeared brilliantly white, like platinum, and possessed electricity in no small degree. The extraordinary hardness of iron acquired, through annealing, such softness that it could be cut out with shears. This degree of softness remained in the iron even when it was quickly cooled; but the original hardness did not return perceptible, even when it was brought red-hot into an ice mixture.[1] On measuring the expansion that the annealed iron had a hardness 2 to 3, while the hardness of the annealed was between 5 and 6, and other quick-steels are reminded at this.

The magnetic moment of the galvanoplastic iron was considerably lower after annealing than before it. Still more remarkable was the disappearance of magnetic force of the annealed iron. One bar lost in five days over half its moment; this fell from 47 to 23, and direct experiment showed that this was not caused by changes of temperature. "On the other hand," says M. Holz, "the most intelligible shaking had no influence; it was found that the deflection of the magnetic mirror was reduced several degrees when the annealed iron lay in a tube. . . . By throwing the bar three times on the ground, I removed four in the whole of the permanent magnetism; a steel bar of the same size was brought, by six times stronger throwing, from 72 to 35·72; and in the last two throws, no further change of the moment took place."

It is generally known that the ordinary soft iron has only very little power of retaining magnetism that the annealed; but the relations of the coercive force to the changed molecular conditions of *one and the same iron* have not hitherto been investigated. "The phenomena of ordinary wrought-iron," M. Holz says, "and those of steel, are, in the molecular changes of these through annealing and hardening, subjected to various conditions; the parts of the bound carbon present experience a different expansion from those of the free or unbound; and both of these, again, not the same as those of the pure iron present. Much more simple is the process in annelectrolytic iron bar; annealing changes the position of the iron particles, without requiring a considerable influence of carbon and its compounds. The change which occurs through annealing of electrolytic iron is accordingly only a change of density and the texture of the metal connected therewith; and in order to determine this entire molecular change in pure iron with reference to its density, with sufficient accuracy, I have merely to ascertain the specific gravity for each molecular state. The specific gravity of the electrolytic iron before annealing was found to be 7·8443, afterwards 7·8744; therefore the determinate results as to the magnetic and density connection of all particles subjected to the annealing."

M. Holz gives his determination of the magnetic moment and specific gravity of various bars of galvanoplastic iron and ordinary steel; and it is shown that in annealing, the moments decrease with increase of density of the iron bars; but the density of the next bars decreases and the moments increase. Annealing has thus, in reference to magnetism, an opposite action on galvanic iron to what it has on steel. Both actions, however, stand in intimate connection with the specific gravity, as appears from the following *resume* of the results:—

The values obtained in the foregoing experiments suffice to prove that through the change of the specific gravity in iron, as in most bars, the coercive force is considerably altered. The opposite results of pure iron and of steel correspond to the causes.

2. Galvanoplastic iron requires, through annealing, a greater specific gravity in order that its more compressed, the relation between annelled and the permanent magnetic moment diminishes about half.

3. Steel bars, by annealing and hardening, acquire a less specific weight; the molecules are further apart (if the arithmetic mean of all distances of the peripheral constituents be hereby expressed), the intervals are, in arithmetical mean, become greater, and the magnetic moment is considerably increased.

M. Wiedemann has shown, by his extensive experiments upon the influence of magnetisation on torsion, that the permanent magnetism decreases through torsion, the temporary magnetism increases through detorsion; and that twisted iron bars unwind on being magnetised. These facts are explained by the relation here found between density and the magnetic force of iron. Torsion condenses the bar; the magnetism must, therefore, decrease, and the case is the inverse of the specific gravity through detorsion, the molecules are separated; the magnetism will, therefore, increase, and it follows that if the magnetism in twisted iron bars can increase, an untwisting must be indicated by detorsion.

The important herewith is the fact ascertained by Maxwell and Wertheim, that through the stretching of a hard iron bar, its temporary magnetic moment is increased. It is also generally known that steel, through hardening, acquires a less specific gravity than it had in the unhardened state; and that in the former case it has a much greater coercive force than in the latter. With reference to pure iron, I am not aware of comparative tables showing the changes of structure and of coercive force.

From the values here given, then, it may be concluded, that the magnetic coercive force is generally a function of the space formed between the molecules, and is dependent on the size of this intervallic space."

THE
TELEGRAPHIC JOURNAL.

VOL. IV. FEBRUARY 1, 1876. No. 72.

VARIATION OF SHIPS' COMPASSES.

By E. T. ROLLS, A.S.T.E.

A number of calamitous wrecks that have taken place on our shores within the last twelve months from unaccountable error in the dead reckoning, of sailors ominously call it—meaning the estimate of position by course steered, distance run, &c., without recourse to astronomical observations—hindances me to believe that the terrible score of erring compass more frequently lures the mariner to his destruction than is generally supposed. A man endeavours to make a passage he has made hundreds of times before, he steers the same courses, allows for the tides and winds, and feels confident of his whereabouts as of walking down well-known road. The weather is thick; all at once, often simultaneously with the cry of the look-out man, there is a disagreeable sibilating sensation, immediately intensified into a violent shock, and the ship is fast on a shoal that had been reckoned miles away. Vain efforts are made by reversing engines or trimming sails to get the unfortunate ship off again. But what success can be expected from such means? A moving mass of two or three thousand tons, such as a moderate size ship represents, with very slight exception, must almost invariably be immovably rigged, and if she has gone on with a "fair" wind, her chances are hopeless indeed.

It is not then a time for men to ask themselves if they got there; rather, if it may be, to find means to get away. But soon after, there is probably a formal inquiry into the disaster, and, unfortunately, then its cause can only be surmised, for all evidence has disappeared.

As most are aware, iron ships, or ships containing much iron, are swung for compass adjustment before proceeding on their voyage. They are taken to a convenient spot, moved into various positions with regard to the magnetic meridian, and the compasses compared with standards on shore. Usually the former are more or less affected by the iron surrounding them, possessing, as it always has a number of magnetic poles indiscriminately charged, sometimes aiding, sometimes neutralising each other, the result, of course, affecting the compass proportionately with its magnitude, and deflecting the needles from the proper position, which have to be restored by the introduction of counteracting magnets on the deck.

Now, if all these conditions were immutable, all would be well. But it has been proved, over and over again, that they may easily be disturbed. As the ship in warping out of dock, a heavy lighter being hoisted in, a slight collision with another craft—all these quite likely events in the career of a ship have been actually known to so destroy the equilibrium of magnetic forces as to render the compass the mariner's most deadly enemy, instead of the inseparable and faithful friend it should always be.

Various plans have been suggested as cures for this fearful evil, the *master aperaud* being, as a rule, directed to removing the standard compass a full tripod; but with iron lower masts this can scarcely be successful. Others have suggested the bowsprit end, and reading the card by means of a mirror and telescope. Iron bowsprits are common, and would therefore offer some of the disadvantages of the iron masts: they are frequently damaged, and, further, many steamers have none.

My plan does not aim at removing compass variation; I fear that is impossible, but simply to ascertain at *any* moment if it exists, and then to correct it. I propose to do this by providing each ship with a pair of astatic needles properly mounted, and having one end of the upper needle shaped as an indicator or pointer; the needles would be used thus:—

At the time of swinging the ship, and after the adjustments had been made, the compass card should be removed from the ship's standard compass, and replaced by the astatic needle, in such a manner that these should move freely upon the same axis that had pivoted the compass card, taking care to introduce the needles with their indicator pointing forward.

The astatic needles, apart from magnetic influence, would of course retain any position given them; but here their position will be determined by the magnetic forces surrounding them, and they will, therefore, as soon as their oscillations have ceased, assume a definite direction. Let this direction be carefully noted by recording it with a mark upon the interior of the compass—a compass, in fact, to the "Admiral's point"—and we shall have all that is required, and the compass card can be replaced. After this observations for the constancy of the compass can at any moment be made. It will simply be necessary to introduce the astatic needles as before, and note the position they assume. If it corresponds with that observed at the time of swinging, well and good; if it does not, then the conditions must have altered, and the correcting magnets should be adjusted until the combined needles have their indicator brought opposite the recorded mark, when the compass card may be returned to its place, and its correctness will be found to be restored.

POCKET COMPASSES.—We have had brought under our notice a very neat form of pocket compass which has lately been brought out by Mr. L. Casella, of 147, Hatton Garden. The instrument, which is of the usual size, is known as that of "The Unalterable True North Compass" has been given, is not painted by Mr. Symons, and its peculiarity consists in the marking of the card (which renders it extremely easy to read, even in a dull light), and in the fact of the "S" of the card being made to point to the true north instead of the magnetic north as is usual in pocket compasses. No difference, however, is made in the way the needle is used, and there have as yet been but few cases in which inconvenience has arisen from the fact not being known and appreciated. Mr. Casella's instruments are well finished and got up in a variety of convenient forms.

Engineering
1 Dec 1875

Correspondence.

Terrestrial Magnetism.

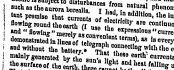
To the Editor of the Scientific American:

In your issue of August 14 appeared an interesting article on the subject of terrestrial magnetism, so-called, in which the views entertained by Humboldt, Hansteen, and Gauss were clearly outlined. During the past year, I have devoted considerable attention to the phenomena of the earth's electricity, and my experiments have demonstrated that there is no such thing as terrestrial magnetism in the sense in which the term is generally employed. To use the term terrestrial magnetism is to indicate that the earth is a magnet, whereas the force which is characterized as terrestrial magnetism stands, with relation to magnetism, precisely as the galvanic current stands with relation to an electromagnet.

I began my experiments in full view of the phenomena set forth in the article to which allusion has been made, namely: The observed declination of the magnetic needle, and its inclination, and the intensity of its action, as well as the facts that these phenomena not only vary in one place from another, but in the same place with time, and that the needle is subject to disturbances from natural phenomena, such as the aurora borealis. I had, in addition, the important premise that currents of electricity are continuously flowing round the earth (I use the expressions "currents" and "flowing" merely as convenient terms), as in every day demonstrated in lines of telegraph connecting with the earth and without the battery.* That these earth currents are mainly generated by the sun's light and heat falling upon the surface of the earth, I cannot but regard as the slightest doubt. That the electricity thus generated is of two well known forms, theretical frictional, there also can be no doubt; nor would it be difficult to estimate the enormous volumes of electricity generated in a day by the impact of the light waves upon the surface.

With these acknowledged facts and observed phenomena, in connection with the results of some experiments of my own, it became an easy matter to show that the surface of the earth is an immense electric helix, or a section of sections of helices or electric belts, whose right angles are the poles.

Taking as a basis the two facts that earth belts of electricity exist, and that their direction is east and west, we are at once brought face to face with the phenomena of deflection of a magnetized needle by the electric current, discovered by Œrsted in 1819, namely, that if a magnetized needle be placed parallel to a wire conductor, the moment an electric current is sent through the wire the needle assumes a position at right angles to the wire, or nearly so, thus:



In Fig. 1 is seen the suspended magnetized needle with its poles parallel to the wire. In Fig. 2 is seen the result when a current of electricity is sent through the wire. And here we have in miniature the cause of the direction of the currents flowing east and west; and, as in this experiment, the compass needle is beyond doubt caused to point north and south by the earth currents, which, flowing east and west, must inevitably cause the needle to assume a right angular direction, which, as we know, is north and south.

But we have not yet made sufficient progress. We have, it is true, satisfactorily accounted for the direction of the needle, but we have not accounted for the dipping of the needle, which, at the poles, is equivalent to its assuming a vertical position. Let us examine further.

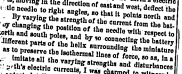
As the electric belts, surrounding the earth, and moving east and west (at least as rapidly as the diurnal revolution of the earth), must form belts or circles of less and less diameter, as we approach the poles, so at the poles we must have the effects of the ends of a helix, or coil of wire; and what are these effects from a helix in which the electric current is flowing? Perhaps I cannot better answer and illustrate than by a diagram of a helix with a compass needle suspended in various positions with respect to the longitudes of the helix.

In Fig. 3 it will be observed that, at the longitudinal center of the helix, corresponding to the earth's equator, the needle, being equally affected by both terminals of the helix, preserves a horizontal position; but that, as we approach the terminals, the needle dips and finally inclines to enter the helix. In this simple form we have all the phenomena of the direction and dip of the compass needle, as the electric current, flowing in the coils of the helix at right angles to the needle, corresponding exactly with the electric belts encircling the earth, and which flow at right angles to the poles, and produces precisely the same results.

The effects of the currents flowing in a helix, it is thus seen, are in every way the same as the effects of the electric currents encircling the earth east and west. The theory that rests in the earth of a great magnet or a series of magnets, is not only utterly improbable, in view of the phenomena observed, as it renders the phenomena impossible; but it is utterly and wholly superfluous. Since we have in the electric earth belts ample force, and a force which we know to be one of the greatest of practical students of natural philosophy, will say: "The actual phenomena of terrestrial magnetism are not in very close agreement with the results which would follow from the presence of such a magnet as the earth's interior, nor do they agree well with the hypothesis of two interior magnets inclined at an angle to each other, which has also been proposed. It would rather appear that the earth's magnetism is distributed in a manner not reducible to any simple exposition." Thus the problem is abandoned in the glamour of an hypothesis, for terrestrial magnetism; yet the same author gives a diagram of the lines of equal intensity in the phenomena of the dipping needle, and these lines are from east to west, precisely as the direction of the electric earth belts, and are closely allied to the thermal lines. The thermal electric belts encircling the earth, it became apparent to me must correspond to the isothermal lines, and this has been shown to be the case.

Although satisfied with the results of my experiments, I determined to pursue the subject more thoroughly, for the purpose of demonstrating the correctness of my deductions. I accordingly took a globe, of the ordinary size, eighteen inches in diameter, and covered it with a single layer of copper wire, in a spiral running east and west with respect to the imaginary poles. When completed, it was as shown in Figs. 4 and 5.

I placed a suspended compass needle near the surface of the globe, so that, when no current was traversing the helix, the needle stood in the position shown at A. The instant a battery was applied, however, so as to give the helix precisely the direction of the earth's belts or currents, the needle assumed the position shown at B, pointing to the north and south poles of our miniature world. Thus in our miniature world, as in the miniature world, the earth's electric current, moving in the direction of east and west, deflect the needle to right angles, so that it points north and south; by varying the strength of the current from the battery, or changing the position of the needle with respect to the north and south poles, and by so connecting the battery with different parts of the helix surrounding the miniature globe, as to produce the isothermal lines of heat, so as to imitate all the varying strengths and differences of the electric currents, I was charmed to witness in the most minute details all the inclinations, declinations, and dips of the needle that we witness on the earth, due to the irregularities of the electric belts in various localities.



The numerous electric disturbances. Perhaps I cannot more clearly than by a quotation, not only the fact that these disturbances of the needle are due to the electric belts, but that these electric belts are continuous, and are of long periods of time, there are minute fluctuations perceptible. To a certain extent, these are dependent on the varying position of the sun; but over and above all regular periodic changes, there is a large amount of irregular fluctuations which are invariably connected with exhibitions of aurora borealis. They are nearly the same at stations many miles apart, and they affect the direction and amount of horizontal much more than of a force" in the magnetic needle.

As we approach the poles of our miniature globe with the helix, it gradually loses its horizontal direction, dipping more and more, just as we observe when we approach the poles of the earth, until we reach one of the poles, when it becomes vertical and tends to plunge into, and to one side of, the helix, as indicated in Fig. 6.

The problem is clear enough when we recall to mind that, as we travel northward upon the earth from the equatorial electric belt, the north pole of the needle inclines downward at the rate of about 1° for 1° of latitude, until we reach the north magnetic pole, latitude 70° 5′ N., longitude 96° 46′ W., at which point the needle points directly down to the earth.

Of the many interesting details of the phenomena observed in my experiments, it is impossible to treat in the space of a single article. At some future time I hope to present the facts more in detail.

What we have learned and what we now know, so far as human knowledge based upon practical experiments can extend, may be summed up as follows:

That the earth is not a great magnet, but that the phenomena of the magnetic needle are due to the electric earth currents, which flow at right angles to the needle;

These are, in brief, the bases of the argument:

1. No placing of magnets in the earth can account for the variations of the magnetic needle.

2. Even if, by a cumbersome and overdrawn hypothesis, magnets could be placed in the earth to produce the effects observed at different places, the variations would still be unaccounted for, for the reason that such magnets would be permanent and without fluctuation.

3. The magnetic theory is utterly superfluous, for the reason that the electric belts surrounding the earth, which we know exist, could not exist without causing the magnetic needle to point north and south.

4. These electric belts, being thermic and frictional, must vary in localities, and accordingly in the situation of the sun with respect to the earth. This we know to be the case, for we not only find the thermic belts of equal intensity, as exhibited in the direction of the needle, closely allied to the isothermal lines, but we find that the needle's perturbations are dependent upon the situation of the sun and auroral displays.

5. The electric belts, not only theoretically, but by actual practical experiment, as we have seen, satisfactorily account for all the observed phenomena.

W. B. HAWKINS.

Washington, D. C.

[1877. MAUSER'S COMPANY, *D. Baker, Boston, Ct.*—dated 28th April, 1875.

The invention relates, first, to the breech in which the cartridge is placed, and which is provided with a receiver employed in connection with a movable breech-block, and with a hammer and a lever which operates the latter, and which is pivoted to the receiver. Secondly, to the peculiar construction of the breech-block, which is provided with a central recess, in which the hammer-lever is pivoted, and with a lateral recess, in which the hammer moves. Thirdly, to the peculiar construction of the hammer and lever, which are provided with a projection and a recess, by which they are locked together. Fourthly, to the peculiar construction of the hammer-lever, which is provided with a projection, which is engaged by the sear, and with a recess, which receives the projection of the hammer. Fifthly, to the peculiar construction of the sear, which is provided with a projection, which engages with the hammer-lever, and with a projection, which engages with the sear-notch. Sixthly, to the peculiar construction of the sear-notch, which is formed through the upper side of the lever, and which is provided with a projection, which engages with the projection of the sear. Seventhly, to the peculiar construction of the lever, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Eighthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Ninthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Tenthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Eleventhly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Twelfthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Thirteenthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Fourteenthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Fifteenthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Sixteenthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Seventeenthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Eighteenthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Nineteenthly, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch. Twentieth, to the peculiar construction of the sear-spring, which is provided with a projection, which engages with the projection of the sear, and with a projection, which engages with the sear-notch.]

The Chinese authorities are only now about to commence mining operations in the very locality referred to in an ancient Chinese history, some 2000 years old, as being the spot where the loadstone was first discovered in China.

19

THE ATMOSPHERE AND MARINER'S COMPASS.

E M July 75

[9181.]—"A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY" (letter 9419, p. 456) has misunderstood my letter on the above subject. I will, therefore, try once more to explain what I mean. If we take two balls or globes and disconnect them as best we can from all other bodies, then, if the matter of which they consist is homogene, there will be in each ball a centre of gravity or inertia and corresponding magnetic poles, irrespective of the axis round which each ball may be turned. But if the matter is heterogene, several minor centres of gravity and corresponding poles must exist. Now, if we connect the two globes with a thin wire, their independence respecting the vibration which takes place in each is very little impaired, although we may throw them in the air and make them swing round a common axis. Now, if we increase the bulk of the matter with which they are connected, their centre of gravity and corresponding poles come nearer to their axis. The same result will be gained by bringing the globes near together. However, practically it would be impossible to construct one globe whose centre of gravity would be exactly in the centre of the axis round which the mass revolves, and especially it cannot be there in the earth, for its matter is heterogene, and constantly shifting. I do not see how "F.R.A.S." could understand me to say that the plumb-line hangs, and bodies fall towards the magnetic pole. What I meant is this: the centre of gravity cannot be in the centre round which the earth revolves, and as the centre of gravity constitutes the magnetic pole, that pole cannot be due north.

J. H. Schucht.

Engineering Sept 75

THE COMPASS AND FOGS.

A MATTER of great importance, especially in regard to our coasting trade, has lately been reviewed in the daily papers by Captain Saxby, R.N. It refers to the possible action of fog on ships' compasses, in producing a temporary inactivity, or large disturbance on the needle, and consequently endangering the safety of all vessels, but especially of those constructed of iron. The subject is one of the highest consequence, considering that our islands, for a large portion of the year, are surrounded by fog, due on the west coast to the contact of the warm air of the Gulf Stream mixing with the cool land breeze, while on our eastern coasts the cause is an inversion of the former case.

"Error in the compasses" has long been assigned as a cause of shipwreck during fog, and frequently has covered faults on the part of the master who has neglected the use of the lead. But in the case of iron vessels it must be remembered that if any excessive cause of electrical disturbance is in action, it is by no means impossible that the vessel may become magnetised, or on the other hand demagnetised; in either case, of course such would seriously affect the compasses which had been previously adjusted to what we may call the normal magnetic state of the vessel. The Northumberland some years ago gave the curious instance of a vessel being actually a powerful magnet when launched, owing to some peculiarity in the direction of its position while building, and from other causes. It is, therefore, evident than an iron ship is always liable to magnetic disturbance, and consequently to react on her compasses.

The question arises how far fog or haze may or does act on the vessel or compass, or on both, and this twofold inquiry involves some important points of consideration. Unfortunately we cannot attempt to properly solve the question by experiment either in the observatory or otherwise on land, because it is absolutely necessary that the floating of the vessel should be a condition of the research. Hence is due the great uncertainty that now surrounds the whole subject.

It has been assumed by those who maintain the influence of fogs that the latter are accompanied by great electrical disturbance, and that this acts on the needle. Many years ago Mr. Crosse, of Taunton, brought some interesting facts on this and other electrical questions before the British Association at its first meeting at Bristol. It will be remembered that he had erected in his grounds insulated iron poles, which by means of connecting wires brought the collected atmospheric electricity into his laboratory. On the occasion of fogs he frequently found the free electricity present to be enormous in its extent, and while previously little or no disturbance had taken place, the arrival of a fog or haze at the wires caused an instant and impetuous torrent of electrical discharges. Other observers have noticed similar results. It would be possible by means of electrical kites or balloons, with wire rope, to carry out experiments on this question on land. The results would be very interesting if not useful.

Returning, however, to the case of the iron vessel, we consider that a very important element of consideration has hitherto escaped notice. It is that of the *direction of sailing* at the time a presumed disturbance of the compass has taken place during fog or haze. The great point would be as to whether the vessel was sailing parallel or nearly so to the magnetic equator, or to the magnetic meridian. It is evident from our theoretical and experimental knowledge of magnetism and electro-magnetism, if not also as regards dia-magnetism, that this would become a most important element of discussion. Two instances will illustrate the point.

Some years ago, in a voyage from London to Edinburgh, during a dense fog at the end of December, careful observations were made from the Nore to Yarmouth. There were three compasses on an iron screw steam vessel placed respectively fore, aft, and middle of the deck. These were controlled by a very delicate pocket compass, and for a period of twenty hours no difference occurred in their indications worthy of notice. The vessel was entirely steered by the compass, as during the whole time it was not possible to see two lengths of the vessel ahead. The question was continuously discussed with the captain, who had been long on the route, but who had no opinion to offer on the effect of fog.

In this instance the direction of sailing was one about *parallel to the magnetic meridian*. But another instance gave the results of sailing in a direction about *parallel to the magnetic equator*. In this case a voyage was taken from Ayr to Campbeltown, on the Clyde estuary, during a dense fog in September. Over the fog was brilliant sunshine and no cloud. Steering by compass, in an hour and a half's time after leaving Ayr, the vessel had reached the north instead of the south of the Island of Arran, which was observed just in time to prevent the vessel running on to the rocks. It was thus discovered that the vessel, an iron paddle, had been steered by compass in a direction nearly 100 deg. out of her proper course, during part of the voyage. The fog rapidly clearing off left the sun setting apparently in the north, instead of a little south of west. The mate then stated that he knew the compass would work sluggish before leaving Ayr, and had advised that a lighter one should have been taken on board, believing as he did in the influence of fog on the compass.

We shall not here enter into any discussion on the different views that have been expressed on this important subject, having desired only to present some important elements of consideration both for and against the influence of fog. It appears very desirable, however, that the condition which we have suggested should be borne in mind by future observers, especially as the approach of the fog season will afford abundant opportunity for research both on land and sea. The importance of the whole question as bearing on the safety of life and property cannot be over-estimated.

[21832.]—**Magnetised Watch.**—The inclosed abstract from *Scribner's Monthly* may help this querist out of his difficulty:—"Watches worn by students and others in technical laboratories are often rendered useless by being magnetised by the magnets used in such places. Magnets kept in the house often create equal mischief by being laid near watches, and much time and expense are sometimes needed to demagnetise them before they can be made to work. A serious case of this kind of injury recently led Professor A. M. Mayer, of the Stevens Institute of Technology, Hoboken, to experiments which resulted in a very simple method of demagnetisation. The magnetised watch was laid upon a table in the neighbourhood of a common compass needle. Each hour on the face was then placed in turn before it to discover the location and intensity of the magnetism in the watch. The movement of the compass showed the N. and S. pole to be located, say, at the figures V. and XI., while the neutral points were at VIII. and II. The watch was then held in a horizontal position before a large bar magnet, the two S. poles being together. A gentle tilting motion was given to it for a moment; and on trying the watch again before the compass, a sensible decrease of magnetism was observed. The process was repeated till the sensitiveness of the watch at that pole was nearly extinguished, when the same thing was tried with the north pole of the watch. After a few trials and comparisons, the magnetic influence was found to be removed, and the watch readily resumed its work."—WALBY.

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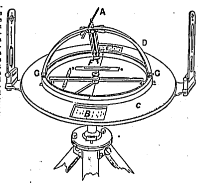
DISTRIBUTION OF MAGNETISM IN THE INTERIOR OF MAGNETS.—MM. Trève and Durassier have read a paper on this subject before the Paris Academy of Sciences. The magnet experimented with was Creusot steel, 454 grammes in weight, containing 1 per cent. of carbon. Heated to 800 deg. C. it was tempered in water at 10 deg. C. Plunged into water acidulated with sulphuric acid of one-fifth, it was left till its weight had been reduced. This was repeated several times, the deviation being noted on each occasion. With the original weight, 454 grammes, a deviation of 45 deg. was noted; reduced to 270 grammes, 27 deg.; to 228 grammes, 22 deg. Reduced to the weight of 33 grammes the proportionality of deviation is lost. It was concluded that if the magnetism penetrated to the heart of the steel, preserving an energy proportioned to the weight, to the limit of 33 grammes, the subsequent sudden decline can only be attributed to the difference of temper. When the proportions of carbon are as low as 0·45 or 0·25 per cent. the law of decrease of magnetism in the ratio of the weight applies no longer. Steels lose less in magnetism than in weight, since, according to this paper, the tempering is more equal in metal rendered less hard, and this leads to the conclusion that there is a direct relation between the magnetism and the tempering. The magnetic power of a steel reveals its degree of homogeneity. The more homogeneous the steel, the more resisting it will be; the magnetism indicates therefore the resisting power of a steel; and the choice of steel tubing for artillery can be regulated by a new law. The authors of the paper carried their attack of magnetised bars to the point of transforming them into thin threads of wire. They still preserved a large amount of magnetic power. This, in saturated steels, penetrates into the whole mass of the metal. In steels of low carbonisation magnetism acquires more in force than it loses in weight, a phenomenon perhaps attributable to a better diffusion of the tempering in a less hard metal. The degree of tempering is thus disclosed by its magnetism; and from this is deducible the homogeneity of the metal—its resisting power. The proportion of carbon in steel, it had been shown earlier, could be indicated by magnetism, and MM. Prève and Durassier, who did so, now show that its physical properties can be indicated in the same way.

Iron Jan 76

AUG. 4, 1876.] ENGINEERING.

DAVIS AND COCHRANE'S MINING DIAL.



THE miner's dial or circumferenter, here illustrated, is entirely of novel construction; the advantage claimed for it is that angles can be taken by it with ease and accuracy, even when used by inexperienced hands, and the tediousness of surveying is very much lessened, as the instrument requires no reading. The following description will serve to explain its construction: B and E are exposed portions of a metallic paper margin or ring about 8½ in. outside diameter, and 1½ in. wide; this margin is fixed to the base-plate of the dial, and to which also the sights are attached; this base-plate moves freely round, carrying the sights and paper margin, leaving the compass, the covering plate C, and remaining parts of the dial clamped to the legs. At D is a semicircular arm working over the compass on axes at G G; this arm carries a brass marker A, which at one end is pointed, and at the other flat, or knife edged. Besides the protection afforded to the ring of metallic paper by the cover C, a small shutter covers each of the apertures at B and E while the instrument is being carried. If the pit should be very damp or dirty the extra precaution may be taken of using a double paper margin with a sheet of carbon paper interposed; by this means a duplicate would be taken of all the angles of the survey.

The first process is to set the dial to the north point, and then to bring down the marker A, and puncture the paper both at B and E; these markings will give the north and south lines on the paper margin; then take the angle required in the usual manner and puncture the paper again, numbering each puncture on the margin; these numbers are booked with distances, &c., to each. If two or more punctures should fall together on the paper margin the marker A may be elongated by the screw F, so that half a dozen or more punctures may indicate the same angles without making any confusion in the margin. In plotting the survey the paper margin is removed from the dial, the north line or points on the paper margin are made to coincide with the north line on the plan, and the survey is plotted at once without the aid of the protractor, the paper ring serving as protractor, and giving all the angles required. When the dial is required for setting out, a paper protractor is supplied in place of blank paper margin, and the angles read off by means of the marker A. This instrument is manufactured by Messrs. John Davis and Son, of Derby.

Transient Variation of Permanent Magnetism.—J. M. Gaugain.—The transient variation of a bar is positive when the bar has been magnetised at a temperature of about 350° and negative when the magnetisation has been performed at any temperature not exceeding 100°. The temperature at which the transient variation = 0 varies in different bars of steel.

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THE LOAN COLLECTION OF SCIENTIFIC APPARATUS, SOUTH KENSINGTON, LONDON.

NATURAL MAGNETS.

On the natural magnets we may notice a large one—the largest at present known—from the Taylor Museum, Haarlem; the weight of this magnet with its armature is 2 cwt., and it is capable of supporting a load of over 2 cwt.; also a Siberian loadstone used by Faraday, and from which he first obtained the induction spark. Large permanent steel batteries are contributed by Dr. Guthrie and the Taylor Museum.

MAGNETIC NEEDLES.

There is a number of modern and historical objects—one from the Naval Museum at Greenwich, with 8-inch needle; meeting on friction wheels, said to have been used by Captain Cooke in his voyages round the world; others similar, but with the needles resting on agate plane; a mariner's compass of Sir James Ross, that at present in use at the Kew Observatory, and another constructed by Dent. Models of needles of various lengths may be employed. Of the ordinary compasses we need say little; here are seen the various forms now in use in H.M.'s ships, standard compasses with four needles, steering compasses with two needles, liquid compass—the compass-box being filled with a mixture of water and alcohol—and compasses for boats, sledges, etc. There is another form of compass-card, however, which should be noticed—namely, that mounted by Sir William Thomson, of which four examples are exhibited. In this instrument the cards have on two sections, each about 2 inches long, placed parallel to each other and on either side of the centre. The whole of the weight, light, is supported by a sapphire cup on a very fine needle being mounted in the middle, and weights with magnets on only 44 grains, that is, only $\frac{1}{10}$ the weight of the Admiralty compass of the same dimensions and period of oscillation. In these compasses there are as many as eight needles fixed symmetrically with regard to the centre. The object of this form of card is to obviate the errors in a certain definition of the error usually introduced by the masses of soft iron which are employed for correcting the deviation of the compass, for with this subject we may notice a model lent by the thermal Diplographical Department illustrating the method of correcting the deviation of the compass in iron ships.

(*To be continued.*)

ILE'S DIFFERENTIAL COMPASS. 76

At the meeting of the Institute, in December last, a model of the working parts of this instrument was exhibited and explained. This compass is intended to obviate any necessity for alteration of the magnetic condition of the iron, either as used in the construction of the vessel or in the cargo, and to enable a mariner to ascertain true bearing by making due compensation.

Its principal difference from the ordinary ship's compass consists in its having two needles suspended in the usual manner, and placed one above the other at such distances as to remain under uniform mutual influences. These needles are counterpoised so as to rest upon agate planes in magnetic—preferably aluminium brass rumbers. The upper one are fastened a brass rumber, the lower one are fastened, about 2 in. long, placed parallel with the body of the needle and the line upon all is one direction. As usual, a magnet lends north and south, and the whole needle will settle in that direction.

The lower needle is composed of soft iron, and magnets of the same materials and dimensions, but with the magnets are fastened to the strip crosswise with the line parallel to the needle, and as all these magnets are placed similarly in one direction, will point east and west. The needles are so placed with respect to order to determine the magnetic force evenly through their length and thus cause them to be equally influenced in position and compensation.

It is evident that if there be no local attraction, the two needles will be parallel to each other in all right angles to the line; but if local attraction does exist, it will be detected by the intervention of the lower needle, toward it at an acute angle; the amount of deflection of each needle depending on the position and strength of the local attraction.

Compensation for true bearing is effected by using the compass point of a fixed object, magnet in either acute angle when placed on any line, and as the compensator can restore 90° when in the opposite, reliable result with the direction of the disturbing cause, the "error" is determined by using the bar magnet in combination with a steel table to be constructed at the factory and to accompany each compass. The position of the bar magnet for obtaining true compensation into been in the ship's bearing, when it will need to be determined there.

MAGNETIC INSTRUMENTS.

In magnetism pure, the Taylor Institution at Haarlem contributes one of the largest natural magnets in the world; and M. Jamin has sent over one of his, by which he demonstrates the greater holding power obtained when the magnet is built up of fine lamina. In terrestrial magnetism are historical dip circles and elliptical recording instruments, as well as many useful for magnetic surveys. Dr. Vogel, of the Sun Observa-

To. 33. AUGUST 12, 1876.

tory, of Berlin, has allowed his complete magnetic equipment, made by Adie, to remain in this country during the Exhibition, and it is now being erected near the Inglefinnan. The subtle laboratory results of Ampère on the attractive and repulsive influence of voltaic currents upon themselves when passing through metallic conductors in the same or in opposite directions; the delicate elaboration by themself in 1820 of the directive influence upon a suspended magnetic needle of voltaic currents passed in a direction parallel to its axis; the development of this by Gauss and Weber in 1833; the work of Sesemanning in 1820, who first used currents from the Voltaic pile for telegraphic purposes; of Steinheil, who discovered, in 1838, the practicability of using the earth as the return circuit; of Seebeck, of Berlin, in 1821, on thermo-electric currents; and the labors and discoveries of Oersted and Wheatstone as regards magneto-electricity, and the laws that regularise the transmission of electric currents through metallic conductors, with their practical application to the transmission of intelligence to distant parts, will be fully shown. The chief interest of collection is this department, as in others, culminates in the original apparatus.

Among the most interesting of the original apparatus of Faraday, which he employed in his electromagnetic researches in the magnetic and diamagnetic condition of gases, and in his researches upon the polarity of diamagnetic force, are of great interest. The series of voltaic current generators comprise, among others, the original elements which were employed by Daniell, Wollaston, Sturgeon, and Grove in their researches. Some of the earlier forms of the magneto-electric machines by Wheatstone are contributed from the physical apparatus collection belonging to King's College, London. From the same collection is the original apparatus by which Wheatstone determined the velocity and duration of the electric spark by means of a rapidly revolving mirror, and the elongation of the electric spark disentangled through a wire half a mile in length, giving an estimated velocity of 288,000 miles in a second. A wonderful series, illustrating the evolution of the electrometer, contributed by Sir William Thomson, must not be passed over.

MAGNETIZATION OF TUBES OF STEEL. 78

By J. M. GAUGAIN.

THE variations of magnetism produced under the influence of heat in a solid bar of steel do not differ from those produced under the same influence in a system composed of a tube and a nucleus. Both appear to depend on the inverse magnetism developed by the mutual reaction of the concentric layers, whether of the bar or of the system.

MAGNETIC CAPACITY. 77

By M. THEVE and DUBOSCQ.

LET a horse-shoe magnet, of any length, be covered on one face with a varnish, or, better, a film of glass. If on the neutral part we place a cylinder of soft iron, we shall see this move towards the poles, which it will reach in a time which is, naturally, a function of the weight of the cylinder, and of the coercitive force of the magnet. The magnetic attraction, then, is here exerted not merely in the limited field which has been assigned to it, but over the whole extent of the magnet.

Thus we have a new way of estimating the magnetic force by the *mechanical* work it does. The product of the weight of the movable body by the space passed through, divided by the time, will be the exact measure of this magnetic force. If we determine this force, e. g., for three large and three small magnets, similar in form and weight, and containing respectively 9·200, 9·200, and 1 per cent. of carbon, we can see how it may perhaps be possible to determine the unit of magnetic force, the "*magnetic*," and to fix its equivalence in kilogrammetres.

We have made great efforts to determine the magnetic conductivity of steels in relation to their proportion of carbon; but the want of a rigorous mode of estimation of magnetic forces has always stopped us. The phenomenon described will fill the gap, and helps us to reach the desired end. We will, however, indicate here the plan we have followed.

If we take 1·2 g. a steel bar, with 1 per cent. of carbon, of our first Crusot series, its coercitive force is found approximately 47 with the compass. We now enclose it in coils, like an ordinary electro-magnet, giving the coils the proportions of Jamin's coils, which, we established by M. du Moncel for obtaining maximum magnetic force; and pass a very strong current. The magnet becomes given 47, has 84". If 47 coils were absolute numbers, we might say that the magnet A. has 47 of permanent magnetism, but can take 84 in the temporary. The 84 would represent the magnetic capacity of the magnet with 1 per cent. But, the maximum capacity of magnetism, that is, the difference between 84 and 47 would give the magnetic conductivity.

Take now B., the sixteen steel of the series, with 0·200 per cent. of carbon. Its coercitive force is 38. If we allow to it the same coils as to A., which are identical in form and weight, we get 69 for the magnetic capacity. The difference between 69 and 38 will be the magnetic conductivity of steel with 0·200 per cent. of carbon.

We proceed in the same way with D., C., and D., and have obtained the following table:—

	Magnetic force.	Magnetic capacity.
A.	47	84
B.	38	69
C.	42·5	67
D.	32·5	62
E.	19	69

The magnetic capacity of a soft piece of iron, the same in form and weight, was 77.

The importance of finding a mode of rigorous measurement of the magnetic force.—*Comptes Rendus.*

The Earth's Magnetic Force.—Captain F. J. Evans, Hydrographer to the Admiralty, read a paper before the Geographical Society, on the 13th inst., on the determination of the Earth's Magnetic Force at the Sea Surface. He said that the value of the magnetic force of the terrestrial magnet governs all the mariner's compass, and noted the discoveries which they had conveyed to the minds of theorists of the magnetic forces in different parts of the earth. The first discovery was that the magnetic force was not constant with the variation of the latitude and longitude, as was assumed in which was absolutely necessary for safe navigation, in no region of the globe—like smaller—this variation was worthy, and in the other—the Atlantic and Pacific Oceans—the variation proceeded to be almost uniformly, and, in fact, quite, particularly in the Pacific Ocean. As a matter of fact, the magnetic condition of the globe was already varying, but in what manner and to what real was wanting. Accurate and many observations were accordingly undertaken. It was taken to be the magnetic discoveries made during the voyage of the Challenger. Further researches the various facts and hypotheses concerning magnetic phenomena, and how these were to be explained. The question was how was to be interpreted them? Whichever way we look at the matter, the facts were undoubtedly of the secular change, we find marvellous complexity and mystery; lines of time and lines are of known, being curves in form likewise as further and further back in the solution. The formula of Hadley, the Astronomer Royal, and Gauss, the more recent hypothesis of the silent men, of the day, all fail to solve the mystery."

FLOW OF ELECTRICITY. 22

Mr. Lodge briefly described a model which he has designed to illustrate flow of electricity, &c., which is fully explained in a paper in the *Philosophical Magazine* for November, and he showed how similar considerations can be applied in the case of thermo-electric currents. The model in its simplest form consists of an endless cord passing over four pulleys, and on one side of the square thus formed it passes through a series of buttons held in their positions by rigid rods or elastic strings, according as they represent bodies of a conducting or non-conducting substance. When considered in connection with thermo-electricity, the buttons are assumed to oscillate on the cord, and if they move in one direction with greater velocity than in the other, the cord will tend to move in the former direction. Now, at a junction of copper and iron, since the metals have different atomic weights, and their kinetic energies are equal, the velocities of the atoms on each side of the junction, and an unsymmetrical oscillation of the molecules must ensue, analogous to that assumed by Sir Benjamin Brodie in Crookes' radiometer, and the cord, or electric current, will advance when two junctions are made. The most convenient way to have observed experimentally the true given difference of temperature the maximum thermo-electric current is obtained when one of the junctions is at 280° C., and beyond this point the current diminishes. The addition of a third bar W. Thomson has shown that the conductivity of iron by electricity; that is, if we have a circuit composed of copper and iron, and one of the junctions be at a high temperature, the current in passing from hot to cold in the iron, or from cold to hot in the copper, absorbs heat. This fact was experimentally illustrated by Mr. Lodge. A strip of tin plate is symmetrically bent, so as to nearly touch the two faces of a thermopile, and is heated at the bend by steam passing through a brass tube on one side from end of the thermopile, and kept cold by a current of water on the other side. As the arrangement is symmetrical, no current is found to pass through the thermopile, but when a powerful voltaic current passes through the strip of tin plate the deflection of the needle is observed in accordance with the above law.

The Steam-Magnet.—M. Benoît Thevenot states that when a current of steam is sent under pressure through a coil of insulated copper wire, through which a small iron cylinder, the latter becomes strongly magnetic. This is a very convenient arrangement for producing powerful electro-magnets, and the writer has applied during the winter to warm the steam current passes through the tube.

Manufacture of Cast-iron Magnets.—M. Jordan publishes some details of a process he has just patented for manufacturing magnets of cast iron. He melts soft metal, very slightly carburetted in crucibles, and runs it into moulds; adding from 10 to 15 per cent. of steel filings, according to the degree of carbonation, to improve the quality of the cast iron. He obtains the best by adding to the iron, when melted in the crucible, from 1 to 1·75 per cent. of nickel and 9 to 10 thousandths of copper, or a per cent. of tin and 50 thousandths of copper. The addition of the copper and tin to the iron facilitates tempering of the compositions (*sic* interpreted) heat. The cast-iron magnets are then annealed, especially of the tin, care be reduced without detriment to the quality of the result by tempering at a higher temperature as their properties is decreased. The best result of all is obtained by tempering just cast iron, at as high a temperature as can possibly be attained, short of reaching a degree of heat which would melt it, above the moulded pieces, or escape from the liability of fracture. *Telegraph Journal.*

or terrestrial objects without being impeded by the quadrantal correctors.

6. Improvements in the method of correcting the compass by observation of the sun, moon, or stars, on a detached azimuth circle.

SIR W. THOMSON'S MARINERS' COMPASS.

IT is well known that ships' compasses are not altogether so satisfactory as mariners and others could wish, and only too frequently fatal defects have existed, more or less directly, the loss of the finest and best-found vessels—a small error, easily made, in the process of adjusting a compass, upsets the most carefully-made observations and calculations; hence Sir W. Thomson has endeavoured to devise, and we believe an improved compass and improved means for ascertaining and correcting its errors. His object has been to obtain—

1. With smaller needles than in compasses hitherto in practical use as long a period of free oscillation as is absolutely working well at sea.

2. Smallness of frictional error.

3. Improved gimbals for supporting the compass bowl to give sufficient steadiness, and to bowl a greater freedom to take up as nearly as possible the true level.

4. Practical methods for applying corrections for the quadrantal semicircular and heeling errors.

5. An improved appliance to the compass for taking magnetic azimuths of sun or stars

FIG. 1

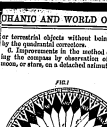


FIG. 2

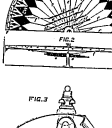


FIG. 3

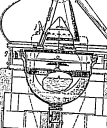


FIG. 4

Sir W. Thomson showed that longnesses of period of free oscillation is favourable for steadiness. It follows from these considerations that it is possible to obtain as large a moment of inertia as possible, with as light a compass bowl, magnets, and frame, as may be.

The improved compass consists of a light aluminium cup with a central cap of agate, or other substance sufficiently hard material for the compass to rest on, and a rim of aluminium from about 4in. to 12in. or more in diameter, according to the size of the compass. The compass card is by preference constructed with an even number of leaves in the rim (16 being preferred for the largest size of compass card), and the central boss has the same number of radii as the circumference. The rim and boss are connected together, as may be, by 32 fine silk threads, c, which form, as it were, 32 spokes. Those silk threads cross, or are knotted, so as to retain them in the holes both of the boss and the rim, after which they are cemented thereto by shellac or other adhesive substance. The compass card is partly supported by these threads, c, directly, and partly by the rim, f, as shown at Figures 1 and 2. Two or more small magnets, d, of which eight are employed in the compass shown at Figures 1 and 2, having their corresponding ends tied together by silk threads, c, of equal lengths, so that the magnets may be as nearly parallel as possible, are attached to the rim by means of fine silk threads, f, as shown.

The following method is said for giving an equal tension to each of the threads between the boss and the rim:—When connecting the boss and rim together, and so as to get the boss to a truly central position, the boss is fixed immediately over the centre of the fine wire ring, the diameter referred to. Each of the 32 threads is then passed outwards through a hole in the rim, where one end is retained by a knot on the inside of the rim, then upwards and over the wire ring, and to its corresponding hole in the boss. Each thread is then threaded through the hole, and then back and finally outwards over the fixed ring above-mentioned, and downwards with a weight attached to it to stretch it with proper force. The rim is then worked about until its boss is truly central, and concentric with the graduated ring. The threads are then passed up to the boss, after which they are drawn through the holes in the boss a sufficient distance, and again connected and the holes sealed up, and again the compass is then obtained while quite steady, extremely light, and yet having large moles of gyration, has very small frictional error with small enough oscillation period to give a very long period of free vibration. For instance, in one of the compasses of this kind, 3in. in diameter, having eight needles of 8mm. 5in. to 6in. long, weighs in all 178 grains, and in this compass has a period of free vibration of 18 seconds, and extremely small frictional error as also has error of the true position of less than one quarter degree.

The third improvement is to swing the gimbals in knife-edges instead of on pivots or journals, as is now generally done, and to adjust the position by the use of a very obvious oil or other liquid contained in the bowl, A, of the compass, fig. 3. The object of this improvement is to give greater freedom to the compass to assume a horizontal position, and to minimise sensibly the use at sea the vibrations of the case due to the motion of the ship are also lessened by the action between the cylindrical journals on which the gimbals are swung and the knife-edges or bearings which they are supported. In consequence of this friction the compass comes rest of itself with a very low level position. With the use of knife edges the compass can also settle truly level position, by the energy-destroying power of the rubbing action at the knife edges on the plane or bearing surfaces fig. W. Thomson employs the level, connected according to the plan, this bottom forming the roof of the bowl, which is then filled with liquid; thus, when there is any motion of the bowl energy is consumed by the frictional or viscous action of the liquid.

The correctors for the quadrantal error are founded on the principle first given by the Astronomer Royal. They consist of iron balls placed in brass fixed in pillars of the binnacle. The semicircular error is corrected by steel magnets according to the general principle also

Steadiness of the compass at sea in stormy weather has hitherto been obtained by making the compass card and needles large and heavy, and sometimes also by adding weights to the compass card. The addition of weights is detrimental, by increasing the frictional error, the needles thereby to make the compass follow the motion of the ship when she moves in azimuth. In a mathematical paper communicated to the British Association in 1874,

first given by the Astronomer Royal. The varying adjustment of the correction required for variation in the ship's sub-permanent magnetism and magnetism induced by the vertical component of the earth's magnetic force is effected in the following manner:—At P, Q, fig. 3, are two similar correctors, one for the fore-and-aft focus and the other for the thwart-ship focus.

Each corrector consists of two bar magnets, O, O, in a vertical vertical, a common horizontal axis, which passes through one of their ends. One of these, the magnet O, is a compound magnet, consisting of two bars rigidly connected parallel to each other, with their poles similarly formed, and with a space between them through which the other magnet, H, passes. The magnet, H, is of a strength equal to the sum of the strength of the two bars of the compound magnet, O, a small piece which is easily fulfilled with sufficient accuracy by making it also a compound magnet of the two said close beside one another with similar poles. The magnets, O, of the two outer bars, G, constitute control magnet. H, has such a spur-wheel at its end, diameter rigidly attached to its inner end. These spur-wheels both revolve round the common horizontal axis, one of them being placed loosely thereon, and they are connected together by means of other spur-wheels in such a manner that when set in motion they turn in opposite directions. The poles of the outer or split magnet, O, and that of the central one, H, at the common axis, are of contrary names, and so, of course, also are the poles remote from the axis. The latter will be called the "serviceable poles," or simply "the poles" for brevity. A circular dial, N, fig. 3, with degrees marked on the outer edge, is arranged concentrically with the common axis of the magnets to indicate the angle of deflection of the magnets from the vertical, and there is a clasp, G, attached to one of the outer bars, G, so that when they have been deflected to any required degree they may be firmly fixed in that position. The spur-wheels attached to the magnets are so connected together that when the two outer bars, G, are vertical the ship being supposed to be upright) the central magnet, H, is also vertical and between the two bars of the compound magnet, O, and when the compound magnet is deflected through any angle on either side of the vertical the central one is deflected through twice that angle, but on the opposite side of the vertical, as shown by the dotted lines at Fig. 3. The correctors are so placed that the vertical line connecting them at a distance is zero, because the split magnet, O, is then at right angles to the central one, and the poles of opposite names are contiguous to each other. The horizontal axis round which the magnets turn for the fore-and-aft corrector, R, is thwartship, and for the thwart-ship corrector, P, S, is fore-and-aft. The correctors, as shown at S and P, are placed one over the other, and both under the compass, as that in their zero position the middle line of each corrector is vertically under the centre of the compass (the ship being supposed to be upright).

If the ship's magnetic force is to starboard the magnets, O, O, of the thwart-ship corrector, P, are turned from the vertical position in such a direction as to bring their serviceable north and south poles to the port and starboard sides respectively; or if the ship's force is to port the correctors are turned in the opposite directions. Similarly if the fore-and-aft component is bowed the magnets of the fore-and-aft corrector, S, are turned so as to bring their north and south poles aft and forward respectively. The spur-wheels may be dispensed with and the magnet of the pair constituting either corrector may be moved by the other pair of the said clamped there simply by hand. Or a single corrector, connected according to the above description, and having sides an eccentric adjustment, and having its two magnets of unequal length, may be used, and is preferable on the ground of simplicity, but is not quite so easily used when the correction is to be readjusted frequently.

When there is a greater amount of error to be corrected than can be conveniently done by the continuously adjustable correctors, auxiliary correcting permanent magnets are used as shown at T, Fig. 3. These magnets are made by preference of steel wire, or round rod steel, hardened, and soldered in brass tubes to project that these from east and from adjacent or from close contiguity with other magnets, and might alter the strength of their magnetism. These magnets are made in pairs of equal strength, and with ends so adapted that when out of use they are to be placed in a box so fitted that they cannot be set into it except with dissimilar poles together. This may be easily effected by making one end of each to the magnet round and the other end square.

For correcting the heeling error, the binnacle contains an upright with a V-groove forming a proper groundwood clamp Q, fig. 4, for holding firmly at the proper height a magnet, R, in a vertical position centrally below the lower of the two pairs of adjustable semicircular correctors.

The fifth improvement consists of a convex half lens placed over the compass between the outer circumference and the centre, with its axis directed to the graduated circumference of the compass card, and its centre at a distance from the division slightly exceeding the radius of the divided circle. This half lens is shown at L, Fig. 3. Another is the lens, i, there is a plane mirror, j, for observing the image of the sun, whose azimuth is required, mounted upon a horizontal axis coinciding with the diameter of the lens, i, and mirror, j, are placed on a frame mounted on a projecting arm, k, for the observer, when looking on the mirror, this frame round its vertical axis, until the mirror, j, and lens, i, are fairly opposite to the object. He then places his eye above the compass and a little between the centre and the graduated ring until the image of the object reflected from the mirror's axis upon a division on the compass card seen through the lens. The point on the compass card where the object is seen will be the bearing of the object. This appliance is called the azimuth mirror. It is provided with a spirit level to show whether the case and level are properly balanced.

The sixth improvement relates to a detached azimuth circle, to be used for finding the azimuth directly by observations of the sun, moon, or other bright enough planet or star, for the purpose of ascertaining from time to time the error of the compass, varying from this with the alterations in the ship's magnetism. It consists of a horizontal detached circle circle supported on gimbals having an inner circle also mounted in a horizontal plane at right angles to the axis of movement of the outer circle. The gimbals of both the inner and outer circle are, as in the case of those of the compass, supported on knife edges. The rim of the inner circle is graduated to degrees, and may also be marked with points of the compass, and this circle carries on a horizontal axis pivoted on it a portion of a hollow spherical surface. This surface is marked with a great circle corresponding to the equator, and with circles corresponding to degrees of declination, as far as 20 degrees on each side of the equator. These declination circles are divided into spaces corresponding to four minutes of arc of time at the rate of a degree to a quarter to five minutes, which divisions are numbered in hours and minutes, the points to which the declination circles are cut by a plane perpendicular to the above mentioned horizontal axis being reckoned as noon. A lens placed with the centre at the centre of the spherical surface is pivoted on a frame so that its axis may be directed to select between the extreme declination circles of the spherical surface. To use the instrument, turn the spherical surface round on its pivots until its equatorial circle is inclined to the vertical at an angle equal to the latitude of the place, then turn the whole round horizontally until the image of the sun or other heavenly body is seen in the lens, and on a point on the equatorial circle. This point corresponds to the apparent solar time, as to the meridian of the body observed, and to the declination of the body at the time. The lens is to be turned about on its vertical until the image is well defined. The effects of refraction and parallax are sufficiently corrected for all practical purposes by bringing, as nearly as may be judged by eye, the centre of the images into the same azimuth with the proper time point of the

proper declination circle. When the instrument is correct and well levelled, the image of the centre of the sun will be seen always below the proper point by the amount of refraction; the centre of the moon's image will be seen above the proper point by the excess of her parallax above refraction.

To avoid expense in the construction, and confusion in the use of the instrument, Sir W. Thomson has divided a geometrical slide which, with other details, avoids the necessity for so many circles and divisions. In the illustrations Fig. 1 shows one-half of the face of the declination card, the segments of which are connected by gunmetal strips underneath the inner circle, which by tongues folded down and attached to the slide on the outer ends. Fig. 2 is a transverse section through the card and centring disc, and needles. Fig. 3 is a sectional elevation of the compass and its box, as placed on board a vessel.

[9603.]—Variation of Compass.—The following are the observations of the magnetic elements (of variation and inclination) at Kew Observatory for eleven years, ending with 1875. As W. F. Ivory surmises, the present variation, or declination as it is more properly called, is about 19° W.

Year.	Declination or Variation West.	Inclination or Dip.	Horizontal tion.	intensity.
1865	20 55	66 7		2820
1866	20 49	66 51		2811
1867	20 45	66 38		2844
1868	20 35	66 7		2846
1869	20 25	66 1		2852
1870	20 18	67 05		2837
1871	20 11	67 04		2850
1872	20 0	67 04		2860
1873	19 57	67 31		2827
1874	19 52	67 10		2861
1875	19 46	67 48		2805

—Artificial Perpetual Motion.

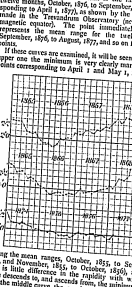
(see reference to "Hare's" question, respecting the variation of the compass, bk. [9607], p. 615, let me first note that the deviation in the direction of any magnetic needle to which its suspension is exactly counterpoised with that element which has been assumed as the constant period.

That "Hare's" question necessarily implies that he suppose there is a constant variation between these two phenomena, but that it is not quite clear in me whether he supposes so or not. Quite clear in me that the variation of the magnetic meridian is a constant, and, therefore, apparently for its period some 300 years. In 1580 the needle at the north at Greenwich pointed due north, and in 1657 the needle at Paris so pointed, having previously, and subsequently, like the north. Hence 1657 both needles have returned to the first authority or nearly so, year by year; and finally the two needles have ten real true. In this the stations westerly deviation had been attained as Paris, but the Greenwich needle had been attained deflected westwards until March, 1818, when it reached the extreme limit of its western deviation. Both needles have since been travelling eastwards, that is, returning towards true north. The greatest westerly deviation attained at Paris was 22° 30′, to about 22°, whereas at Paris it is 19 (historical) westerly deviation attained at London the greatest westerly deviation attained at Greenwich 24° 41′ 30″ (Airy). Again, the inclination or dip of the needle was when it was first carefully observed, about 1576, 71° 50′ (Norman), and in 1720 (Graham), 74° 30′. In 1780 (Cavendish), 72° 30′. In 1827 (Hansteen), 70° 21′. In 1865 (Sabine), 70° 21′. In 1876 (Ivory), 67° 48′. Now, if the needle is the northern, the tongue of the needle's deflected by magnetic (the Earth), may be easily by suppose that the Earth, may be easily by suppose that the Earth, may be [illegible] at Greenwich of London in 1576, may be [illegible] at the North Pole, and has in the travelled round between the west of such a space 300 years. See do article of mine in the Standard of January, 1875. There is more information [illegible] with the work's magnificent [illegible] article of my "Light Sleeves for Leisure Hours."

ever, been studied. The accompanying diagram will show this for the last three minima.

If we suppose that the mean diurnal movement of the magnetic needle is determined for each month, we obtain the amount of the oscillation or range; the mean of the ranges thus found for twelve successive months is represented by a point in the curves; thus the last point in the lowest curve represents the mean of the ranges for the twelve months, October, 1876, to September, 1877 (corresponding to April 1, 1877, as shown by the observations made in the Trevandrum Observatory *specially* on the magnetic *equinox*). The point immediately preceding represents the mean range for the twelve months, September, 1876, to August, 1877, and so on for the other points.

If these curves are examined, it will be seen, that in the upper one the minimum is very clearly marked by two points corresponding to April 1 and May 1, 1876 (repre-



senting the mean ranges, October, 1875, to September, 1876, and November, 1875, to October, 1876), and that there is little difference in the rapidity with which the curve descends on, and ascends from, the minimum.

In the middle curve the epoch of minimum is by no means so distinctly marked; the minimum is, as by no eye, not the point for January 1, 1876, but the point for the ninth following that of a minute of arc) higher. In this curve the change of ranges in the diurnal oscillation is quite insignificant from November 1, 1874, to April 1, 1877, an interval of three years and five months. If this result is confirmed by other observations, as I believe will be the case, no such constant state of the earth's magnetic action will have been observed since the last years of the eighteenth century.

The observations of sun-spots, even if they give as accurate a measure of the intensity of the cause as that obtained from the movements of our magnets, cannot be observed with the same continuity, nor be measured with the same precision; but I have little doubt they will confirm generally the result shown in the last curve, as they have in preceding cases.

With regard to the aurora borealis, the appearances seem to have been very rare during the last two winters. In the report by Capt. Sir G. Nares, on the Arctic expedition, he says that in the winter of 1875-76, "Light flashes of aurora were occasionally seen on various bearings, but most frequently passing through the south; none were of sufficient brilliancy to call for notice. The phenomena may be said to have been insignificant in the extreme, and, as far as we could discover, were totally unconnected with any magnetic or electric disturbance" (NATURE, vol. xv. p. 58).

In the twelve months including September, 1875, and August, 1876, including the epoch of minimum disturbance and of several frequency, I observed in the south of Scotland on last, 55° 35') thirty appearances of the aurora, and from September, 1876, till the end of 1876 forty-nine appearances were observed at this single station.[1] Making every allowance for the continuous watch over the magnetic instruments at the Makerstoun Observatory during these years, the difference between Capt. Sir G. Nares' result, in so high latitude, in 1875-76, and that for the south of Scotland, is very distinct. I ought to add, with reference to the apparent want of connection of the faint auroral appearances with the magnetic disturbance noticed by Sir G. Nares, that several of the auroras observed by me were of the very faintest kind, mere "traces," as I have termed them, which I could never have remarked had I not been the sky with the greatest attention. Again, in no case have I seen the faintest trace of an aurora without finding at the same time a corresponding irregularity in the movement of the force or declination magnets.

I am unacquainted with any observations of the aurora made in the British Isles during the last two winters; I believe that no scientific institution exists in this country which makes the look-out for auroras throughout the night a definite portion of its work, and that all our knowledge of this phenomenon appears to be left to the chances of some one being out, at the hour of a display, sufficiently bright to attract his attention who will take the trouble to communicate his observation to a public journal.

JOHN ALLAN BROUN

P.S.—I have to thank Mr. A. Buchan for kindly furnishing me with a note of the auroras seen at the stations of the Scottish Meteorological Society during the year 1876. These amounted to forty-two in number, twenty-six in the first half and sixteen in the second half of the year. The greater part were seen in the most northerly stations, including the Orkney, Shetlands, and Faröe Islands; nine only having been seen south of the Forth. I cannot, however, compare the total result from the hundred stations of the Society with that from the single scientific station of Makerstoun in 1844, since much depends on the nature of the watch kept in each case. It is, however, gratifying to find so much attention given at the stations of that highly useful association, the Scottish Meteorological Society, to the observation of this phenomenon.

December 31, 1877

[1] "General Results of the Makerstoun Observations," by Isaac Pitman, Esq. See Edin. Trans., vol. xxvii. p. 1.

[2] I do not understand the expression of "equivalent light," which he uses as synonymous with the number of the aurora, which he considered a spectrum of some solar origin. Auroras, vol. xv. p. 226. The spectrum must have been common and brilliant in the dark days of September and October before dawn (about five o'clock), when I frequently saw the aurora in the south-east. In the two years, however, it is very rarely seen in the south or south-west at Makerstoun: every fifth night during which observations were made, on an average of many years, and only once in the month at 9 P.M. I would be glad to know of nearly three hours such as I remember during the latter part of 1844, and what with a bright or brilliant aurora in the south-east, and a fine display in the north, I was unable to sleep for excitement. I have, of course, seen many auroras since, both with other observers in Ireland and Scotland, and I had therefore formed a high standard. I would be most important, especially as made so frequently at the epoch of minima.

ON COMPASS ADJUSTMENT IN IRON SHIPS[1]

II.

AN important objection was made to me some years ago by Capt. Evans against the use of compass-card corrections in the Navy, that they would prevent the taking of bearings by the pelorus-and-sooth arrangement, which forms part of the *Admiralty* standard compass. The azimuth mirror (Fig. 5) applied to the compass before you was designed to obviate that objection. By its use even bar shifting bearings of objects on the horizon is not interfered with by the plate corrections, the quadrantal corrections, even if their highest points rise as high as five inches above the glass of the compass-bowl. It is founded on the principal of the camera lucida. The observer when taking a bearing turns the instrument round in vertical axis until the object and line see fairly opposite to the object. He then looks through the lens at the degree divisions of the compass-card, and turns the mirror round its horizontal axis till he brings the image of the object to fall on the card. He then reads directly on the card the compass bearing of the object. Besides fulfilling the purpose for which it was originally designed, to allow bearings to be taken without interference from the quadrantal corrections, the azimuth mirror has a great advantage in not requiring any adjustment of the sights to suit the altitude of the object, as in the pelorus-and-sooth the line is brought to exactly cover the object. The focal length of the lens in the azimuth mirror which I use is only 2·4 per cent. longer than the radius of the circle of the compass-card used, and thus, by an elementary optical principle, it follows that two objects a degree asunder on the horizon will, by their images seen in the azimuth mirror, cover a space of 1·024 of the divided circle of the compass-card however high the objects are above the horizon. The instrument round its vertical axis through one degree will only alter the apparent bearing of an object on the horizon by 1°. Thus it is not necessary to adjust it exactly to the direct position for the bearing of any particular object. If it be designedly put even as much as 4° away on either side of the direct position, the error on the bearing would hardly amount to half a degree. If the instrument were to be used solely for taking bearings of objects on the horizon, the focal length of the lens should be made exactly equal to the radius of the circle, and thus even the small error of 1·2° in the bearing for one degree of error in the setting would be avoided. But one of the most important uses of the azimuth instrument is to get a correct bearing by means of the azimuth instrument at sea is to correct the bearings of sun or stars at altitudes of 15° or 20° or 60° above the horizon. The actual focal length is chosen to suit an altitude of 25°, or thereabouts (this being the angle whose natural secant is 1·1), for those objects whose altitudes are

[1] Report of paper read to the Royal United Service Institution, February 15, 1878, by Archibald Smith, M.A., LL.D., Trin. Coll. Camb., Professor of Physics in the University of Glasgow, and Fellow of St. Peter's College, Cambridge. Revised by the Author. The Council of the R.U.S.I. have kindly permitted it to be published by W. Thomson's Copper Engraver, and have printed it on the use of the illustrations.—ED.] Continued from p. 322.

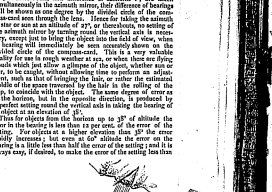


FIG. 5.

a degree by turning the instrument so that the red point, which you see below the lens, shall point within a degree of the position marked on the circle of the compass-card by the image of the object.

But taking star azimuths the azimuth mirror has the great advantage over the prism compass, with its lens invisible hair, that the image of the star is thrown directly on the illuminated scale of the compass-card. The degree of illumination may be made less or more, according to fairness or brilliance of the object, by holding a timesaie lamp in the hand at a greater or less distance, and letting its light shine on the portion of the compass-card circle seen through the lens. Indeed, with the azimuth mirror it is easier to take the bearing of a star somewhat bright star by night than of the sun by day: the sun is seen as a fine point on the illuminated compass-card, and it is easy to read off the position laterally by estimation to the tenth of a degree; whereas, as well as the most accurate of all, however, is the sun when bright enough and high enough above the horizon to give a good shadow on the compass-card. For this purpose is the small silk thread which you see, attached to the framework of the azimuth mirror in such a position that when the instrument is properly placed on the glass of the compass-bowl, the thread is perpendicular to the glass and through the central bearing-point of the compass.

Another advantage of the azimuth mirror particularly important for taking bearings at sea when there is much motion, is

level of the platinum wire. By aid of a totally reflecting prism, like that of the polarimetric scientific apparatus, with one side convex, the user of the instrument looking downwards sees where the black line on the cut of the prism is exactly level with the zero on the glass plate. This mode of sighting has proved very accurate, is very quick and quickly used, and it is so sensitive that with the finer motion and magnetic power of the instrument in it shows easily a variation of vertical force corresponding to 1 on the card's vertical force in this locality. The accompanying printed instructions for the adjustment of my compass circles is sufficient detail the way of using it for correcting the heeling error.

In the instrument before you there is a divided paper circle in the bottom of the box to serve as a "dumb card," to be used with the azimuth mirror when there may be occasion for the use of a non-magnetic azimuth instrument. This appliance has nothing to do with the dipping needle, and is introduced because, while adding little or nothing to the cumbersomness of the instrument, it saves the adjuster the necessity for carrying a separate azimuth instrument with him.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—From the University Calendar for 1878 we learn that the Undergraduates, who were last year 3,500, have now risen to 3,650, while the members of Convocation have increased from 4,870 to 5,006. During the year 300 have taken the degree of Master of Arts, and 456 that of Bachelor of Arts. The number of matriculations, which in 1868 was 370, and which in 1876 was 650, rose in 1877 to 770. But this increase was due to the number of candidates for a musical degree. The list of members of Congregation—that is, of the legislative body of resident members of Convocation—has increased, but only slightly. In 1876 they numbered 314; in 1877, 322. But the proportion between clergymen and laymen has considerably changed during the year. In 1876 there were 160 clergymen and 154 laymen; in 1877 the laymen have risen to 154, and the clergymen have fallen to 168. Of the whole body of Fellows (exclusive of Christ Church, resident and non-resident, there are at present 192 laymen and 110 clergymen.

CAMBRIDGE.—The Council of the Senate having had under consideration a letter from Prof. Hughes, Woodwardian Professor of Geology, representing the need for additional assistance, propose that an assistant be appointed, with a stipend of 200*l.* per annum, whose duties shall be to assist the Professor in the arrangement and care of the geological collections, to give such instruction and demonstration as may be required, and to assist students generally out of the museum. It is proposed to vest the appointment in the Professor, with the consent of the Vice-Chancellor.

EDINBURGH.—A site has been secured in Chambers Street, close to the University, for the erection of a new school of medicine. The extra-academical teachers, on the spot formerly occupied by Surgeon's Square, so long the scene of the demonstrations and practice of eminent extra-mural lecturers.

TAUNTON COLLEGE SCHOOL.—A testimonial, edited by Smith and Beck, with other valuable appendices, has been presented to Mr. Rev. W. Tuckwell by his assistant-masters in the Taunton College School, as an expression of their personal sympathy and their recognition of the services rendered by him in the higher education.

TRIESTE.—January 20 was a red letter day for a number of professors in Prussian universities, no less than fifteen receiving orders of different ranks from the Emperor William.

DARMSTADT.—On May 1 the Royal Polytechnic Institution at Dresden will celebrate the fiftieth anniversary of its foundation. Originally confined to the narrowest limits, the Institution has rapidly developed, and is now one of the most frequented polytechnic schools of Germany.

GREIFSWALD.—The attendance on the university shows a decrease as compared with the past summer. The students number 43 in the theological faculty, 73 in the legal, 126 in the philosophical, and 228 in the medical. The corps of professors and privat-docents is at present 60. A library of 60,000 volumes, well equipped laboratories and collections, and ample reverium place Greifswald on a par with most German universities, but for a number of years it has failed singularly to compare in point of attendance with many poorer centres of study.

THORNTON.—The university shows at present the highest winter attendance since its foundation. The students are divided as follows: Theology (evangelical), 215, (catholic), 108; law, 256; natural sciences and medicine, 222; philosophy, 145.

MÜNSTER.—Prof. R. Sturm, of the Darmstadt Polytechnic, has been appointed to the chair of mathematics, rendered vacant by the late death of Prof. Heis. The number of students at present is 312.

BERLIN.—Prof. Schweckener, of Tübingen, has received a call to Berlin to fill the second professorship for History lately created at the University.

VIENNA.—In the lately presented educational budget of Austria the sum of 50,000*l.* is appropriated for the erection of new buildings for the Vienna University.

DORPAT.—The hitherto rigorous rule of Russian universities requiring from all instructors the possession of Russian diplomas of the doctorate, &c., has been modified in the case of Dorpat, recognition being made of foreign degrees and professorial positions.

SIENNA.—The Imperial Commission appointed to settle the long-debated question as to the University of Siena, has definitively given the university the title of Royal University, with one of the seven Universities because of its central position in Tuscany, its larger population, and extensively scholastic area, as at Omie, and the larger number of secondary schools. Several Siennese merchants have endowed the future University with considerable sums of money.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 31.—"On the Expression of the Product of any Two Legendre's Coefficients by means of a Series of Legendre's Coefficients," by Prof. J. C. Adams, F.R.S.

"Royal Society, February 14.—"On the Use of the Reflection Grating in Eclipse Photography," by J. Norman Lockyer, F.R.S.

The results obtained by the Eclipse Expedition to Siam have led us to think that, possibly, the method of using the coronal atmosphere as a circular slit, suggested by Prof. Young and myself, for the Indian eclipse of 1871, might be applied under very favourable conditions, if the prism or train of prisms hitherto employed were replaced by one of those reflection gratings with which the generosity of Mr. Rutherfurd has endowed so many of our observers.

To test this notion I have made some experiments with a grating, which I owe to Mr. Rutherfurd's kindness, containing 17,280 lines to the inch. The results of these observations I propose the honour of laying before the Royal Society.

In front of the lens of an ordinary electric lamp, which lens was adjusted to throw a parallel beam, I have introduced a circular aperture, cut in cardboard, forming an almost complete ring, the breadth of the aperture in thirteen diameters, the breadth of the ring about one-fifth. This was my artificial eclipse.

At a distance from the lens equal to twice its focus, I mounted a 3½ inch Cooke telescope, of five-feet focus. As I bought, from distance about of this focus I placed Mr. Rutherfurd's grating, and, where the first solar spectrum fell, I placed a focussing screen. To adjust for sharp focus, in the first instance, the grating was so inclined to the axis of the telescope that the image of the ring reflected by the silver surface adjacent to the grating was thrown on to the screen. This done, the grating was placed at right angles to the axis, and the spectrum of the circular slit, illuminated by sodium vapour and carbon vapour, photographed for the first, second, and third orders on one slit. The third order spectrum, showing the coquidite rings due to the carbon vapour fairings was produced in forty-two seconds. The first order spectrum, also adjusted to the Society, was produced in the same period of time, and was very much over-exposed; it is, however, I think not expecting too much that we should be able to take a photograph of the eclipse, in the third order, in one minute; but let us make it less. Similarly, we may hope for a photograph of the second order in two minutes, and if in, I

in the western suburbs of London, and perhaps also in other parts. Two remedies are recommended for warding off the insects; one by scattering amongst the plants some pulverised gas-lime, and the other by watering with the liquid from pig-sties. The clouded yellow butterfly (*Colias edusa*) was, it seems, "the great appearance of the year," and was first seen near Dumfries early in June, and across the south of England it was generally observable from June till October. The frequent death of the larvæ when feeding on various clovers and trefoils is mentioned as a point of interest relatively to its permanent settlement, as also the great difference in the quantity of the sexes noticed at various stations which may be followed by coincident variety of appearance next year. The report is published by Mr. T. F. Newnam, Botolph Lane, Eastcheap, from whom we believe copies may be obtained. Every information on the subject will also be supplied on application to the Rev. T. A. Preston, The Grove, Marlborough, Wilts, E. A. Fitch, Esq., Malden, Essex, or Miss E. A. Ormerod, Dunster Lodge, Spring Grove, Isleworth.

THE St. Petersburg University has addressed a note to the Ministry of Public Instruction requesting that the necessary steps be taken for the preservation of any valuable manuscripts which may be found in the Turkish towns occupied by Russian troops. Valuable manuscripts were preserved in this way from destruction in the War of 1829, and important manuscripts have already been discovered in the museums of Tiflous.

A SMALL Japanese "line" book comes to us in the shape of a report by the department of Public Hygiene on some of the mineral waters of the country and the uses to which they may be put. Japan seems to contain a great variety of such waters.

At the meeting of the Musical Association on February 4 a paper was read by Mr. D. J. Blaikley, "respecting a Point in the Theory of Bass Instruments." The necessary difference between such instruments and contact tubes was pointed out, and a new experimental method for determining the positions of the nodal points in tubes, especially applicable to such as are of varying section, was shown. As an instance may be given a conical tube open at both ends and of the pitch C 512 vib. The node is nearer the small than the large end of the tube, and by sliding one end in water and holding a fork of the pitch of the tube over the other, the exact position of the node is shown by the level of the water when the tube is giving its maximum resonance.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*) from India, presented by Lieut.-Col. Fielden; a Grivet Monkey (*Cercopithecus griseo-viridis*) from North-eastAbbissinia, presented by Mr. E. H. Lockley; a Banded's Night Heron (*Nycticorax gardeni*) from South America, presented by Mr. Henry Batrell; three Chimpanzees (*Troglodytes niger*) from West Africa, deposited; a Black-faced Spider Monkey (*Ateles ater*) from East Peru, a Collared Peccary (*Dicotyles torquatus*) from South America, a Globose Curassow (*Crax globicera*) from Central America, a Black-footed Penguin (*Spheniscus demersus*) from West Africa, a Harp Parrakeet (*Pezoporus wallicus*), purchased.

ON COMPASS ADJUSTMENT IN IRON SHIPS[1]

I.—*New Form of Marine Azimuth and Steering Compass with Adjuncts for the complete Application of the Astronomer-Royal's Principles of Correction for Iron Ships.*

THIRTY-EIGHT years ago the Astronomer-Royal showed how the errors of the compass, depending on the disturbing experienced from the iron of the ship, may be perfectly corrected by magnets and soft iron placed in the neighbourhood of the binnacle. Partial applications of his method have since been made use of in merchant steamers, and within the last ten years have become universal not only in the merchant service, but in the navies of this and other countries. The compass and the binnacles before you are designed to thoroughly carry out in practical navigation the Astronomer-Royal's principles. The general drawback to the complete and accurate realisation of plan for carrying out these principles heretofore, has been the great size of the needles in the ordinary compass which renders one important part of the correction, the correction of the quadrantal error for all latitudes by means of soft iron placed on the two sides of the binnacle, practically unattainable; and which limits, and sometimes paralyses, the other, the other chief part of the correction, or that which is performed by means of magnets placed in the neighbourhood of the compass. Five years ago my attention was directed to the subject through my having been called upon by the Royal Society Committee on Standards, and by Admiral Archibald Smith, with an account of his adaptation of one of the mariner's compass and ships' magnetism, and I therefore endeavored to make trial compasses with much smaller needles than any previously in use; but it was only after three years of very varied trials, in the laboratory and workshop, and at sea, that I succeeded in producing a mariner's compass with the qualities necessary for thoroughly satisfactory working in all ventilers and all seas, and in every class of ship, and/yet with small enough needles for the perfect application of the Astronomer-Royal's method of correction for iron ships. The needles small enough which I selected, partly by experiment at sea in my own yacht, and partly by dynamical theory analogous to that of Fourie with reference to the rolling of ships, was that steadiness of the compass at sea was to be obtained not by heaviness of needles or of compass-card, or of added weights, but by largeness of vibrational period[1] of the compass, however this largeness is obtained. This, if the addition of weight to the compass-card improves it in respect to steadiness at sea, it is not because of the additional friction on the bearing-point that this improvement is obtained; on the contrary, dulness of the compass-card, or heaviness of needles, is always accompanied by less friction at the point of support. The secret of the wonderful changes of the ship's head, then it would be were the point perfectly free and frictionless, supposing for the moment this to be possible. It is by increasing the vibrational period that the addition of weight gives steadiness to the compass; while, on the other hand, the increase of friction on the bearing-point is both injurious in respect to steadiness, and detrimental in blunting it or breaking it down, and boring into the cup, and so producing sluggishness, after a short time of use. If weight is, however, to be added to produce steadiness, the plane to add it would be at the very circumference of the card. My conclusion was that no weight is in any case to be added, beyond that which is necessary for supporting the needle; and that small enough needles to admit of the complete application of the Astronomer-Royal's principles of correction, the length of period required for steadiness at sea is to be obtained, without sacrificing freedom from frictional error, by giving a large diameter to the compass card, and by throwing by its outer edge as nearly as possible the whole mass of light weight which is required for steadiness.

In the compass before you (Fig. 1), it is these principles which are carried out. The compass-card is a thin rim of aluminium, and the two needles are thirty-two inches or four copper wires stretched from the rim to a small central boss of aluminium, sixteen wires to a needle, as it were, of the wheel. The needles of thin strong paper, and all the central parts of it are cut away, leaving only enough of it to allow conveniently the poles and degree-divisions of the compass. The central boss consists of a thin disc of aluminium, with a hole in its centre, which rests on the projecting lip of a small aluminium inverted cup mounted with a sapphire cup, which rests on a fixed iridium point (Figs. 2 and 3).

Eight small needles from 3½ inches to 2 inches long, made of thin steel wire, and weighing in all fifty-four grains, are fixed like the steps of a rope ladder on two parallel silk threads, and slung from the aluminium rim by four silk threads or four copper wires through a pin in the centre of the small pair of needles.

The weight of the central boss, aluminium cup, and sapphire

[1] Report of paper read by the Royal Naval Service Institution, February 19 by Sir Wm. Thomson, LL.D., F.R.S., F.R.S.E., Professor of Natural Philosophy in the University of Glasgow, and Fellow of St. Peter's College, Cambridge. Reached by the Author, 11th October 1877. Read by Fleet-Engineer H. T. Denny, R.N. Printed by permission of the Council of the Institution. Illustrated by Diagrams.

[1] The vibrational period, or the period (as it may be called for brevity) of a compass, is the time it takes to perform a complete vibration to and fro when deflected horizontally through any angle not exceeding 5° or 6°, and left to itself to vibrate freely.

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Terrestrial Magnetism.

To the Editor of the Scientific American:

Allow me to offer you the details and results of some experiments which I made recently, and which, so far as I have been able to ascertain, are original.

By way of introductory remark, I may say that about twenty years since, in a work entitled "Key to the Geology of the Globe," I endeavored to show that the trends and main mountain ranges of our continents bear a direct relation to certain phases of the ecliptic, being usually secondaries, or, in other words, at right angles to the sun's apparent path at the solstices, then forming angles respectively of about 23° or thereby with the meridians. These trends therefore correspond in the main to the position assumed by the needle at its extreme easterly east and west elongation, as far as we can judge from the magnetic observations made at Paris since 1580. The magnetic phenomena are now generally supposed to result from the effect of strong thermo-electric currents passing from east to west, between the tropics, along the apparent path of the sun.

As solar energy is some of its manifestations appeared to me, by reasons from the earth's interior on its exterior crust, to have an intimate connection with dynamical geology, and hence possessed great interest for me, I have, during the twenty years above alluded to, been devoting such time as I could spare from my collegiate duties to terrestrial magnetism in connection with physiographic and dynamical geology.

Just before the Buffalo meeting of the A. A. A. S., I had sent in the title of a paper which I had prepared, and intended to read, on this subject; but in consequence of a sunstroke I received I had to withdraw it. Since then, having recovered sufficiently to engage in some original experiments etc communications, to be followed probably by two more, to the Indianapolis *Daily Journal*. Inasmuch, however, as that journal may probably fail to reach some scientific men who might find an interest in these results, I offer you the following synopsis of the more recent experiments and results:

Using a delicate galvanometer, accurately adjusted, and the necessary amount of insulated fine copper wire for making the attachments, and being kindly aided by Mr. Brown-Wyllie, of the physical department, we drove iron rods of ⅝ inch diameter six feet into the ground. On the upper end of these I had had good sized eyes formed at the blacksmith's shop, so that with a round wooden lever inserted in the eye, and a few blocks as a fulcrum, we could take the rods up, in order to drive them again elsewhere. Sometimes these rods were driven due east and west of each other, at other times due north and south, at from 100 to 300 feet apart, while the insulated wires, finely stitched respectively to the two rods, were brought through the open windows of the museum, where, as that is under my charge, the galvanometer could be undisturbed. Being carried previously, by deflected by a known current (as for instance, from the carbon pole of the potassium bichromate battery) connected with a given binding screw, we could then be quite certain as to the direction of the so-called current transmitted from the iron rod or other material along either wire.

In this way we experimented at different hours of the day, and during varying weather on different days; we also attached one wire sometimes to an iron oil tank sunk six or eight feet under ground in the campus, at other times we formed wire connection with a water tank having a cast iron collar. We also sometimes connected one wire with the lightning rods or metallic gutters and spouts, and occasionally another wire from the underground tank, while the other was attached to an iron column above ground in the museum. The results of these experiments may be thus summed up:

1. Whenever both wires connected with underground objects north and south of each other, the current was invariably from south to north and usually strong, making a deflection of the needle, after breaking and connecting a few times, of at least 50°.

2. When the rods were east and west of each other the current was from the west, but comparatively weak, as high, however, sometimes as 45°.

3. When we experimented with a long cast iron fence, even in reader, placing the galvanometer and its wires in that central space (in which rose the connection with the earth's crust was made only by the stone pillars to which

the iron pillars of the fence were riveted), then the result showed currents from the south.

4. But when we brought one wire from an underground metallic source, and the other from a metal pillar, stove, fence, or the like above ground, then the current, as far as yet tried, was from the atmosphere to the earth.

The above experiments would seem to justify the conclusion that those electrical currents in the earth's crust are due to the thermal difference between countries southward of us, such as Mexico and Central America, and our portion of Indiana, or regions northerly from us.

It would be interesting to repeat those experiments here, as I shall do if health permits, during the summer, there having all been made in January and February of this year. And, as we are here *west* of the agonic line, it would be interesting also to repeat them in some of our eastern cities which are situated *east* of said agonic line. If the currents then should be found to come from the southeast, occasioned probably by the great heat in northern South America, the variation or declination of the needle would then appear to cause said needle to assume a position parallel to the so-called currents. The magnetic needle does often undoubtedly assume that relation to a weak current transmitted along a single wire, although when the current is strong, as in the solenoid, the needle places itself at right angles to the current.

One more suggestive thought before I close: In stellar electricity, the nonconducting glass of the Leyden jar enables that peculiar mode of motion to accumulate on the surface of the gold leaf within the jar when charged. A much somewhat similar mold the molecules of steel may, perhaps, explain the reason why *pure iron* easily receives and easily parts with that mode of motion, or form of energy termed magnetism, while steel, in which molecules of carbon, comparatively non-conductors, are interposed between the molecules of iron, retains its magnetism.

In the case of the Leyden jar, if we connect the pent up motive molecules of gold leaf with the outside foil by a conductor, we have a rapid transference of motion; but if no conductor is presented, the motion remains bottled up, so to speak, just as with other modes of motion (first vital, then chemical action and heat) derived remotely from the sun, there is energy bounded up in the stick of firewood or lump of coal, to be converted, under certain circumstances, into the artificial heat necessary to maintain normal nervous energy (probably another form of motion) during periods of great climatic cold.

[illegible] the same way, perhaps, magnetism remains dammed up by the carbon, until, by the proximity or contact of a conductor, we render practicable the transference or propagation of the motion. Of course, besides the magnetism which we can induce by proximity of magnetized bodies, the earth's inductive action is always operative on all iron vessels, giving them, while they remain in certain fixed positions, the properties of a magnet; and if of steel they soon become *permanently* magnetic. By running a sewing needle through a short cork, and using the former as a pivot for a delicate magnetic needle, the above phenomena can be readily observed in all permanently placed stoves, hinges, locks, etc., even in iron tinned cups piled on each other and subsequently detached, thus first forming a long magnet and then a number of smaller magnets. The magnetism, or polarity, *here and of your stove*, especially if it is of a round or cannon form, uniformly attract the south end of your needle, while the upper part of the stove, hinge, tin cup, etc., as invariably attracts the *north* or marked end of your needle. Should new facts present themselves, I may perhaps offer a statement of them in a future communication.

Very respectfully yours,

RICHARD OWEN,
Professor Natural Science.

Indiana State University, Bloomington, Ind., Feb. 8, 1878.

[We have since received a later communication from Professor Owen, dated February 11, 1878, in which he states that he has been able to repeat these experiments a number of times and in a variety of ways, during four additional days. The results were the same, except that the amount of deflection varied; being, however, usually from 28° to 30°. He of Paris, described in the Scientific American of February 2d, although the results obtained by the French physicist, in his experiments with the galvanometer and water tank, were given to the public previous to his own, still he even believes himself to be the first to indicate the direction of the current in the earth's crust.]

Eastward Progress of Terrestrial Magnetism

As the progress of weather eastwards is one of the subjects now engaging attention, while the possible connection between meteorological and magnetical phenomena is another, we are led to ask if there be no traces of an eastward progress in certain of the phenomena of terrestrial magnetism.

I cannot yet affirm that such is the case, but it may interest your readers to know that, as far as a preliminary investigation goes, there are some indications of such a progress when we compare together the Declination-ranges at Kew and at Trevandrum. It will, however, require a more thorough discussion before the fact can be considered as at all established.

Manchester, May 4 B. STEWART

(SEQUEL.)—Magnetizing.—Place the magnets on a board parallel to each other, and at a distance apart equal to the length of the magnets, the poles of pure horseshoe magnet. Across these poles lay a piece of soft iron, two bits of soft iron, so as to form a rectangle. Secure this in the board. Then place the large magnet on them, the poles not one on each material [illegible] other. The effect is always about to the other end. Then lift it off, and repeat the process. Then reverse the magnet, occasionally reversing the magnets over.—F. E. FLOYD.

MAGNETIC FIGURES.

To the Editor of the Chemical News.

SIR,—In your last issue you published the report of a meeting of the Physical Society held on Saturday June last. In that report it is stated that Mr. S. P. Thompson exhibited a series of "magnetic figures produced by electrodynamic solenoids." These figures are produced by laying upon glass plates the curves obtained by the use of iron filings scattered in a magnetic field. There are probably few who deliver courses of lectures upon electricity and magnetism who have failed to make use of some such simple device for showing the nature of a magnetic field in that now dignified by the term "magnetic figures illustrating electrodynamic relations." But the very device used has also been employed. As a lecture upon the "Telephone" which was delivered at the United Trade and Mining Schools in April last, I exhibited some of these figures upon the screen, and described the method of preparing the plates which resulted in exactly similar to that now employed by Prof. Thompson. I have also used this figure to illustrate various other lines drawn on the 29 figures which were traced in a similar manner, now in the Physical Cabinet at that Institution, and have been either extensively used, both in my own and other classes.

One of Prof. Thompson's students was present at this lecture, and a full report appeared in the Bristol papers.

ERNEST H. COOK.

Ilfracombe, July 4, 1876.

INTERNAL MAGNETISM.—M. J.M. Gaugain, from experiments upon steel tubes and anchil, concludes that the changes of magnetism which are produced, under the influence of heat, in a solid steel bar, do not differ from those which are produced under the same influence, in a system composed of a tube and a nucleus. Both seem to depend on the inverse magnetism developed by the mutual reaction of consecutive layers, either of the bar or of the system.

surrounded by an atmosphere containing sufficient hydrogen sulphide, the opposite effect occurs. Now the needle, when strongly electrified, turns from copper to iron; when oxidized, from iron to copper. The conclusion to be drawn from these facts appears to be that the electrical behaviour of metals in metallic contact is, if not entirely, due to the difference of their affinities for one of the elements of such compound gases as may be in the atmosphere surrounding them. This would be entirely analogous to their behaviour in electrolytes containing these same elements, *e.g.* iron is positive to copper in an oxidizing electrolyte such as water, because of the affinity of oxygen for iron being greater than for copper, while iron is negative to copper in potassium sulphide solution, because of the affinity of sulphur being greater for copper than for iron. J. HAWKS

Ebenezery House, Belfast

Solar Halo

THE following was noticed at Bordeaux on April 4, at 11 A.M.:—1. A well-defined and very complete circumzenithal circle (86° in diameter), of a brilliant white light, passing through the sun. 2. An iridescent circle, larger than the first, and resting it at two points 60° distant from the sun. The second circle showed more especially the red rays on its concavity (*i.e.* towards the sun), except at the parhelia, where it was bright iridescent. Near the western parhelion the brilliancy of the mock sun was quite insufferable to naked eyes.

The morning was very warm, but the night had been very cold. E. DURUTE

29, Rue Saulnat, Bordeaux, April 29

FLOATING MAGNETS

THE extract from the *American Journal of Science* describing experiments with floating magnets by Mr. Alfred M. Mayer to illustrate the equilibrium of mutually-repellent molecules each independently attracted towards a fixed centre, which appeared in NATURE, vol. xvii. p. 487, must have interested many readers.

It has interested me particularly because the mode of experimenting there described, with a slight modification, gives a perfect mechanical illustration (easily realised with satisfactory enough approximation) of the kinetic equilibrium of groups of columnar vortices revolving in circles round their common centre of gravity, which formed the subject of a communication I had made to the Royal Society of Edinburgh on the previous Monday. In Mr. Mayer's problem the horizontal resultant repulsion between any two of the needles varies according to a definite law of their mutual distance readily complicated function of their mutual distance readily calculable if the distribution of magnetism in each needle were accurately known. Suppose the distributions to be precisely similar in all the bars and in each to be accomplishing to the following law:—Let the intensity of magnetisation be rigorously uniform throughout a very large portion, *c*, in the whole length of the bar (Fig. 1), and let it vary uniformly from C and D to the two ends A and B. The bar will act as if for its magnetism were substituted ideal magnetic matter, or polarity, as it may be called, uniformly distributed through the end portions CA and DB; the whole quantity in D B to be equal in amount and opposite in kind to that of C A. For example, suppose true northern polarity in A B and true southern in B D. The lengths of C A and D B need not be equal. Let now A′C′D′B′ be another bar with an exactly similar distribution of magnetism to that of A C D B, and let the two bars be held parallel to one another. The mutual repulsion will vary inversely as the distance, if the distance be sufficiently small in comparison with B B′ or C A, and if each of these be infinitely small in comparison with C D. If the bar A′B′ of a powerful bar-magnet be held in a true south pole S of a powerful bar-magnet be held in a line midway between B A and A′ A, at a distance from the ends B and B′ infinitely great in comparison with B B′, and comparable with the length of each needle, the horizontal component of its effect on each magnet will be a force varying directly as its distance from the central axis. Under these conditions Mr. Mayer's experiments will show configurations of equilibrium of two, or three, or four, or any multitude of ideal points in a plane, repelling one another with forces inversely as the mutual distances, and each independently attracted towards a fixed centre with a force varying directly as the distance. This, as I showed in my communication to the Royal Society of Edinburgh, is the configuration of the group of points in which a multitude of straight columnar vortices with infinitely small cores is cut by a plane perpendicular to the columns; the centre of inertia of a group of ideal particles of equal mass placed at these points being the fixed centre in the static analogue.

The consideration of stability referred to by Mr. Mayer has occupied me much in the numerical problem, and it is remarkable that the criterion of stability or instability is identical in the static and kinetic problems. In the static problem it is of course that the potential energy of the mutual forces between the particles, together with that of the attraction towards a fixed centre is less for the configuration of stable equilibrium than for any configuration differing infinitely little from it. The potential energy of the attractive force in a function of distance from the central axis, diminishing as the distance increases, and the statement of the criterion may be conveniently modified to the following:—

For a given value of this function the mutual potential energy of the atoms must be a minimum for stable equilibrium. When, as supposed above, the attractive force varies directly as the distance its potential energy is:—

$$C - \frac{1}{2}\alpha r^2$$

where C, α denote constants, and $2r^2$ the sum of the squares of the distances of all the particles from the attractive centre. And when the law of force between the particles is the inverse distance, their mutual potential energy is equal to—

$$K - k \log. (D\,D'\,D'' \ldots)$$

where K, k denote constants, and D, D′, D″, &c., denote the mutual distances between the particles. Thus the condition of stable equilibrium becomes that the product of the mutual distances between the particles must be a true

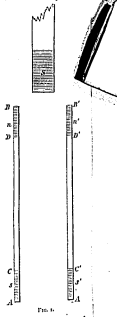

FIG. 1.

minimum for a given value of the sum of the squares of their distances from the attractive centre. A deduction from this condition must be that the centre of gravity of the particles must be the attractive centre. Now the condition of kinetic equilibrium of a group of vortex columns, that is to say the condition that they may revolve in circles round their common centre of inertia is, as proved in my communication to the Royal Society of Edin-

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EXPERIMENTS WITH FLOATING AND SUSPENDED MAGNETS, ILLUSTRATING THE ACTION OF ATOMIC FORCES, THE MOLECULAR STRUCTURE OF MATTER, ALLOTROPY, ISOMERISM, AND THE KINETIC THEORY OF GASES.

By ALFRED M. MAYER.

I HAVE recently devised a series of new experiments which are so easy to make and so well adapted to illustrate the action of atomic forces and the molecular structure of matter, that I think a description of these experiments will be acceptable to all those who are interested in the study or teaching of science.

Any portion of matter, whether solid, liquid, or gaseous, is forced into a smaller volume when subjected to pressure (in other words, matter is compressible), and when this pressure is removed, the matter expands into its original volume. This shows two things: first, that the matter of which the body is formed does not really fill all the space which the body appears to occupy; and, secondly, that in the body is a force which, acting from within outward, resists the outward pressure and expands the body to its original volume when this pressure is removed.

There are several instances where a volume of one liquid when mixed with an equal volume of another liquid does not form a mixture of two volumes, but their combined volume is considerably less than the sum of their separate volumes. Thus, when one mixes one volume of water with an equal volume of alcohol, their combined volume is less than the sum of the volumes of the water and alcohol before the mixture. These experiments show that the spaces which the volumes of water and alcohol appeared to fill were not really filled with water and alcohol matter, but that vacant spaces (vacuola) existed in these liquids. In other words, these liquids are porous, like the ether. This shrinkage of the mixed alcohol and water is all the more remarkable when we remember that each additional atmospheric pressure on water lessens its volume only by the $\frac{1}{22000}$th part.

These phenomena of compressibility and porosity, which we have just described, may be explained by supposing that all matter is built up of very minute parts, and that these parts do not touch, but are kept asunder by the action of two forces which exactly balance one another. One of these forces is a constant attraction which tends to bring these minute parts together; the other is a force of repulsion which constantly tends to separate them.

There are two laws in chemistry which lie at the foundations of that science, and which cannot well be explained except by the assumption that matter is really formed of these minute parts, and, also, that the minute parts have definite and constant forms, volumes, and weights. The volumes and weights, and probably the forms, differ with the different kinds of matter. These minute parts are called *atoms*. These atoms are assumed to be ruled by forces of attraction and repulsion, so that when these two forces exactly balance, the atoms will be separated and arranged in a geometric manner around some central point. Such a combination of atoms is called a *molecule*. A molecule may be defined as the smallest portion of any kind of substance which can have the chemical properties of the substance, while an atom is defined as the smallest particle of elementary matter which can enter into the composition of a molecule. Thus a molecule of water may be supposed to be formed of two atoms of hydrogen and one of oxygen. This is the smallest mass of these two atoms which can form water, for if one of these atoms should be removed from the molecule, the molecule would break up into hydrogen and oxygen.

The first of the two laws of chemistry, above referred to, is this: The same body is invariably composed of the same elements united in the same proportions. Thus, water, no matter how formed, is composed of one part by weight of hydrogen united to eight parts by weight of oxygen; and carbon dioxide, whether formed by a burning candle, by the combustion of carbon in oxygen, or by breathing, is always formed of six parts by weight of carbon united to sixteen parts by weight of oxygen. This law is readily explained by the suppositions we have made as to the existence of atoms and the structure and nature of molecules. For, since the molecule of the same matter is always formed of the same number (or weight) of atoms, and since masses of matter are made up of combinations of many molecules, it follows that these masses of matter will have the same proportions by weight of the same elementary atoms as compose the molecules.

The second law is this: When an element unites with another in different proportions, the higher proportions are invariably multiples of the lowest. This nitrogen and oxygen show and form the following five different compounds:

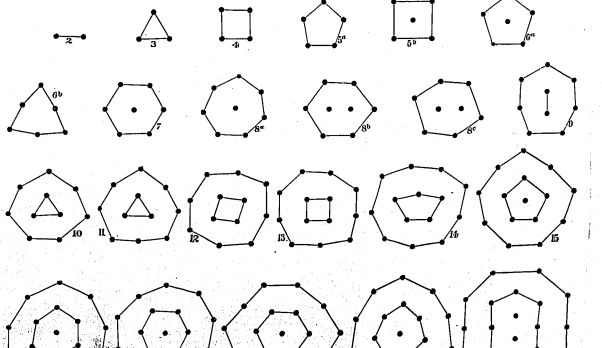
1. Nitrogen monoxide contains 28 of nitrogen and 16 parts of oxygen.
2. Nitrogen dioxide contains 28 of nitrogen and 32 parts of oxygen.
3. Nitrogen trioxide contains 28 of nitrogen and 48 parts of oxygen.
4. Nitrogen tetroxide contains 28 of nitrogen and 64 parts of oxygen.
5. Nitrogen pentoxide contains 28 of nitrogen and 80 parts of oxygen.

In this series of compounds oxygen unites in five different proportions, and if you call the lowest proportion, in the monoxide, *one*, then the proportions of oxygen in these compounds are *one, two, three, four, five*.

This second law may be explained by the supposition that, as we have stated, the molecule is a combination of atoms, and that there is always the same number of these atoms in a molecule of the same substances. Thus, in the five oxides of nitrogen mentioned, of oxygen, the molecule of nitrogen may be supposed to always consist of two atoms of nitrogen, and may be represented by **N N**.
The molecule of oxygen we may suppose formed of a single atom and may be represented thus, **O**. If this be granted, then these molecules unite as such, it follows that the various combinations of nitrogen and oxygen must take place as the second law states, and these compounds may be represented by the following table of the combinations of the symbols **N** and **O**:

Nitrogen monoxide	= **N N O**.
" dioxide	= **N N O O**.
" trioxide	= **N N O O O**.
" tetroxide	= **N N O O O O**.
" pentoxide	= **N N O O O O O**.

There is a law, known as the law of Avogadro, which states that equal volumes of gases contain equal numbers of molecules; but as atoms of different elementary substances are of different size and weights, it follows that molecules



EXPERIMENTS WITH FLOATING AND SUSPENDED MAGNETS.

REMARKABLE CHANGES IN THE EARTH'S MAGNETISM!

ONE of the most important, scientifically, of the special lectures at the Geographical Society, was that by Capt. Evans, in March last, on the subject of terrestrial magnetism. The

[From Letter of the Royal Geographical Society, March 11, by Captain F. J. Evans, R.N., R.A., Hydrographer to the Admiralty.

URE [May 16, 187

escaping portion, especially, is of high scientific importance. Capt. Evans gave a bi-chromic sketch of the course of terrestrial magnetism from the time of the discovery of the dip of the magnetic needle. After specifying further on various departments of inquiry, Capt. Evans went on to say—

"We have now passed in review the successive stages of development of our branch of knowledge, from the pregnant epoch when its principles were established by Gilbert, till the period when the well-directed assiduousness of its own and other Governments dotted the earth's surface with observatories, and furnished land and sea expeditions, specially equipped, for the determination of the magnetic elements. We have seen how, at length, the foundations for future generations to build on were laid, gaps slowly, and insensibly the symmetry discernible even surrounding the needle's daily and yearly movements, in the inconsequents to their primary centre, the sun; and how by the perseverance of states and of individuals, we are now in possession of a comparatively complete knowledge as to the distribution of magnetism over the surface of our globe, as represented by the variation and dip of the needle, and by the measure of the force connected with these component elements. But the task, from a scientific point of view, is by no means completed while we remain in ignorance of the causes of greater changes in the earth's magnetism going on from year to year, and so, probably, through all time. From a practical point of view, so far as the interests of men are concerned, the collection of records will be a never ending task, for every generation must observe and chart the magnetic elements of its time.

"The subject of secular change is then one of such great interest that the remaining portion of my address must be chiefly devoted to it. The solution of such problems must be chiefly the first, to the probable extent of future endeavours, as one of observation—the variation of the elements; secondly, to the mode, and projecting them on polar charts, as the form that the convergence of the lines of force in the north and south magnetic areas in each hemisphere. On this is to be based the question as to whether the whole globe of the earth is one great magnet, having two magnetical poles or points of attraction and repulsion, or whether it is made up of a number of such, as some of the world is governed by a number of these magnetic poles in addition to over the new magnetic poles, Halley saw, as he confessed with despair, the difficulties in the way of such a proposition, "on having heard of a certain sect having four poles," but there were the facts manifested by the needle, and he was too sagacious not to accept a phenomenon because he was too sagacious not to accept a theory which, however true, he accordingly propounded perhaps did at the time by a man of his position, he occasioned, for of genius, and may probably be, nevertheless within a hit of the truth. Halley stated independently of the external shell of the earth, which he considered as passing through the centre; but the two men believed in each other and the movements of the convergent four imaginary poles in each tion of the problem.

"Humboldt, looking at the same problem a century after Halley [1827-29], and much on the same lines, arrived at the same conclusion with regard to the four poles of attraction; and he had discovered the secular magnetic attraction of the first who seem, with the natural aid of his extensive travels, to have further, not consulted, but on his geographical position as a probable period of the variation of this element, however a step in the direction of this subject, and the general question of the conjunctions he found that the North American pole or pole traversed 1,292 years, and that the North American pole or magnetical pole, the Siberian 962 years; the pole in the Antarctic near Cape Horn, 1,304 years.[1] 2,634 years; and a secondary pole investigations on the minds of subsequent inquirers may easily be traced.

"The learned views of Sir Edward Sabine on the secular changes—enunciated in the clearest manner in 1864-72—are deserving of the highest consideration. An ardent admirer of

[1] *Untersuchungen über den Magnetismus der Erde.* Cotta'sche, 1810.

Challenger's officers;[1] at Valparaiso and Monte Video, compared with those made in preceding observers, show that within half a century the whole force has been steadily diminished one-sixth and one-seventh—that the Falkland Islands one-sixth. Further north we find at Bahia a decrease of one-fifth, in the same period of time, an equally marked diminution of one-sixth of the force. This mass of diminishing force is seen at St. Thomas, at Trinidad, at Hobson on the east; at the Cape of Good Hope there is evidence of the force decreasing.

"Such are the facts, and how are we to interpret them? Which, over way we look at the subject of the earth's magnetism and its secular changes, we find marvellous complexity and mystery; in lapse of time and increase of knowledge appear to have thrown no further and further back in the vistas of the past. The terrells of Hallley, the revolving poles of Hansteen, and the more recent hypotheses of the ablest men of the day, have failed to solve the mystery. We must not, however, be discouraged at these repulses in the great conflict for the advancement of human knowledge. The present century has been productive of keen explorers in the field of terrestrial magnetism; other centuries will have no less pressing exigency than the present; and knowing as we do that knowledge shall be increased, we may confidently anticipate that the day when duly, one of Nature's most formidable secrets, shall be revealed."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

At the annual meeting of the Convocation of the University of London on May 14, a report from the senate committee was presented with the recommendation above mines and co-operation of the colleges and medical schools affiliated to the University with each other and with the Senate, and also more direct participation by the University in the work of higher education and in the encouragement of new original work. The following resolutions were carried by large majorities after an animated debate, in which Drs. Sharpey, Payne, Hayter, Pye-Smith, and Weymouth, and Messrs. Hutton, Carey Foster, R. N. Fowler, and Finch, took part:—That this Convocation is of opinion that the admission of candidates for degrees in the faculties of the teachers of the candidates by a body independent of the course of study pursued in those institutions should be brought into closer connection with the Senate. 2. That with under the present Charter of revision, it is desirable to exercise its powers of, and from time to time call a meeting of affiliated bodies for this purpose, including in the invitation to or excluding from the University examinations for degrees, such other colleges as the Senate may in each case determine. 3. That the Senate be requested to take into consideration the question whether it would be desirable to constitute, by delegation or otherwise, a Board of Studies, consisting of such persons as it may think fit, to whom shall be referred for consideration and report all questions relating to the course of study for the examinations of the University, either in its faculties or collectively, as from time to time may arise, and that the delegates of deliberating together and of consulting with the Senate, and to make such determinations as shall be binding upon the University. That it is desirable that the University should take advantage of such opportunities as may present themselves of promoting, by the institution of University chairs or otherwise, the cultivation of such higher or less usual branches of study as can be most conveniently or more efficiently taught by a central body. 5. That it is desirable for the Senate to consider the importance of recognising independent research in the examinations for the higher degrees in such way as the Senate may approve.

M. Barbier has sent to the French Chamber of Deputies a letter, and law, in order to organise in the colony superior of France. An *école préparatoire* of medicine was established fifteen years ago.

The late Prof. Wilhelm Pütz, well known through his excellent geographical and historical hand-books, has bequeathed the

[1] This extended and carefully made series is prepared for publication; we cannot too highly estimate this valuable contribution to magnetical science.

THE PHYSICAL SOCIETY.

On Saturday, the 22nd instant, a meeting of the Physical Society was held at the Science School, South Kensington, under the presidency of Professor W. G. Adams, F.R.S.

Two papers on electrical subjects had been deposited of,

Professor Balfour Stewart, F.R.S., which exhibited a series of Magnetic Figures, illustrating Electrodynamic Induction. A copper disc, mounted like the rotatory remarks, he observed that the lines of magnetic force around a wire carrying an electric current can be shown by passing a wire through a glass plate, showing two fillings around, and tapping the plate gently. The filings may be fixed in their places. If the plate has previously been gummed to a card, by soaking the gum with steam. Such a prepared plate may be used to show the figure of the magnetic curves in the lantern. Two parallel disc currents in the same direction attract each other, and tend to set the action; or they repel if travelling in opposite directions, the repulsion being evident from the form of the curves. It was shown in the remaining numbers of the series that, in a similar way, a very large number of electrodynamic relations could be illustrated by curves produced in a similar manner. Figures were thrown upon the screen, illustrating the law of action and reverse, the attraction of a magnet into or its repulsion out of a coil, the attraction of a magnet by a coil when the current is in a certain tendency to rotation of a current and a magnet, &c. A very interesting figure was produced by a current running through a magnet lengthwise. A transverse section of the bar of iron or of a pole given under the radial lines of the magnet nor the circular lines of the current, but a series of spirals. It was argued that Faraday's conception of the lines of force leading to electric themselves supplied the means of interpreting the phenomena, and of predicting the results of new experiments.

During the course of the meeting, the President intimated that, in addition to the papers fixed to come on, there were a modified form of Professor Hughes's microphone, by Mr. Hollaer, and a combination of the *Stenotelescope* and telephone, by Mr. Varley.

Owing, however, to the number of papers before the meeting, neither of these was described. Mr. Frederick Elliott also withdrew his paper on Electrical Resistance and a Conductor under Influence.

Prof. Fitzgerald, at the close of the meeting, intimated that that was the end of the session, and adjourned the Societies.

Researches on Magnetic Rotatory Polarisation.—

M. H. Becquerel.—Since Faraday's discovery the phenomenon of magnetic rotatory polarisation has been the subject of numerous researches. It has been remarked that bodies endowed with natural rotatory power also a great magnetic rotatory power; but the exceptions to this rule have hitherto prevented any connection between these two physical relations from being established. The author finds in his experiments that the sign of the rotation a regular increase or decrease in the index of refraction augments. The exceptions observed may be attributed either to the effects of lamellar polarisation, as in the diamond and garnet; or to the presence of magnetic bodies, as in the following cases.—*Comptes Rendus*, vol. lxxx., No. 23, p. 1577.

(20352.)—Magnetic Meridian.—To raise into any desired position the variations in declination of the needle would seem to be a matter of no difficulty, and would now seem to be easily accomplished. I may tell you that the needle is never constant for any two days together, but is always varying, and that in a very irregular manner. The largest variation I have observed is 1° 30′ W., 1860, 25° W., 1865, 21° 30′ W., 1870, and 19° 30′ W., 1875, and for probability it is, I am sure, the course of the next, the two meridians will approach each other, and the compass will point due north and south. Now, the greater part of the world from the geographical meridian, and would now have the full variation from the true meridian. You are aware that the variation is almost the same at Dunbar in Scotland as at Plymouth in England, and that it is the same at Dublin as at Liverpool. Now, I am not aware that there is any difference between geographical and magnetic meridian at Dunbar, Plymouth, Dublin, or Liverpool, but at these places the variation is 20° W., 1875, and the same equal declination or any other equal form of magnetic meridian at each place, in other words, the variation is the same at Dunbar, Plymouth, Dublin, and Liverpool. Nevertheless, 2° 30′ greater difference between Greenock Glasgow, 2° 30′; Liverpool, 1° 30′; London, 1° 30′; Plymouth, 1° 30′; Dublin, 2° 30′; Dunbar, 2° 30′. All geographical meridians have a longitudinal north only. The lines on such maps are, therefore, of no use to the navigator. It is impossible to obtain any data for longitude having to give you the magnetic meridian. Such can only be obtained by observation.—W. J. Lancaster.

(20353.)—North Pole of a Magnet.—According to certain theories, the great call (as real centres of force) would be found in the earth in relation to the north pole of a bearing on the following page. The point has not action may be expressed as follows:—If does not matter —as it is of interesting bulk ways at the same instant.

(20354.)—Battery Power.—To Mr. W. J. Lancaster.—You cannot send a current through one wire in a lot without equally affecting every one of the others. What you are going wrong. Can you tell me how much you want to obtain? Then, I think, I can tell you how you can do it. Double, &c. A prepared paper can be sent to you. You must would be as satisfactory as paper that you can cut. You can suggest a better attaching you to use. Your battery is not good, and a bit of blue litmus paper will make sure you want the battery to do, and then you will be the best battery for you to have.—W. J. Lancaster.

Floating Magnets

I HAVE no intention of discussing the beautiful experiments of Prof. A. M. Mayer on floating magnets; but as a pictorially-expressed epitome of nine has appeared in NATURE, vol. xviii., p. 260, I feel bound to defend it. The mutual repulsion of the vertical floating magnets varies nearly inversely as the fourth power of the distance in great distances, and nearly inversely as the square at small distances. The horizontal attraction of the magnet, held vertically in the water, varies nearly inversely to the fourth power at very great distances. At a certain moderate distance it attains a maximum of force, and close to the centre it varies directly as the distance. It is easy to see that variations of the magnetisation of the lengths of the magnets, and of the distance of the large magnet from the surface of the water, may account for the observed results. I will consider, under different conditions, he forms of unstable equilibrium. Prof. Meyer thinks that the configurations . . . can never be stable. It is easy to see that in a form of equilibrium, and is true that any given size of hexagon will be brought into equilibrium by placing the large magnet at a suitable distance. It may, therefore, be in equilibrium when the floating magnets are on the circle of maximum attraction of the feed magnet. But, in this case, the equilibrium is stable; for work would be expended in altering in any way the position of any one of the floating magnets. If this were carried away from the others they repel it back, and it will be brought back; if it were carried across the others they repel it more, and again it will be brought back.

The nature of equilibrium where there are several degrees of freedom may be illustrated by considering a tract of country upon which water can flow. The hollows mark positions of stable equilibrium; the summits and passes (cobbles) are positions of unstable equilibrium. Then, if any one speaks of the former as more or less stable (as Prof. Meyer does of stable configurations), he may be as independent as the flows of the surface of the hollow, or to its level, or to some vague and mixed character.

It is very easy to understand why the form . . . should be difficult to produce or maintain. It is because the floating magnets are in this case at much greater distances from the centre than when they assume the form . . . Hence, the potential energy of the system is much greater in the latter form . . . of the latter. The reverse is the case with . . . and . . . and still more so with . . . and . . . , and so with greater numbers of magnets.

C. S. Pierce

THE "DIP" OF THE MAGNETIC NEEDLE.—This property of the needle was discovered by Robert Norman, about the year 1576.

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Freeing a Magnetic Bar from the Influence of the Earth's Magnetism.—Dr. Joules' method may be well known to most readers, while that of Professor Trowbridge may not be so well known, and, therefore, we give it a place among our "Notes." An ordinary tangent galvanometer is to be constructed that the coil is free to turn about a vertical axis, and also about a horizontal one. The coil is first placed in a plane, perpendicular to the magnetic meridian; it is then turned about its horizontal axis until the component of the strength of the current acting in the horizontal plane shall be just equal and opposite to the horizontal component of the earth's magnetism. A figure can be easily constructed to assist in the illustration of this system. Draw rectangular co-ordinates x, y; draw $a\,b$ to represent strength S of current passing through galvanometer coils at the angle θ which the plane of the coil makes with a vertical plane. We have S cos $\theta = \mu_1$ in which μ_1 is the counter-balanced force of the earth's magnetism. Under these conditions, the magnetic needle is in a state of unstable equilibrium, and, if placed perpendicularly to the magnetic meridian, will vibrate through small arcs free from the action of the earth, and subject only to the attraction in the field of force in which it may be placed. A bar of soft iron placed in the vertical plane which passes through the suspension of the needle perpendicular to the magnetic meridian at a suitable distance from one of the poles of the needle, serves to bring it back to zero, just as the controlling magnet serves a similar purpose in Thomson's reflecting galvanometer.

Mist of Magnetic Storms '79.

It is surprising that an accomplished telegraphist like Mr. Mance (NATURE, vol. xix. p. 469) should rest on the necessity and advisability of expressing earth-currents in webers. It is precisely on that account necessary, as I said, to express the magnitude of an occasional current or set of currents in terms of the unit we do as if Mr. Mance's plan were adopted, that I should say, the webers, or rather, in more convenient sub-multiple, the millionth part of a millionth (the current produced by one Daniell's cell (nearly one volt), through 1,000 ohms. Currents can be reduced to this unit from any galvanometer. The tangent galvanometer is, perhaps, the simplest to use—it is that which we employ in England. Supposing for simplicity that your constant, viz., one Daniell cell through 1,000 ohms (including cell and galvanometer) gives 45°, then the tangent of any other reading will give you the current in millionths. Then, knowing the resistance of your circuit and its geographical position, you have all the data necessary to determine the elements of earth-currents.

I will not on Mr. Mance's suggestion, and being the matter before the Society of Telegraph Engineers with a view of organising a systematic mode of observation in different parts of the world.

Whitfield, March 8 W. H. Preece

Curious Facts in Magnetism.

At the meeting of the New York Academy of Sciences, February 17th, the article in the March number of *Harper's Magazine*, entitled "Gray's Magnetic Motor," was incidentally alluded to, and Prof. C. A. Seeley made the following remarks: The article claims that Mr. Gray has made a discovery of a neutral line or surface, at which the polarity of an induced magnet, while moving in the field of the inducing pole, is changed. The alleged discovery appears to be an exaggerated statement of some curious facts, which, although not new, are not commonly recognized. If a bar of iron be brought up, end on, near a magnetic pole, the bar becomes an induced magnet, but an inferior magnet quite different from what our elementary treatises seem to predict. On the first scrutiny it is a magnet without a neutral point, and only one kind of magnetism—namely, that of the inducing pole. Moreover, the single pole is pretty evenly distributed over the whole surface, so that if iron filings be sprinkled on the bar they will be attracted at all points, and completely cover it. Now if, while the bar is covered by filings, it be moved away from the inducing pole, the filings will gradually and progressively fall, beginning at the end nearest the inducing pole and continuing to some point near the middle of the bar; the filings at the remote end will generally be held permanently. When the bar is carried beyond the field of the inducing pole it is simply a weak magnet of ordinary properties—i. e., of two poles and a neutral point between them.

A plausible and simple explanation of this case is that the inducing pole holds or binds the induced magnetism of opposite name, so that it has no external influence; the two magnetisms are related to each other as are the positive and negative electricities of the Leyden jar. So if the inducing pole be N.; the B of the bar will be attracted by it and bound, while the N. of the bar becomes free, and, moving from and [illegible] moving the bar from the pole the positive electricity is retained and a part becomes residual magnetism. Now, when the neutral line passes the fine magnetism which is of opposite name, we are on Gray's neutral line. In a fantastic sense there is a change of polarity over the half of the bar analogous to the inducing pole; on the other half there is no change of pole in any sense. Experiment with a shingle nail in the place of the filings, as Dr. Gray, tying the nail to the induced neutral pole, and it may be held, except at the neutral line. Now, if one will read the magazine article with such ideas as these, he will feel pretty sure that the writer of it has used words recklessly, that Gray has not made an original discovery, and that the "neutral" line, whatever it be, has only an imagined relation to the "principle" of the motor.

The Gray Motor as a perpetual motion scheme, of course, is not worthy of serious notice from a society devoted to science. It has no more merit or novelty of construction or conception. Mr. Gray is afflicted with the very old delusion of the cut-off or shield of magnetism, which is to cut less than, when cause from it. His cut-off is a sheet of iron, which we

On the Electrical Aftercurrents of Transversely Magnetized Iron Rods.—By Prof. H. Streintz.—The experiments referred to in this paper were carried out by the author in conjunction with Dr. F. Streintz. The phenomenon was discovered by Villari, that in a rod of iron or steel through which a galvanic current has passed, when agitated after the interruption of this current, a galvanic current is again generated the same in direction as that originally conducted through the rod. He subsequently investigated some properties of these aftercurrents, and gave an explanation of the phenomenon;—namely, that the rod is transversely magnetized by the current; and if we employ the notion of molecular magnets, these arrange themselves in concentric circles around the axis of the rod. Now, if the rod be agitated after the interruption of the current, the molecular magnets obey the direction-forces which tends to mingle them again irregularly. We can here avail ourselves of the representation of the molecular magnets returning to the positions which they had before the action of the current. Now, in this return they generate in the rod an induction-current, to which Villari gives the name of "agitation-current," but which may with equal usefulness be designated as an aftercurrent. Afterwards H. Herwig studied the properties of transverse magnetism on iron tubes. The author now shows that in a very simple manner the quantity of the magnetising force can be calculated which is exerted upon the molecular magnets by the current originally conducted through the rod. Starting from Biot and Savart's theorem, that a rectilinear current of infinite length acts upon a pole of a magnet with a force inversely proportional to the perpendicular distances of the pole from the conductor, the problem is reduced to one of the plane; so that we have to calculate the action of a circular surface with uniform mass (the pole investigated had a circular cross section) upon an mass-point situated in the surface. In accordance with the laws of force previously stated, however, a circular line with uniform mass exerts no action on a point situated in the enclosed surface, while it acts on an external point in the same plane as if the mass of the circle were collected in the centre. Now by this the calculation becomes very simple, and we obtain, as the force which is exerted upon a magnetic pole situated at the distance r from the axis, $p = \frac{2\pi}{r}$, in which i has constant, and a the semidiameter of the rod. The total moment upon all the molecular magnets c. . . nd in the rod is then $R = Ki\sigma$, where R, i, and σ have the same meaning as above, and K denotes the length of the rod. The author has also investigated by experiment the properties of the aftercurrents; and in so doing he found some method which could be foreseen from the theoretical developments, and also discovered various other properties, some of them, indeed, very striking, which could not have been determined *a priori*.—*Entwicklet Absolute Wiesenchaften in Wien, math.-naturw.* 78

Magnetism of Loadstone and of Steel.—

Dr. A. L. Holz has investigated the comparatively-feeble magnetism of loadstone (Magnetic oxide of iron) and the powerful magnetism of steel. He has created stone and open glass-lenticular rod. His researches were conducted by measuring which are the following: 1. The maximum of permanent magnetism in the loadstone, for equal volumes, is about the same as that in the best steel. 2. The coercive magnetism of the loadstone is the greatest of all magnetisms of the loadstone is the greatest of all magnetisms bodies yet investigated. 3. The permanent magnetism of the loadstone is nearly zero that the maximum of the intensity of temporary magnetism which disappears after the magnetising force is removed, is less in the loadstone than in steel. Ap. 79

Magnetic Storm, May 14, 1878

At the *Bellelle Mound* of the observatory of Zi-ka-wei, near Shanghai, China, the following interesting remark occurs in the number for May, 1878 :—

"During la nuit du Mai, une seule perturbation a été enregistrée par le magnétographique; elle commença le 14, à 8h. 20m. de l'après-midi, et se termina 24 heures après; sa plus-li la différence, par extraordinaire, ne présenta pas d'oscillations dignes de remarque, mais de très-nombreuses petites oscillations comme le lithiline."

On examining the photographic trace of the Stonyhurst magnetograph I find that the only magnetic storm in May last commenced on the 14th at 6h. 40m., and lasted rather more than twenty-four hours. The longitude of Zi-ka-wei being 8h. 15m. 32s. E. of Stonyhurst, the storm began at the same time at both stations. The character of the movement was also identical, for the only disturbance at Stonyhurst from 6 A.M. until 4 P.M. was a tremulous motion of the declination and horizontal force traces.

The storm was at its height at midnight, when all the magnets were much disturbed, and the vertical force magnet was thrown completely off its balance.

It is impossible to obtain more than the roughest outline of a magnetic storm from hourly readings, but even this slight data as from Chino shows a general agreement in the declination curves during the storm at these two distant stations.

The *Monthly Record* of the Melbourne Observatory also mentions the same magnetic disturbance, which commenced there at 4 P.M. on the 14th, and lasted until 8 A.M. on the 17th. Melbourne lies 9h. 39m. 54·3s. E. of Greenwich, and therefore 1h. 24m. 10s. E. of Zi-ka-wei. We thus see that the Zi-ka-wei storm commenced 3h. 55m. Melbourne time; it was therefore simultaneous at the three observatories.

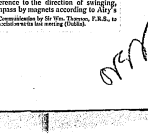
Stonyhurst Observatory, September 27 S. J. Perry

On Gaussin's Warning Regarding the Sluggishness of Ship's Magnetism.

Practical Rule and Caution

1. After steering for some time on westerly courses expect—
   1. (*a*) Westerly error if you turn to the north;
   2. (*b*) Or easterly error if you turn to the south.
2. After steering for some time on easterly courses expect—
   1. (*a*) Easterly error if you turn to north;
   2. (*b*) Or westerly error if you turn to the south.

The diagram representing case 1 (*a*) illustrates the physical explanation, N and s representing the north and



south poles of the compass card (or *true south* and *true north* poles of its needles), and the small letters, $s_1 s_2 s_3$ true southern polarity, and $n_1 n_2 n_3$ true northern polarity, induced in the port and starboard ends of deck beams and port and starboard sides of ship while steering east, and remaining for some time after she has been turned to north.

In the "Admiralty Compass Manual" Gaussin's warning is given with reference to the direction of swinging, in correcting the compass by magnets according to Airy's

* Being an abstract of a Communication by Sir Wm. Thomson, F.R.S., to Section A of the British Association at its late meeting (Dublin).

first method. In the Reports of the Liverpool Compass Committee and in Mr. Towson's "Information for Masters and Mates regarding Ship's Magnetism," instances of perplexing changes in the compass are given, and are referred to the same cause. The "sluggishness" of ship's magnetism, according to which it depends generally in part on the influence experienced some time before the time of observance, and not wholly on the influence at the time, seems to have been first definitely noticed and discussed scientifically by Sir Edward Sabine in his analysis of the results of the magnetic observations in the Antarctic and Arctic Expedition of Sir James Ross in the *Erebus* and *Terror*, in the years 1840-41.

The practical rule and caution given above is of great importance in the navigation of iron ships. The amount of the error which may be found cannot be predicted for ships in general, nor for any particular ship except after much experience and careful observation. A small effect of two or three degrees, such as that referred to in the Admiralty Manual as found in M. Caussin's experience, may be observed in the course of quietly swinging a ship by hawsers or steam-tugs. If the ship under way is steamed round on the different courses the amount of the "Caussin error" may generally be greater than if she

is hauled round by warps; but we must not be sure that it will be so, because the *choke* of the screw which enhances the magnetisation on the east or west courses may shake it out again before the observation is made on the north or south courses.

A good practical rule in correcting the compass is, after having got it quite correct on the north and south courses, correct just half the error which is found after that on the south and north course, in the regular swinging of the ship.

The warning at the head of this article is particularly important for ships of war after firing guns when on easterly or westerly courses; if the compass is then changed to north or south, and particularly if, after the firing, the change of course is effected under canvas, without the shaking of the ship's magnetism produced by the engines and screw.

The warning is also very important for ships steaming through the Mediterranean eastwards or westwards, and then turning south through the Suez Canal or north round Cape St. Vincent; and for ships steaming eastwards from America and then turning northwards or southwards into St. George's Channel.

NICKEL COMPASS NEEDLES.

Joseph Wharton has sent to the French Academy a marine compass with a nickel needle, constructed nearly after Sir William Thomson's model. Four similar compasses have been placed on Bordeau cruisers. It is proposed that the fifth should be put on a French ship for comparison with steel needles.—*Comptes Rendus.* [illegible]

Magnetic Storm of May 14, 15

The magnetic storm of May 14, 15, which was observed simultaneously in England, Chili, and Australia, and which made itself felt in the telegraph wires of Paris and Italy, was also perfectly observed in America. Mr. G. F. Kingston, director of the government observatory at Toronto, Canada, has kindly forwarded to me a tracing of his magnetograms, and I find that all the principal inflexions of the declination, as well as of the components of the intensity, bear a striking resemblance to those recorded at the Stonyhurst observatory. The correspondence between the two vertical force curves on May 14 is very remarkable for such distant stations. Comparing the times of the principal minimas in the V.F. curve, and of the chief maximum of the declination, we have the following results in Toronto mean time:—

	Principal V.F. min.	Secondary V.F. min.	Decl. max.
	h.m.	h.m.	h.m.
Toronto Observatory ...	6 17 ...	4 0 ...	6 39
Stonyhurst Observatory	6 42 ...	4 20 ...	6 54
	0 25 ...	0 20 ...	0 15

The disturbing force would there appear to have been felt somewhat earlier in Canada than in Europe.

The extent of the extreme oscillation of the V.F. magnet cannot be compared, as that at Stonyhurst was too sensitive, and was excessively thrown off its bearings; but the rapid movement of the declination needle immediately preceding the maximum was almost identical in England and in Canada, the Stonyhurst curves showing a rise of 38 30′ in less than twenty minutes, and that of Toronto an increase of 37 53′ in the same time.

It is important to note that I have used the terms maximum and minimum in reference to increase and decrease of ordinate, but it so happens that an increase of ordinate signifies a decrease of H.F. and V.F., and also of W. declination in the Toronto curves, which it shows an increase of all these elements in the magnetograms of Stonyhurst.

S. J. Perry

Stonyhurst Observatory, December 28, 1878

— — ongnetic Storm, may 14, 1878

I am inclined to think that Mr. Mance's observations (vol. xlv. p. 148) upon the earth currents observed at Barcelona have been incorrectly reported. To agree with the observations in China, Stonyhurst, Greenwich, and Hawsterhaven, they should have commenced at A.M. on May 15, and terminated at 5 P.M. on the same day (Barcelona mean time).

It is a pity that short times do not record these currents in absolute units. To say that the current was equal to one Daniell cell means nothing unless the resistances present are also given. If an earth current is observed to exist in a cable it is easy to reproduce the current upon the same galvanometer with a known resistance and a known electromotive force, and then to express its value in ohms or millionohms. Thus if at Kurrachee the deflection through a total resistance of 125 ohms, then the current would be equal to $\frac{E}{125}$, or 5 millionohms, a magnitude which every electrician would understand. Moreover, if the length, resistance, and general direction of the cable or wire were given, as well as the direction of the current itself, the difference of potential of the earth at the two ends would be known. This if the cable were 246 Se per mile, then in the above case

$$E = \frac{\text{Se}\Omega}{1230}$$

$$E = 5^{\text{Se}}/_{246} \text{ volts},$$

which is the difference of potential at the two ends.

If simultaneous observations were made in this way at numerous stations on the earth's surface, we should be able to plot out the distribution of potential on the globe, and arrive at some better knowledge of the cause of earth-currents than we have at present.

December 20 W. H. Preece

A DELICATE MAGNETIC NEEDLE.

[3333]—A. Perry has constructed a delicate magnetic needle suspended by a method new to me, and as it is so sensitive I think that a description of the principle may not be uninteresting to those who have never previously tried such an arrangement. The needle may be made as follows:

Take a piece of fine wire, well magnetised, and covered all over with a thin coat of tin by means of gravity by a light covering through which one tiny hole is made, just large enough for the insertion of the point of another needle. A second needle is magnetised, and the point is placed in the hole just mentioned. On touching the middle portion of the first needle the magnetism in the point of the second needle is reversed. If the second needle is held vertically, the first will point north and south, and will have a few vibrations to a local place. The whole arrangement resembles a letter T, the vertical needle being held in the hand or fixed in a horizontal piece of ebonite.

The horizontal needle loses from the other if not carefully handled, but at the same time it becomes very sensitive to small local errors in the vertical. On resting it from top to bottom of all the vertical iron bars within reach, the needle has proved these bars to be temporary magnets by influence of the earth's magnetism. One end of the needle oscillated before the upper half of each bar trial, but the other end of the needle attended before the lower half of the bar. The bars were then placed in the opposite way, so that the ends had been turned up and down in front of the upright permanent magnet. On testing with other needles, differently suspended, they pointed with either extremity to the whole length of the vertical iron bar, and hence it is evident that the bars were magnetic through the inductive action of the earth.

The light needle was found to be reversed by means of the horizontal needle to present its skyward.

J. Trott.

Reply

[3331.]—Variation of the Compass.—In plotting colliery or other plans with surveys made with the magnetic needle, I have often first great attention should be given to the time of the magnetic meridian, as the accuracy of the survey depends. Plan observations being made of the variation with which it was plotted, and of all subsequent surveys made, the error at that original variation. The changes of the compass with the magnetic needle possesses of various kinds, and the knowledge of variations of the compass—sufficient differently disregarded to allow extensive workings to be a very large error. "T. P." must therefore allow for the difference of 5° 31′ in plotting surveys made now with the 1878 variation. For the 1st of July, 1878, the variation is 19° 31′ W.

[3334.]—Variation of the Compass.—Can any reader who desires the true north and south at any colliery must observe the variation of this year or at whatever time for such course to be added if west, or deducted if east of Greenwich. 3. Have a true meridian line, and observe it as a datum. When properly adjusted, the statements for observed to the selected meridian line, and the variation. When the compass has become quite steady read off the number of degrees between the north point, as the compass, and the 360° of the circle. Should the needle pass to your plan which are still to be found, it is the variation required. Carefully note on the plan the angle which the alignment of the two points makes with the meridian north on the plan. Then observe the angle which the said two points make on the land with the true north, and the difference will be the variation. The difference of the said angles, one of the old plan, the other of recent observation, will show how much the magnetic north has varied (or is supposed to have varied) since 1793, the date of the old plan. Thus, in the old plan, the angle which the two points made with the north point was 20° 30′ east, which will give a new angle showing the true north as the old plan. For example, the magnetic variation now observed is 19° 45′ west of north. Then the angle which the two points make with the true N. is 20° 30′ + 19° 45′ = 40° 15′. The alignment between two known points answers on the ground to 39° 30′ from the magnetic north marked thereon. But on remeasurement on the land it measures, say, 21° 25′. Then the difference, 21° 25′ from 39° 30′ = 2° 5′, is the error of the alignment of those two points from the magnetic north. Then, as the angle which the two points made with the old plan was 20° 30′ east of true north, we have 21° 25′ − 20° 30′ = 55′, the angle which the true north must be plotted to the new 360 west of the alignment. I know this is clear enough for "J. P." [illegible] Dewar.

CURIOUS FACTS IN MAGNETISM.

At the meeting of the New York Academy of Sciences February 17th, the article in the March number of *Harper's Magazine*, entitled "Gary's Magnetic Mouse," was incidentally alluded to, and Prof. C. A. Seely made the following remarks: The article claims that Mr. Gary has made a discovery of a neutral line or surface, at which the polarity of an induced magnet, while moving in the field of the inducing pole, is changed. The alleged discovery appears to be an exaggerated statement of some curious facts, which, although not new, are not commonly recognized. If a bar of iron be brought up, end on, near a magnetic pole, the bar becomes an induced magnet, but an induced magnet quite different from what our elementary treatises seem to predict. On the first scrutiny it is a magnet without a neutral point, and only one kind of magnetism—namely, that of the inducing pole. Moreover, the single pole is pretty evenly distributed over the whole surface, so that if iron filings be sprinkled on the bar they will be attracted at all points and completely cover it. Now, if while the bar is covered by filings it be moved away from the inducing pole, the filings will gradually and progressively fall, beginning at the end nearest the inducing pole and continuing to some point near the middle of the bar; the filings at the more distant end will generally be held persistently. When the bar is carried beyond the field of the inducing pole it is simply a weak magnet of ordinary properties—*i. e.*, of two poles and a neutral point between them.

A plausible and simple explanation of this case is that the inducing pole holds the lines of the induced magnetism of opposite name, so that it has no external influence; the two magnetisms are reluctant to each other as are the positive and negative electricities of the Leyden jar. Let the inducing pole be N.; the S. of the bar will be attracted by it and bound, while the N. of the bar becomes abnormally free and active. On moving the bar from the pole the bound magnetism is reduced and a part becomes residual magnetism. Now when the residual balances the free magnetism which is of opposite name, we are on Gary's neutral line. In a restricted sense there is a change of polarity over the half of the bar contiguous to the inducing pole; the other half there is no change of pole in any sense. Experiment with a shingle nail in the place of the filings, *A la* Gary, bring the nail to the induced bound pole, and it may be held, except at the neutral line, where if one will read the magazine article with such ideas as these he will feel pretty sure that the writer of it has used words recklessly, that Gary has not made an original discovery, and that the "neutral" line, wherever it be, has only an imagined relation to the "principle" of the motor.

The Gary Motor as a perpetual motion scheme, of course, is not worthy of serious notice from a society devoted to science. It has no noteworthy variety of construction or conception. Mr. Gary is afflicted with the very old delusion of the out-of or shield of magnetism, which is to cost less than what comes from it. His cut-off is a sheet of iron, which we know acts simply as an armature.

43

New Use of the Magnet. 79

The millers of Minnesota have been annoyed a good deal of late by wires in the wheat, caused by the use of wire-binding harvesting machinery. At one time the matter had become so troublesome that they thought seriously of advising the disuse of such machinery. But a way has been found out of the difficulty by the invention of a simple and hitherto seemingly ingenious device consisting of two gangs of horseshoe magnets, four in one and five in the other, placed in a spout through which the wheat passes. The process of extracting wire from the wheat in this manner was exhibited before the Millers' Association, in session at St. Paul, Friday. The *Press* of the 8th inst. says: "By the severest tests it was demonstrated that every particle of wire was arrested. Numerous pieces, from the size of a pinhead to an inch in length, were mounted and mixed with a quantity of wheat, and being passed through the spout the exact number would be found opposite the magnets. The millers were highly pleased with the workings of the simple device, and it will be undoubtedly introduced into all the mills. The chief point of interest of this matter is the fact that this is not a patent, nor have its projectors any to sell. It is merely a hint to millers that with an outlay of a few dollars they can themselves put magnets into their mills which will obviate the objections hitherto urged against wire-binding harvest machinery. —*Chicago Tribune.*

Terrestrial Magnetism.—One of the most remarkable results discovered by Mr. Broun is the fact that the

variations from day to day of the earth's daily mean horizontal force were nearly the same all the world over. He finds certain coincidences in these daily means which were due to the moon's resolutions and others to a period of twenty-six days: the latter he considers are due to the sun's rotation. It results from these investigations that the observed variations of the earth's daily mean horizontal force have been represented with considerable accuracy in all other sealed features by the combination of the means calculated for these different solar and lunar periods. During the discussion of these periods Mr. Broun found that the great magnetic disturbances were apparently due to action proceeding from particular points or meridians of the sun, a fact of very great importance. In succession he has also traced the apparent simultaneity of the changes of daily mean barometric pressure over a great part of the globe, and the whole discovered a lunar-periodic period of twenty-six days nearly. He was also the first to commence and carry out a long series of most systematic notes of observations of the motions of clouds at different heights in the atmosphere; and, lastly, he has found certain laws connecting together the motions of the atmosphere and the directions of the line of equal barometric pressure.

Magnetism and Polarized Light.—An interesting experiment has recently been made by M. Henri Becquerel. Two rays of light polarized in the same direction were passed through a plate of quartz, and then subjected to opposite directions to the action of an electro-magnet, as in Faraday's experiment. On leaving from the lenses the two rays were brought into interference with each other; and it is observed that when the current passes in the electro-magnet the fringes are displaced in one direction, while when the current is stopped they are displaced in the opposite direction.

Mch 7 79

A NEW THEORY OF THE EARTH'S MAGNETISM.

At the last meeting of the Physical Society, on March 8, Professor Ayrton brought forward a new theory of Terrestrial Magnetism, originated by himself and Professor Perry, of the Imperial Engineering College, Japan. It is well-known that mental cages act on screens against induction in the case of static electricity, or electricity at rest, and hence Clerk-Maxwell, at the B. A. meeting for 1876, suggested that no earth connection was necessary for lightning conductors since a cage would be sufficient. But dynamic electricity is different from static in this respect, and Professors Ayrton and Perry found that even a thick block of copper will not screen a coil of wire from the induction of a *current* flowing in a neighbouring one. Some

experiments of Dr. Muirhead, not yet published, would seem to favour the view that a current is a series of intermittent changes of potential, and that the inductive effects are due to a difference in the epochs of the currents in the two coils. It was found by Helmholtz that a quantity of static electricity in mechanical motion performs work. Conversely, Mr. Crookes finds that the streams of molecules from a — pole in vacuo is electrified and may be deflected by a magnet. It is upon this fact that Professors Ayrton and Perry have based their theory, which is easily explained by supposing the earth to be an isolated sphere with a static charge residing on its surface. Then since each electrified particle at the surface will be moving relatively to a point in the interior, it follows that the interior must be magnetic. The theory is independent of the existence of the interior; but in order to simplify the working, the authors treated the case of a solid iron ball, and curiously enough arrived at the result expressed by Biot's law for the distribution of magnetism on the surface of the earth.

$$\delta = m\sqrt{1+3\cos^2}$$

and similarly they found that if the earth were electrified to the potential of 10^8 volts relatively to interplanetary space, its magnetization would be as it is. If the earth were alone in the universe then, by this theory it would have its own magnetic axes by virtue of its electric charge and axial rotation. If other bodies, in the universe, however, had their magnetic axes inclined, their magnetic influence the earth's, and hence we should have terrestrial tides and storms of magnetic force, such as are known to exist, as for instance when changes take place in the sun's atmosphere by approach of planets or other causes. Lastly, the virus in the interior of the earth may give it a certain amount of coercitive force, but the theory does not rest on this.

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ON THE NEW THEORY OF TERRESTRIAL MAGNETISM. 79

To the Editors of Nature.

Sirs,—In your issue of the 24th of March appears a very amusing review of the "New Theory of Terrestrial Magnetism" communicated by Professors Ayrton and Perry to the Physical Society at the meeting on the 8th inst., the fun of the article arises from a total misconception, on the part of the writer, of the point in question, viz. what to take whether "they have adopted their magnetic speculation to secure, varied, and repeated examination," as shown how completely he has lost sight of the fact that their theory is not based upon any doubtful experiments, but is a logical mathematical deduction from the experiments performed by Mr. Broun on Professor Hicholtz's (Helmholtz) theorem, and by Professor Helmholtz in the *Philosophical Magazine* for September, 1870, on the electricity (of which the reviewer makes absolutely no mention in his article) proved that a quantity of statical electricity in mechanical motion acted like a current in deflecting a magnetic needle.

Starting with this result Professors Ayrton and Perry have deduced the following conclusions: Since the points of the earth's surface have different linear velocities from those in the interior (although all the points rotate in the same angular velocity of rotation round the earth's axis) it follows that if the earth had an initial electrical charge, resulting of course in an enormous potential relatively to interplanetary space, the electrified particles would have relative motion to the remainder; and hence, as a direct consequence of the results of the experiments performed by Professor Helmholtz, the interior of the earth would be a magnetic field; and the conclusion, contrary to the assumption poised by the reviewer at the outset, is independent of the internal constitution of the earth, or the existence or not of other earths in the universe. By exactly similar reasoning it could easily be proved that external to the earth there is also a magnetic field.

Next they have deduced mathematically (again be it remembered without any special assumption regarding the constitution) that if the earth had an angular velocity of rotation round its axis ω, and a uniform charge of electricity e, there must be an electro-magnetic potential at any point inside the earth equal to

$$\frac{4\pi}{5}\omega e\, r\cos\theta,$$

and at any point outside the earth equal to

$$\frac{1}{5}\omega e\, a^5 \frac{1}{r^3}\cos\theta,$$

where the unit of length is the earth's radius, r the distance from the centre of the earth, and θ the angle that r makes with the equator.

Now the value of the magnetic intensity at different points of the earth's surface—existing with this electrostatic potential—will depend on the interior constitution of the earth, and will depend on their conclusion they assume that the earth is not in order to simplify the working, the authors treated the case of a solid iron ball, and curiously enough arrived at the result expressed by Biot's law for the distribution of magnetism on the surface of the earth.

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Compasses with Nickel Needles.—According to the *Comptes Rendus*, Mr. Jos. Whanon has sent to the Académie des Sciences a marine compass with a nickel needle. Four such compasses constructed on a plan recommended by Sir W. Thomson) have been placed on Russian cruisers, and a fifth is to be placed on a French ship for comparison with steel needles.

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formula for the distribution of magnetic intensity on the earth's surface, hence so far from agreeing with the reviewer that their theory of terrestrial magnetism is visionary, I cannot but feel that it has much weight.

Lastly, to put a rough approximation of what must be the difference of electric potentials between inter-planetary space and the earth, so that his own electric plaything alone combined with its known rate of rotation round its axis shall produce the earth's magnetism, we have calculated by the above rule, on a supposition of a solid iron globe of the size of the earth, and rotating with the earth's velocity, and have proved that a difference of potentials of almost a hundred million volts would be sufficient. Now, as they remark, there would be no difficulty in imagining such a difference of potentials, or a much higher one, to exist between the earth and space, if surrounded by an atmosphere of cells of interplanetary ether, of which the resistance is probably far higher than that of the best Crookes' vacuum, and experience has shown that some thousands of cells cannot cause a discharge across even a thin film of such a vacuum.

In the review there is given a confused description of the new body moving round the earth, and that I presume is the reviewer's version of the "magnetic ring" (mentioned in the introductory to his paper) by Professor Ayrton, and hence out, as he describes, by some unpublished experiments of my own, of the same way mentally senses do not exist, a body free from ponderability as they are known to do from static inductive action. But such a supposition, which is not necessary, and not at all affect the proposed theory of terrestrial magnetism, does not affect it in any way beyond on the other, the reviewer has been so unfortunate as to call the foundation

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of the new theory, and so having raised a phantom of his own imagination has marshalled his forces to destroy it.

W. E. Ayrton.

Yokohama, Japan, January 24.

[We have not had the advantage of perusing Mr. Ayrton's paper (we hope soon to have the pleasure of reading it in extenso before our scientific publications); and this is the reason we permit at the meeting of the Physical Society, we had in form our opinion of the "new theory" from the—as it appeared to us—imperfect exposition of the author. If we should find it necessary to do so, in justice to Mr. Ayrton, we will give the writer further attention when his paper is published—Eds. N.]

At the International Meteorological Congress which will meet in Rome on April 14, the project of establishing an Arctic observatory at Nova Zembla, will be discussed. Electric and magnetic observations have been undertaken as part of the scheme of work which has been devised by Messrs. Weyprecht and Payer.

Magnetism and Clouds.—The auroral or magnetic circus is the name given to a remarkable set of meteorological circus orbits seen during auroral displays, and the Hon. Rollad Buchan, in the last *Quarterly Journal of the Meteorological Society*, argues that they are caused by the magnetic action of the earth or by atmospheric electricity. Cloud forms would seem to exist in the air at different levels in localities until a certain degree of condensation from the effect of external force is attained. Auroras and the phenomena of meteors are probably forces with this power. Mr. Buchan was led to this conclusion by observing an ordinary lunar halo, seen through cirrus clouds on the night previously known as Biela's night, on the night of Oct. 23rd, 1872, to change its form under the influence of the luminous waves of a meteoric shower.

Modifications of Ampère's Laws.—Mrs Marsden has communicated to the Vienna Academy the results of her investigations on the Theory of Application of Electro-Magnetic Rotation," which he embodies in the two following laws:—1. If a portion of a magnet rotates in the neighbourhood of an unmagnetic conductor, about an intersectional axis, then an impulse, a current will be induced within the conductor, but if a rectified hydrostatic pressure about its own axis, in the neighborhood of a magnetic pole, no current will be produced in it. 2. The rotation of a magnetic pole be produced in it. 2. The rotation of a magnetic pole around a rectified conductor about the pole produces the rotation of the conductor about the pole produces the rotation of the conductor about the pole produces an induced current. The first portion of the first law is a simple necessity relation; it has also been demonstrated by E. Naumann, and adopted as a fundamental law of the phenomena of unipolar induction. H. W. Weber, who first specially investigated the phenomenon to which Faraday invited attention, disputes the sufficiency of Ampère's explanation of the rotation of a magnet on its own axis when it is traversed by a galvanic current.—*Ann. der Phys. und Chem.*

the small lantern or shield. When the retaining catch is removed by similar means to those employed in connection with the striking mechanism of clocks, the notched wheel makes one-half of a revolution before it is again arrested by the catch, and in so doing it either closes the stop-cock and raises the shield so as to surround the burner, or vice versâ. If the stop-cock is closed the gas still continues to flow through the side passage, forming a minute flame which is protected by the shield. When in due course the warning cath is again removed, the notched wheel completes its revolution and the gas is fully turned on and the shield lowered. In Fig. 1

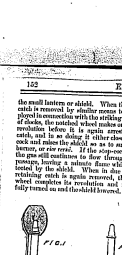


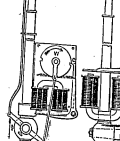
FIG. 1.

FIG. 2.

is shown the arrangement for turning the gas on or down by means of clockwork. In the case of the notched wheel W is merely fixed on a spindle S by a cord and weights, and on this the cord is passed through the coils of the clock mainspring, the free arm subsequently passing over and the wheel W makes a half-turn and moves the tap in the usually way. In the drawings the tap is represented by curved dots, the small flame being protected by the shield; on sending the cord through the circuit, which obviously may include a large number of lamps, the magnet attracts the armature, withdrawing the catch and allowing the shield to move in the direction of the arrow until the notch on the opposite side is reached. Each motion will of course lift the shield and cause a full supply of gas. See figure, the parts being set as represented each time the lamp is lit.

SEVERN'S TELL-TALE MARINER'S COMPASS.

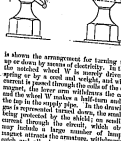
AN ingenious fisherman's compass for the use of masters of vessels has recently been patented by Mr. H. A. Severn, (Dublin New Zealand), a gentleman who frequently contributes to our columns, and who has already taken a position as a scientific instrument maker. The compass is represented in the accompanying illustration, and is intended to be placed in the captain's cabin, so that he can see at the wheel. It is obvious, however, that it may be hung in any other part of the vessel if he so chores to do. The compass itself is of the ordinary kind, but it gives a perspective illustration of the compass itself, and how much wilful deviation the captain the method of its action. An ordinary compass card carries a couple of magnetised needles on its lower surface, and attached to the centre of its upper surface is a metal bar C, which moves with the card. A wire two milled heads below leads, B B'. The milled headscrew actuates the globe lid of the compass box, the handle are fleshy, and at the free ends carry heavy platinum wires, D D', Having ordered the vessel to be kept on a certain course, the captain sets his tell-tale compass—allowing a certain amount of latitude according to its form it necessary to steer close'or free—by putting the index heads B B' at a greater or less distance on each side of the bar C. The point carrying the card is connected to one pole of a constant battery (four Leclanchés), and the milled heads with the index heads B, and the platinum wires D, are connected to the other pole. A bell is placed in the circuit which rings directly the position of the vessel alters the bar C in contact with one of the platinum wires The latter are made heavy enough to turn them the cards against the polarity of its needles, so that until the vessel is brought back to her proper course the bell continues to ring, and a pointer is fitted into the lid of a resonant box enclosing the whole apparatus, the sound is loud enough to be heard above the thrash of the engines in the forward part of the vessel. By the aid of this ingenious application of electricity, a captain can manage to remain with the exception of very fellows to carry out his orders, or any neglect on the part of the man at the wheel will be immediately detected, while those left in charge will naturally be more careful when they know that a detector is in the captain's ear. The compass can be used in the usual manner without the bell, by lifting the milled heads until the platinum wires swing clear of the compass box.



The invention will readily commend itself to all masters of sea-going vessels, as it takes from fellows there is a constant anxiety, inseparable from close attention on the part of the officers, and necessarily hard work. The compass is so arranged that it may be readily indicated differently to that of the binnacle, and therefore if little use as a check on the steersmen, but with the arrangement above described any deviation between the two compasses is at once apparent, because a stationary card is at that to be replaced.

LEESON'S ADJUSTABLE SPANNER.

AN improved adjustable spanner or wrench has recently been patented by Mr. W. H. Leeson, of Hopkinsville, Somerset, who sends us (39250) on p. 68. The invention is applicable to spanners and also to hand-screws, and depends mainly on the use of a toggle bar, so applied between the movable jaw and the shank or handle of the spanner as to cause the shank to be firmly gripped on pressure being applied to the jaw in a direction feuilloe to open the jaw. To release the jaw, the toggle bar is straightened and the movable jaw being pressed forward by a spring, the pressure on the shank is relieved. The toggle or lobster is applied between the shank and the movable jaw, and consists of a bar or bars of the spanner or handle of the shank of the bar or bars to distribute the pressure of the toggle bar. The upper surface of the shank of the jaw, the free end of this block and the edge of the shank along which the toggle bar moves are formed with a flange to prevent slipping. A spring is applied to bear on the toggle bar up to its shank and its teeth engage with those of the shank in order to hold the jaw immovable immediately pressure ceases apart from the act of loosening it. A spring is not absolutely necessary although it is preferable to use one, as the pressure caused in the labour and the strength of the movable jaw up to its work, a slight pressure is applied upon the releasing hook with the thumb. The releasing rod which terminates in a knob is attached to the movable jaw, and passes through a hole in the shank of the spanner, so that the knob is always within reach of the thumb. The end of the rod is bent at right angles to the shank of the spanner, and is provided with a projection which is adapted to engage with the teeth of the shank, and so hold the jaw in any position.



Proceedings of Societies.

PHYSICAL SOCIETY.—APRIL 26TH, 1879.

Prof. W. G. Adams, in the Chair.

Mr. C. V. Boys gave an account of some experiments made by Dr. Gothele and himself on the subject of Ampère's rotation. The experiments were begun with a view to determine if the drag on a copper disc when a magnet is made to revolve beneath it, or on the magnet if the disc is made to revolve above it, could be made use of for determining the velocity of running machinery.

They made the magnet revolve and obtained the angle of deflection of a disc suspended by a torsion thread the hair spring of a watch. The disc was of Snow, Harris, and was found to have, that other metals, the speed of the drag depends properties not to be used as that if the torsion of the thread could be relied on, and the strength of the magnet did not change, a perfect voltameter could be constructed. They consider that this method is better than observing the deflection of a magnet over a resisting disc, as in this case they are limited to less than a right angle, and changes in the absolute magnetism of the earth would affect the results.

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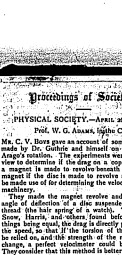
They also determined the effect of change of distance, thickness, diameter and nature of the disc, &c., their results agreeing with those of former experimenters. They observed that the effect of concentric circular cuts was far greater than that of even many radial cuts; and that when radial sectors were entirely separated from each other the effect was much less than when these were united at the centre.

They then experimented on liquids by suspending a sphere or cylinder of the liquid between the poles of a revolving electro-magnet, and succeeded in getting a decided and measurable effect. The improvement of this is very great, for they have thus a means of determining the conductivity of liquid electrolytes by currents induced in the liquid without the useful electrodes and without polarisation.

Dr. Gottlieb states that as the push on the liquid is directly proportional to the current quantity, they hope to measure the conductiveness of liquids and connect these to the conductivity of solids through the intervention of mercury. Dr. Gothele stated that a conducting jelly made by dissolving gelatine in sulphuric glycerine at 100° was being prepared for trial.



Prof. Sylvanus Thomson then communicated five laboratory notes from University College, Bristol. The first relates to the source of sound in the Bell telephone receiver. Two theories are now being discussed as to this effect; the molar theory regards the motion of the diaphragm in mass as the source of sound, the molecular theory finds it in the molecular movements of the magnetic core of the instrument. Prof. Thomson applied his method of using rough cut curves with iron filings dusted on gummed glass to this problem. He found that there are curved lines formed in the telephone, the magnetic lines springing from the pole of the magnet, they gather together on the diaphragm opposite the pole, and spread out in the form which is represented lamellarly, or like a magnetic shell. The size of the plate beyond this region is, however, magnetised radially, the external poles n n being of the same name as that of the magnet, and between these two zones there is a neutral circle s s. It was remarkable, too, that the lines of force f f, touching the plate, were bent back around this circle forming a kind of valley v. When the current passed in the coil, in a direction so as to reinforce the magnetism, the lines are gathered more closely on the central region of the plate. If the current diminishes the magnetism, the lines are, on the other hand, repelled from the plate. The neutral ring is also silenced. In the first case it shrinks in size, in the second it expands. A small, thick disc is wholly magnetised lamellarly; a disc entirely magnetised radially becomes slightly conical in shape. In the actual telephone the disc is flat at the middle and conical at the edges. As the neutral ring shifts, the diaphragm will assume new radial lines. Dr. Thomson concludes that the molecular theory is not, therefore, necessary to account for the speech of the telephone, although it may exist. As confirming this view, he found that with iron, ring-wound a cardboard diaphragm and an iron core gave the enunciation was good though the timbre was altered; whereas, with radial pieces of iron on the cardboard, the timbre was good but the enunciation bad. In reply to Prof. Adams, Dr. Thomson said that the stronger the magnet the smaller the lamellarly magnetised space became, and that with a thicker disc the neutral ring was not so well marked.

Dr. Lodge suggested that the best place for the coil would be in the valley over the neutral ring which was in no unstable condition. It is also worthy of remark that the lines curve round the edge of the disc and project beyond the centre region n.

Dr. Thomson next wrote on a new blank with a magnet and dusted iron filings on it which arranged themselves so as to trace the writing. This is usually done on a steel plate, but a new retains the virtue for six or eight months. A modification of this experiment, due to Mr. Stroud, is writing on the blank with one pole of a powerful battery, the other pole being connected to the end of the blank.

The third "note" recommended the use of fine steel filings, got by breaking iron gauze of 24 meshes to the inch, instead of iron filings for exhibiting magnetic lines. The fourth note showed that the lines of force got by filings fixed on cards are magnetic, that of a bar magnet acting as a magnet. The fifth note explained that solid magnetic "figures" could be got by casting iron filings in shellac to make them rigid, and floating them in water; or by mixing filings in a wet paste of plaster of Paris, which could be cut into sections on hardening.

A. Bienfait a observé de nombreuses étoiles filantes et n'a jamais vu de mixte.

Modification des appareils d'Ampère. — M. Soubeiran répète facilement l'expérience de la rotation d'un aimant sous l'influence d'un courant au moyen de la disposition suivante (fig. 10). L'aimant est cylindrique et traversé par deux pointes. La pointe inférieure repose dans une capsule *a* remplie de mercure; la pointe supérieure est maintenue par un petit anneau *b*. Une courbe *c* est prise au centre d'une ouverture laissant passer librement l'aimant. On y verse du mercure qui, fermant un mini-que convexe, vient s'appliquer sur l'aimant. —*a* et *c* sont reunis aux pôles d'une pile; avec un élément Bunsen, l'aimant fait plusieurs tours à la seconde. L'expérience montre que la cuvette *c* doit être placée vers le milieu de l'aimant.

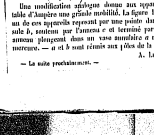


Fig. 9. Fig. 10. Fig. 11.

La modification adoptée donne aux appareils de la table d'Ampère une grande sensibilité. La figure 11 montre un de ces appareils reposant par une pointe dans la capsule *b*, soutenu par l'anneau *c* et terminé par un petit aimant plongeant dans un vase annulaire *a* rempli de mercure. — *a* et *b* sont réunis aux pôles de la pile.

A. Ledieu.

— La suite prochainement. —

La corrélation du magnétisme terrestre et du rayonnement solaire

M. Ellis, directeur du département-magnétique et météorologique de Greenwich, vient de présenter à la Société Royale un mémoire *sur la relation entre la valeur diurne des variations de la déclinaison et de l'intensité horizontale et les périodes de l'apparition des taches solaires.*

Nous sommes heureux de trouver dans un travail si rigoureux toute l'exactitude du cercle dans un établissement célèbre, une confirmation indirecte des idées que nous exposons aujourd'hui même en tête de ce recueil.

Le rectenseur de cet éclatant scrupuleux établissement cherche à établir que les périodes magnétiques suivent les périodes de taches. Elles arrivent 27,066 d'années après, en enlevant tous les orages magnétiques. Si l'on se borne à faire la correction de l'inégalité annuelle, le retard tombe à 19,866 d'années. Possible serait-il admissible encore si l'on ne faisait pas de correction du tout et si l'on se bornait, méthode peu scientifique, à comparer les nombres que nous donne la nature. Car, les époques de maximum et de minimum concordent presque exactement pour le magnétisme comme pour les taches solaires, les variations de durée sont à peu près identiques, et les orages de magnétisme terrestre éclatent avec ceux de l'envelappe du soleil. Ils progressent ainsi dire, parallèlement elle à elle; ils finissent en même temps, comme si les uns et les autres dépendaient probablement d'une cause identique.

Expliquer cette intime liaison et se refuse de reconnaître l'universalité du magnétisme est une difficulté insurmontable.

Mais, ne pas trépaster les nombres sous prétexte de les corriger, est une idée trop simple pour être acceptée dans les observatoires.

ON MAGNETISATION OF STEEL DURING HARDENING.

IT is known that in proportion as permanent magnets, the steel is less hardened and then magnetised, because in hard steel, though the temporary magnetism is less, the fixation of the magnetism succeeds better. After Scoresby and De Senarmont proved, however, that the temporary magnetism of steel continuously increases — up to a dark red glow, it seemed possible, that remarkably powerful permanent magnets might be obtained if the magnetisation were effected during the very process of hardening. Experiments in this direction were made by Parelle in 1821, also by Hebbert, Abbe, and others. These researches, however, have not quite convincing in their results; partly because of the paucity of the experiments, and partly because of the lack of accurate description of how the methods used, and comparison of their results. Herr Holtz has therefore been led to take up the question anew, since, also, it is one of considerable theoretical and practical interest. His researches are described in the *Annalen der Physik*.

To get comparable results it was desirable to operate with two exactly similar steel bars, in the same way, with the same magnetising force, except that in one case the force should be made to act after hardening, in the other, during the process. As means of magnetisation Herr Holtz used in the first half of his experiments an electro-magnet, in the other a magnetising spiral. The current was supplied by one to three Grove elements. The steel bars were round and of various thickness. They were all 150mm. long, and from the same metals. The same bar could be used three times. A most important difference appearing in its magnetic behaviour. All the bars were quenched when red, and bright red, so that during the magnetisation all points had passed the dark red glow. Each pair of bars was heated to the required degree as regularly as possible in a wood charcoal fire; then one bar was quenched, and afterwards the other, after and while the magnetising force acted on it. The time of this action was fifteen seconds. Then the first bar was exposed to the same magnetising force for the same time. The time of magnetisation of both bars thus amounted to somewhat over thirty seconds, during which time the intensity of the current certainly remained constant. Other bars were being heated during the magnetising process. Then 20 to 30 pairs were ready in an hour, or 1½ hour. The magnetism was measured by the method of oscillation, each bar, suspended by a long cocoon fibre, being laid acting under the magnetic force of the earth, and observed with a telescope having cross threads.

We will not here pursue far the details of the two methods. Where an electro-magnet was used a portion of the end was left free of wire, and the coil was also protected from the water used in the hardening process by an envelope. The bars were fixed in holders, with which they were pressed against the last poles of the electro-magnet. In the case of a magnetising spiral being used, this was protected by being wound round a copper tube with caoutchouc, and surrounded by a metallic cylinder. The width of the copper tube was so chosen that the diameter of the thickest bar to be inserted, so that the water might get freely to the latter; and the renewal of the water by it insured by narrow the case in it. Experiments were made, in both cases, with constant and with variable magnetising force, the latter somewhat irregular.

The general result was, that the magnetisation during hardening is only conditionally worse than to ordinary magnetisation. The explanation of this follows from the behaviour of the iron at special points, which Herr Holtz expresses in the following propositions:—

The superiority of magnetisation during hardening decreases,

1. Where the magnetising force increases.
2. Where the thickness of the bar increases.
3. If it proceeds, where, with weak magnetising force, the bar is at the same time partly withdrawn from the action of the same magnetisation.

4. If is less, or passes into an inferiority, where with great magnetising force a great thickness of bar is used.

The third proposition is only a consequence of the first, the fourth a consequence of the first and second. Herr Holtz proceeds to indicate what circumstances the causes of these effects.

With regard to the practical bearing of the above, it appears that magnetisation during hardening could furnish magnets which, however are not limited in their power by the strength of the magnetising machine of installation. Their absolute strength was not remarkably small, because it was only with exceedingly weak magnetising force that so great a difference appeared. The more the latter increased, the more did the difference diminish, till at length the difference became in favour of the ordinary mode of magnetisation. With the maximum magnetising force used, three large Grove elements and a coil of 850 windings, a bar with even the thickness of 6mm. was better magnetised after hardening than during it. But for production of strong permanent magnets stronger forces would probably be used.

Nor did the permanent magnetism of the bars magnetised during hardening seem to offer a greater resistance to external influences.

The conclusion therefore from these and other considerations is reached that magnetisation during hardening presents no practical advantage whatever over the ordinary method of magnetisation.

Wm. V. De Pauls [illegible] 5 1849

A GIRL, 17 years of age, at Hamden, Ontario, is said to be a perfect electric battery. Very few can shake hands with her. By joining hands she can send a sharp shock through 18 or 20 people. Her magnetic attraction is so great that she cannot let go of any article of steel she has picked up. A paper of needles will hang suspended from her finger.

Wm V. De Pauls [illegible] 5 1849

Ed. Journ. [illegible] 1849

Elias Journ. [illegible]

MAGNETIC INCREPENCE.—Herr Narr finds that the specific magnetism of magnetic ironstone is greater than that of any other magnetic substance known. Its magnetic susceptibility exceeds that of glass-hard steel, permanent magnetism exceeds that of steel, and is sooner neutralised by external forces than that of steel.

TESTING IRON AND STEEL BY ELECTRO-MAGNETISM.

June 7th

TWO interesting practical applications of electro-magnetism have recently appeared. In one it is applied to discovering the flaws of bars of steel; in the other to measuring the hardness of steel. The theory of the former principle was explained by Mr. Herring, an American mining engineer, in 1845. When an iron or steel bar is passed through a coil which is traversed by an electric current, the bar becomes a magnet. If the metal be homogeneous, the polarity of the bar may be inferred from known laws of electro-magnetism. If, however, there be a want of continuity of fibre at some point—a flaw, in fact—new poles are formed there, which a properly-mounted needle will readily detect, also giving a measure of the extent of the imperfection among those false poles. The apparatus is so contrived, then, that the wire or rod to be tested is passed horizontally first through a magnetising bobbin, then through a hole in a block of wood, which supports a nicely-balanced magnetic needle as magnetometer. The apparatus is, of course, adapted to the size, weight, and shape of the pieces to be examined. In testing plates the bobbin is flattened, and a number of magnetometers are mounted at short intervals on a bar, which can be moved to and fro in front of the bobbin and fixed at any desired distance from it. The new apparatus of Professor Tomlinson, of Dragon, for measuring the hardness of steel electro-magnetically, is a development into more practical form of a former idea of his. Its principle is that hardness of steel may be very correctly inferred from a numerical determination of its coercitive force. In its main features the arrangement is as follows:—From one end of a balance arm are suspended successively, in a horse holder, bars of the steels to be examined (these being as nearly as possible equal in weight). The other arm bears slidingly a movable coil, and bears a constant weight. Motion of the beam causes a pointer to move radially over a scale, the movement being magnified by toothed wheels. One of the steel bars having been suspended, the sliding coil, equal to it in length, is mounted on a stand so as to enclose the bar, and fixed with a binding screw when it dips. A galvanic current is sent through the coil; then the coil is released and moved gradually down, pulling the bar with it, till the latter is drawn away, and the deflection of the pointer is noted at which this occurs. This affords an estimate of the hardness of the steel. For example, a bar A gives a maximum attraction, 36°; a second bar, B, 100°; a third, C, 14°. It is inferred that A is harder than B, and B than C, and of the two latter C is harder than B.

Cautions are taken in the apparatus to prevent injury to the parts from the sudden recoil when the field of the coil on the bar ceases.

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JULY 12, 1879.] Scientific American

A MAGNETIZED WATCH.

A lady in Madrid, Me., who carried a valuable gold watch, was in a house last summer when it was struck by lightning. The watch stopped at the time, and, although jewelers have repeatedly examined it and pronounced it perfect in every particular, it cannot be made to move. It is so magnetized that watchmakers say no part of it could ever be made to do duty if taken out and put into another set of works.—*Springfield (Mass.) Union.*

S. American

L'ELECTRICITÉ

REVUE SCIENTIFIQUE ILLUSTRÉE

BEAUX-ARTS — INDUSTRIE — MARINE — ART MILITAIRE — MÉDECINE

2e SÉRIE — N° 11 — 5 JUIN 1879

L'ORIGINE DU MAGNÉTISME TERRESTRE

Sans l'étonnante propriété que possède l'aiguille aimantée de se diriger vers le pôle nord de notre hémisphère, l'Amérique ne serait peut-être pas encore découverte. C'est grâce à la connaissance de ce fait capital que le glorieux Génois brava la révolte de ses équipages et continua sa marche vers l'Ouest.

Mais l'application de cette puissance merveilleuse à la physique du globe reste encore à faire ; malgré les admirables travaux dont le magnétisme terrestre a été l'objet, les conclusions générales auxquelles nos plus savants prédécesseurs sont arrivés, sont ignorées du public et oubliées des académies mêmes dont ils étaient membres.

Nous allons essayer de combler cette grande lacune en rappelant les théories établies par Hansteen, directeur pendant un demi-siècle de l'observatoire de Christiania.

Quelque étonnant que soit le pouvoir directeur du globe terrestre, il n'est pas possible un seul instant de supposer rationnellement que cette merveilleuse propriété est particulière à notre sphère.

Autant vaudrait dire, comme on l'enseigne encore dans trop d'écoles publiques, que la Terre est la seule planète dont la surface est couverte d'êtres organisés, d'animaux et de plantes!

Pas plus que la vie, le magnétisme ne peut être le monopole de l'humble boule qui porte l'humanité et sa fortune!

Transportée dans tous les climats du firmament, l'aiguille aimantée éprouverait des orientations analogues à celles que constatent nos navigateurs en passant de l'équateur vers les pôles.

Si, par impossible, un aéronaut pouvait circuler dans le milieu céleste en dehors des limites de l'atmosphère, le pilote pourrait en regardant les vibrations de sa boussole se rendre compte de sa marche dans l'immensité.

L'intensité des soubresauts serait variable suivant la qualité et la grandeur du globe dans le voisinage duquel il passerait. Mais les approches d'un astéroïde seraient saluées aussi bien que celles d'un soleil.

Les astronomes qui nient l'universalité de la vie ne peuvent être convaincus d'erreur que par des raisonnements tirés de l'analyse spectrale ou de la constitution des météorites.

Tout en reconnaissant l'unité de matière répandue par le Créateur dans les espaces célestes, il leur reste cependant la ressource de prétendre que le groupement des molécules qui permet la constitution d'animaux organisés n'est possible que dans les conditions de lumière et de température spéciales à la distance du soleil où le hasard nous a placés; ils peuvent, à la rigueur, soutenir que les extrêmes limites sont, d'une part, les régions inférieures de l'air, et de l'autre, le fond des gouffres océaniques.

Ils peuvent soutenir que ce carbone qui tombe des plages lointaines du système solaire ne peut organiser autre part qu'à la surface de la terre des cellules vivantes.

Ces débris de mondes explosionnés ont beau ne révéler même aucune nuance nouvelle au microscope ou au spectroscope de nos chimistes, l'obstination de ces astronomes peut résister à cette éloquente analyse, en se réfugiant dans les conditions climatologiques.

Il n'en est pas de même pour le magnétisme terrestre. En effet, l'aiguille aimantée nous indique, par ses oscillations mêmes, que les deux astres principaux, le soleil et la lune, sont doués d'un pouvoir de nature identique.

En suivant avec soin les oscillations de la boussole, les physiciens ont reconnu, à l'aide d'un nombre infini de mesures précises, qu'elle ne se dirige pas constamment vers le nord, mais qu'elle s'en écarte de petites quantités. Les choses se passent comme si, malgré ses liens invisibles, elle cherchait à suivre encore les mouvements de ces deux grands

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be introduced, the difference can be at once detected by the sound. Thus, if a couple or of sovereigns/rods from the Mint be placed one in each hand, the balance is not upset; but if one of these coins be subjected to a very slight degree of attrition, the balance is destroyed and the ticking of the clock becomes audible. In this way not the existence of impurities in metals, or of inequalities in alloys, but minute to be discovered by analysis, are instantly detected, while perfect similarity is also as instantly proved. Many very interesting investigations with an instrument embodying the principle have been carried out recently at the Mint by Mr. Chandler Roberts.

From this brief description it will be seen that the value of the Hughes induction balance is not confined to telegraphic uses, but has wide and varied applications, many of which have been facilitated by the discovery Hughes himself, who has thereby placed in the hands of the scientific world the means of obtaining an electrical balance on scientific principles as it is simple in principle and construction.—*Engineering.*

ON SPIRALITY OF THE ENERGY IN BAR MAGNETS.

By R. C. SUTCLIFF, M.D.

1. THE very extensive field of research as to the cause of magnetic and diamagnetic phenomena has been brought within the compass of a brief paper by a new method of investigation and the discovery of the law regulating the force upon which the phenomena depend.

2. The method consists in an examination of the lines of force in bar magnets of a few powers, by means of test magnets made from the points of the finest needles; such test magnets being suspended with the greatest delicacy.

3. The great sensibility of these needles thus suspended possess as methods of research must be obvious—

First.—From the fact that the lines of magnetic force are always projected in lines of greater or lesser curvature, and

Second.—From their extreme lightness and delicacy of suspension they are capable of being moved by magnetic force of very low power.

FIG. 1.

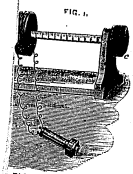
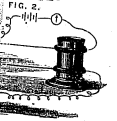


FIG. 2.



INDUCTION BALANCE.

It has been ascertained—

1. That the equator of a bar magnet is oblique and declinated.

2. That the impulses of energy or force pass from the equatorial direction to and the pole ends in oblique lines.

3. That similar impulses of energy or forces pass from the pole ends toward the equatorial direction.

4. That the moments or impulses of energy meet at a given point which is called for convenience of description the centre of balance, and that they then collide and are ejected in parallel lines from the side of the pole at each end.

5. That the energy which passes from the equator toward the ground line, for convenience of description is considered as that primarily induced, or the action which is disturbed by external force, the direction and energy of which action correspond with the direction and energy of such external force.

6. That the energy which passes from the pole end toward the ground line, for convenience of description—considered as secondary, or as the reaction, which according to Newton's third law of motion is always equal and opposite to action.

7. That this reaction takes place within the pole end in proportion to the capacity the body operated upon offers for the same.

8. That the power of exhibiting magnetic phenomena is also, and in proportion, to the energy with which these lines of force collide as they escape from the bar.

9. That the momenta impulses from either direction are oblique and characteristic by energy, which have forces—action and reaction—mutually exact as the colliding forces.

10. That this beverage increases from either direction toward the centre of balance, consequently the needle points resting on the magnet, and which are indices of the direction and degree of force, gradually becomes less oblique until at the centre line they take a direction at right angles to the axis of the bar.

11. That the reaction acquires a perfectly vertical direction

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Exqueer July 1879

Mr. HENRY A. BESSEMAN, of Herne Hill, has associated in producing a marine's compass which enables the captain or officer in charge to hear, by the ringing of a bell, when the vessel is out of her proper course. The apparatus is contained in a small box which is screwed to the bulkhead, and is intended, as a rule, to be placed in the captain's cabin. The compass is mounted in gimbals which can be adjusted to any angle allowing a greater or less deviation in steering to either the port or starboard side. Assuming the captain, on quitting the deck, to have given instructions to steer the ship on a certain course, he sets the index hands to at that angle, allowing the requisite given limits for deviation, either to the right or left of that course. Should the ship be steered off her course beyond the limits allowed, the needle of the electric alarm will rise instantaneously and, moreover, continuous ringing until the right course is resumed.

Murray & Brooks July 14 1879

Magnetizing Molten Iron.

Mass., July 14, 1879.

In a letter to Dr. C. W. Siemens, and communicated by him to the British Society of Telegraphic Engineers, Mr. R. Cherneff records a very curious experiment. Believing that if it were possible to magnetize white cast iron a magnet of greater permanence than any made of steel would be obtained, Mr Cherneff cast some white refined iron in a mold, surrounded by an electro-magnetic reel, along which a current was allowed to flow during the process of casting, so that the fluid metal became magnetic, and cooled under the influence of the magnetic current.

The result so far justifies the expectation as to give a magnetized bar of white cast iron; but the form of the bar and the coiling what was expected. On allowing the metal into the mold to cool until the metal set, Mr. Cherneff observed a singular agitation of the metal, which could not have proceeded from damp, as the mold was thoroughly dry. On cooling the bar proved to be hollow, the cavity being symmetrical and extending about two-thirds the length of the bar. The metal was thinnest just opposite the center of the reel, where it did not exceed the thickness of writing paper. The agitation of the metal in cooling is accounted for by the repulsion of the molten metal toward the poles of the magnet.

By casting under pressure it may be possible to obtain by this method extremely permanent and powerful magnets of white iron. Possibly also this experiment may lead to some useful modification of industrial processes for casting hollow cylinders without cores.

Sc. Am. Fire Electrical Alarm Compass

A short time since Mr. Henry A. Besseman, of Herne Hill, England, brought out an ingenious compass alarm for use on shipboard. Its purpose is to make the compass signal automatically any considerable deviation of the ship from a desired course. Over the compass card are placed two index hands which can be adjusted to any angle; and these hands are so connected with an electric alarm that the moment the compass needle passes the limit of variation prescribed an alarm bell will ring in the captain's office, and continue ringing until the ship's proper course is restored. In this way any departure from the ship's course, as ordered by the officer in command, whether due to the steersman's inattention to duty or to a misunderstanding of the orders given, will be instantly made known. The officer on the other deck gives his orders to the steersman as now, the index hands to correspond, and after that he is relieved of the necessity of constant observation of the compass to be sure that his order is strictly carried out.

This invention is just now receiving much attention in the scientific and other journals in England; and it is extensively described as novel as well as unlikely to be useful. In novelty, however, is open to question. In principle, and apparently in mechanical construction, it is substantially identical with the electro-magnetic attachment to ship's compasses invented in this country by Alfred Fauvest, July 15, 1872.

The essential part of the claim for this patent was the construction and arrangement of a compass, so that, by reason of any material variation in the route of the vessel, the needle of the same would close an electrical or magnetic circuit and sound an alarm.

The apparatus was in demonstrating the practicability of this system was made in this city by Mr. William F. Heinke, model maker, now at No. 32 Park Row. Why the invention has remained so long undeveloped is not known.

Sc. Am. Aug 9 1879

Magnetization of Molten Iron.

To the Editor of the Scientific American:

In your issue of July 26 I notice a report of "Magnetizing Molten Iron," the experiment having been made by Mr. Cherneff and reported by Dr. C. W. Siemens. I do not know that it is a matter of much importance, but believe I was the first person to try the experiment, which I did in the foundry of the Fall River Iron Works in 1872. I had never thought it important enough to report in the scientific press, though I at the time reported it to some of my friends, among them Prof. John H. Appleton, of Brown University; Prof. Barker, of Pennsylvania University; and afterward Prof. Farmer, of the U. S. Torpedo Station.

I had two objects in view, one of which was the production of powerful permanent magnets, the other the application of malleable iron by a polarization of the atoms in the direction of the current, during the change from a molten to a solid condition. In the first I failed, as I believe every one else will; for, since heat destroys a magnet, heat will also prevent permanent magnetization. In the second I succeeded to a certain degree, and samples of the iron I made, heated to a cherry red, and drawn under the hammer to chisel points, are now, or were at one time, in the possession of Mr. A. A. Pope, President of the Cleveland Malleable Iron Co., and of Dr. W. W. Keen, Philadelphia.

If it would be of sufficient interest, I will send you a sketch of my apparatus and description of my experiments. I made use of the 60 cup Bunsen battery, of Brown University, kindly loaned me by Prof. Appleton, and was unable to carry the experiment to the end I would wish, because of the evolution of nitrous acid from my battery, which nearly suffocated the workmen at the foundry. I would like to try it again with a powerful Bunsh machine, for the results were very interesting.

My bars of iron came out of the mould solid, and if hollow ones were produced, by some one else, the reason must be sought in some defect of making the mould or pouring.

SEVERIN BORDEN.

Fall River, Mass., July 31, 1879.

Mining & Sci. Press July 19 1879 53

A New Theory of the Earth's Magnetic Poles.

From a study of the movement of the compass-needle produced by declination at London, Mr. R. G. Jenkins, of the Royal Astronomical Society, has become convinced that the various variations of the needle during the last 300 years can best be explained by the supposition of a strong magnetic pole above the earth's surface, and revolving around the geographic north pole in about 500 years. The only other magnetic pole, as ordinarily believed by Halley and Hansteen, is the one which is supposed to explain all the phenomena of terrestrial magnetism, but he places these poles at the earth's surface in the antipodes. These poles he regards as the free ends of as many loops of the earth's solid, ferruginous crust like the vicinity of the north pole to the equator, the other two coming down from the south pole to meet them, the highly magnetized of the northern belts uniting with that of the natural magnetism of the southern belts about the magnetic equator. These bands he believes to penetrate at about equal relative distances the poles of the earth, producing secular variations.

It will be observed that Mr. Jenkins describes the magnetism of the northern hemisphere as "normal." Contrary to the current theory, he holds that the north end of the compass-needle is a true north pole, and that the facts observed, when properly understood, in full accord with the great magnetic truth that like poles repel and unlike poles attract.

After adducing the evidence in favor of this view, Mr. Jenkins argues in this wise: If the north end of the needle is attracted to a south pole, pointing to the ground in Scotland (where Sir James Ross located the south magnetic pole) must be attributed to attraction. If it is attracted it is attracted by the magnetism in the crust of the earth at or in the center of the globe. If there is something in the earth's crust which attracts the needle in Scotland, it ought to attract the needle in London. But the needle in London is attracted westward, as the crust at Scotia ner to the earth's center. Again, Mr. Jenkins says, that the north pole of the needle pointed to the ground almost perpendicularly in Scotia became it was attracted by the true north magnetic pole in the atmosphere above that region when Sir James Ross was there 30 years ago.

Further evidence as to the existence of the alleged magnetic pole above the earth's surface is promised. Meanwhile, it is of the first importance, Mr. Jenkins thinks, that it should be clearly settled whether the magnetic variations are or above the earth. According to his calculation it should now be in latitude 72°, longitude 112°, in Prince Albert land.—*Scientific American.*

THE COMPASS.—The secret of the mysterious of a large compass [illegible] of the ship's head upon [illegible] of a large [illegible] is the simultaneous [illegible] three of a large [illegible] in the [illegible] period were by the methods of [illegible] in common use. In some [illegible] the *Admiralty* "card, pivoted for use in stormy weather] there is a swelling in the middle of each of the steel needles to make them heavier; in others heavy brass weights are attached to the compass cards as near the circumference as may be, being sometimes, for instance, in the form of a small brass [illegible] almost the inch and a half in diameter. Another method, scarcely less scientific, is to bind the bearing-point by grinding it or striking it with a hammer, as has not infrequently been done to render the compass less lively. Still another is the cup with brick-dust, as is reported by the Liverpool Compass Committee to have been done at sea by a captain, who was surprised to find after using it that his compass could not be trusted within a couple of points. All these methods are founded on the idea that friction on the bearing-point is the cure for unsteadiness. In reality, friction introduces a peculiar disturbance of a very serious kind, and a very ineffective in remedying the proper unsteadiness of which something is essential and inevitable in a compass on board a ship. Some time due east or due west.

Electro-Measurer of the Hardness of Steel.

A new apparatus has been produced by Professor Wattenhofen, of Prague, for measuring the hardness of steel electro-magnetically. Its principle is that hardness of steel may be very correctly inferred from a numerical determination of its coercive force. In its main features its arrangement is as follows:—From one arm of a balance arm are suspended successively, in a brass holder, bars of the steels to be examined—those being as nearly as possible equal in weight. The other arm holds obliquely downward, and bears a constant weight. Motion of the beam causes a pointer to move nobly over a scale, the movement being magnified by toothed wheels. One of the steel bars having been suspended, a magnetizing coil, equal to it in length, is raised on a stand so as to inclose the bar, and read with a leading screw when it does. Then a current is sent through the coil; then the coil is released and moved gradually down, pulling the bar with it, till the latter breaks away, and the deflection of the pointer is noted at which this occurs. This affords an estimate of the hardness of the steel. For example, a bar, a, gives a maximum attraction, 9·6; a second bar, b, 10·6; a third, c, 11·6. It is inferred that *b* is considerably harder than *a* and *c*, and of the two latter *c* is harder than *a*. Precautions are taken in the apparatus to prevent injury to the parts from the sudden recoil when the hold of the coil on the bar ceases.

1003. Magnetic Apparatus for Operating Pendants, *R. Sandeman*, Great Bed Street, Clerkenwell, Middlesex.—Dated 2nd April, 1879.

This invention consists in the employment of electro-magnetic apparatus for the purpose of causing the striking of a mechanical bell or gong at any desired moment, and for any desired number of times in succession, by the action of a clock or watch, or by the action of any other mechanism capable of giving motion to a suitable contact-maker at the moment when the striking is required to be effected, which contact-maker is thereby caused to complete an electric circuit, and so to form a temporary connection between the source of electricity, the coils of which, when acted upon by the current, form a magnet, and the bell, gong, or [illegible]

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An Electric Alarm Compass, which, from its description, promises to become a valuable adjunct to the mariner's compass, has been devised by Mr. Henry Al. Stevens. The purpose of the device is to make known to course, should the man at the wheel fall asleep or misunderstand his instructions. Without attempting a description of the attachments, which would be difficult of comprehension without an engraving, it will suffice to say that it is applied in connection with the compass so to sound an alarm should the vessel deviate from her course beyond a certain limit, which is permit to be arranged at pleasure. The alarm is given automatically by the striking of a ring until the ship's course is righted, when, consciousness returning to the helmsman, it ceases. The value of the device is too obvious to be dwelt upon. A full description will be found in London *Nature*, July 3d.

The electro-magnetic rotation of the plane of polarization of light in gases has recently been proved and studied variously by Kundt and Röntgen, Bichat and H. Becquerel. The last-named observer, by a superior method, measured the phenomenon especially in ordinary coal gas, while the others demonstrated the rotation in sulphide of carbon vapour, gaseous sulphurous acid, and sulphuretted hydrogen. In a paper to the Vienna Academy, Prof. Lippich, of Prague, describes additional experiments on the subject. He aimed especially at perfecting the optical part of the apparatus, and attained remarkable accuracy. He succeeded in demonstrating the rotation *in air*, using a large coil of 5 metres long, with 365 m. length of copper wire (nearly 3 mm. thick) in twelve layers. The current was from sixty average Bunsen elements, combined in a battery of thirty double elements. The light-ray was simply sent through the hollow part of the coil. Under these circumstances an unmistakable electro-magnetic rotation was observed, and it was in the direction of the current coursing round the air. The angle of rotation could not have been far from 6 to 10 seconds of arc. (An exact determination was not possible, owing to the provisional arrangement of the optical apparatus.) *Nature*, July 24 1879.

Eine Abbilde ist darum durch ein Mittel, womit sich ein Schiff mit den anderen über seinen Cours verständigen kann, von höchster Bedeutung. Und dieses Mittel besteht lediglich in einem verbesserten Ziffernblatte für den Compass, der in seiner ursprünglichen Einrichtung nicht die geringste Veränderung erfahren, sondern nur an den gewöhnlichen Stellen mit den Zahlen und Inschriften versehen werden soll, wie sie die hier mitgetheilte Abbildung zeigt.

Die Ziffern, welche einer jeden Richtung oder den Inschriften auf dem Compasse beigefügt sind, zeigen die Signale an, welche ein Schiff mittelst der Dampfpfeife zu geben hat, um seinen Cours anzudeuten, und zwar ähnlich, wie bei Feueralarmsignalen der District bezeichnet wird, in welchem es brennt. Steuert z. B. ein Schiff im Nebel genaulenus nach Nord, und der Schiffskapitän will ein in der Nähe befindliches Schiff seinen Cours wissen lassen, so giebt er das Signal 212 vermittelst zweier rasch aufeinander folgender, dann nach einem kurzen Zeitraum mit einem, und dann nach einem gleichen Zeitraum wieder mit zwei aufeinander folgenden Pfiffen (11—1—11), und der Kapitän des anderen Schiffes sieht sofort auf seinem gleich eingerichteten Compass die Lage jenes Schiffes, kann auszeichnen und dem Nachbar antworten. So verhilft es sich mit allen den durch Zahlen angegebenen und verschiedene Richtungen bezeichnenden Mittheilungen, wie es sich aus der hier beigefügten Abbildung leicht ausfinden lässt.

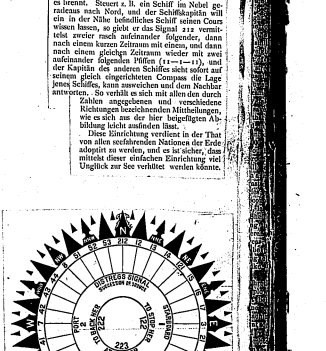
Dieser Einrichtung verdient in der That von allen seefahrenden Nationen der Erde adoptirt zu werden, und es ist sicher, dass mittelst dieser einfachen Einrichtung viel Unglück zur See verhütet werden könnte.

Der Techniker 1879

Hughes' Nebel-Signal-Compass.

Es sind schon zahlreiche Versuche angestellt worden, ein System von Signalen zu ersinnen, mittelst dessen Schiffe in dunkler Nacht oder bei dickem Nebel die Stellung oder den Cours anderer Schiffe bestimmen und dadurch Collisionen vermeiden könnten. Aber dieselben sind entweder zu complicirt oder praktisch unausführbar gewesen. Nun aber hat Capt. W. Hughes, der seit vielen Jahren schon als Steuermann auf den zwischen San Francisco und Oakland fahrenden Ferryboooten thätig war, ein solches entworfen, das einfach, leicht anwendbar und zuverlässig ist.

Das Schallmittel für Schiffe, welche sich in nebligem Wetter nahe bei einander befinden, besteht in den Umständo, dass keines derselben weiss, welchen Cours das andere einhält. Dadurch können die schlimmsten Collisionen vorkommen, selbst wenn man auf dem einen Schiffe in Folge der Dampfpfeife von der Nähe des anderen unterrichtet ist. Denn in nebligem Wetter ist die *Richtung* des Tones schwerer zu bestimmen, und es ist dadurch kein Schutz gegen ein verhängnisvolles Unglück gegeben.



Hughes' Nebel-Signal-Compass.

Fog Signal Compass

THE TELL-TALE MARINER'S COMPASS.

A very ingenious apparatus for reducing the risks of navigation has lately been patented by Mr. Henry A. Severn, of Ilfracombe, which will be understood by the accompanying engraving. It consists of an ordinary seaman's compass placed in connection with a small battery, and so arranged as to enable the captain or officer in charge of the deck to ascertain at any time the helmsman's due course. It is placed in the usual binnacle, and having, on spotting the deck, the first orders as to the course to be steered, he is enabled by the ear alone to detect any departure from his instructions. In designing this compass, Mr. Severn utilised the constant pointing of the card, and the ever-varying position of the ship for the purpose of making and breaking metallic contact. A pair of brass bands placed above the compass card can be adjusted to any angle, the one hand to port and the other to starboard of the direct course, thus allowing for a given amount of deviation to one side or the other. If the ship is steered off her course beyond the limit thus allowed on either side, an alarm bell instantly rings, and will continue to ring until the right course is resumed. In our engraving Fig. 1 is a section and Fig. 2 a plan of the compass with its accessories, the battery and bell. In practice these several parts are placed together in a small box, and can be easily carried about, and can be placed in any part of the ship.

Referring to our engraving, L' and K' are two flat brass milled bands of which the latter is adapted for being conveniently turned about their centres by the fingers. These milled heads are on the upper surface of the metallic lid of compass, and are themselves metallically attached to the rod L, which passes through and rotates within the hollow tube K which is attached to the milled head K'. Both the movable bands pass through the socket I which is cemented in the glass lid. The milled heads can be made to revolve within the socket I, and the band L' rotates in either direction within EC. The socket I is placed in metallic communication with the zinc of brass around the lid by means of the covered wire H. Under the glass lid and attached respectively to the terminations of the wires H and G are fixed the two metal bands K', L'. At the ends of these bands are suspended platinum wires K², L², which are free to move in metallic contact with the brass zinc O and connecting cover C. The metal point for suspension of the card is connected by a brass bevel at B', and is connected with one pole of a few cell constant battery cell. Mr. Severn prefers to use the card two magnetised needles, and not in actual contact with the metal cone for suspension. B B' is the metal point, A' the brass centre, and A A the card. Attached to the top of the brass centre A' is a light metal arm A³, the end of which is made of platinum for a length of one inch. This metal arm is therefore in metallic communication with the zinc O attached to the pole of the battery. To complete the circuit all that is necessary is to bring one of the hinged wires K² or L² (either will do) into contact with metal arm A³, and if an electric bell is placed in the circuit it will ring whenever the contact is made. Availing himself of the ever stationary position of the compass card, and the ever varying position of the brass pointed end, Mr. Severn simply moves the two index bands and their hinged wires K², L², as to bring them respectively to any required distance on either side of the metal arm A³, and so long as the vessel does not vary her course (so as to bring one or other of the wires K² or L² into contact with A³), no alarm bell will ring. If, however, that distance is reached or crossed, the bell will immediately ring, but will stop as doing so the helmsman or movement is rectified. It will continue to ring till a variation continues, because the hanging wires K², L² are very easily influenced by the slightest velocity of the card and its needles. The experienced officer using this apparatus has merely to adjust the index bands by means of their two milled heads, to any angle he pleases, after the vessel is on her course, and in heavy or fine weather, by night or day, the alarm bell rings when the steering is bad. The metal bands can be raised 1/4 in. through the socket I, and the bands can be raised from free of the metal arm A³, and the hanging wires are then at their lowest position.

It will thus be seen that by the aid of this compass the captain, when below can ascertain, without any trouble to himself, when the steering is bad, or the vessel is out of her course, and can have her right at once, by night or day. It will tend to make it known instantly as both officers and seamen are below. Another important point is that it will give intimation at night to the officer on deck when the vessel alters her position by swinging around her anchors. In short, the bell-tale compass appears to be well calculated to aid in preventing the risks and dangers of both coast and ocean navigation generally.

SEVERN'S TELL-TALE COMPASS.

Fig. 1.

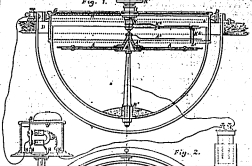


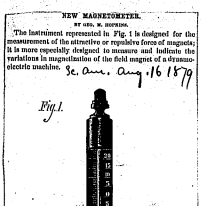
Fig. 2.

NEW MAGNETOMETER.

BY GEO. M. HOPKINS.

The instrument represented in Fig. 1 is designed for the measurement of the attractive or repulsive force of magnets; it is more especially designed to measure and indicate the variations in magnetization of the field magnet of a dynamo-electric machine. Sc. Am., Aug. 16 1879

Fig. 1.



NEW MAGNETOMETER.

The changes in the resistances of the current from the modern dynamo-electric machines effect a corresponding change in the magnetism of the field magnets. An indicator that faithfully shows these fluctuations will give a correct idea of the strength of the current. The instrument illustrated does this, and it may also be used in detecting the location of the greatest magnetic force in an electro or other magnet.

The instrument shown in Fig. 2 is virtually an electrometer, as it indicates the electro-motive force of the dynamo or magneto machine when its helix is included in the electrical circuit. These instruments are quite simple, and are nearly alike so far as the upper portion is concerned.

The horizontal metallic plate, which in one case is supported by the columns and in the other by three milled screws, is centered in the middle and supports a steel diaphragm that is held in place by the vulcanite cap secured to the plate by several screws, so as to clamp the diaphragm tightly.

The vulcanite cap is chambered out to receive mercury, and it has a stuffing box for holding a glass tube of small caliber. A vulcanite screw at the side of the stuffing box serves to adjust the height of the mercury in the tube. The graduations on the scale at the side of the tube represent the number of pounds of attractive force exerted on the instrument. The graduations from 0 upward indicate the degree of upward pressure when the force of repulsion is measured.

A short rod is attached to the middle of the diaphragm, and projects down through a hole in the base plate to receive in one case (as shown in Fig. 1) a convex soft iron armature, and in the other case (as shown in Fig. 2) a cylindrical armature or core which extends into the helix.

The instrument shown in Fig. 1 may be placed upon any part of the field magnet. The one end full of the mercury in the tube, resulting from a deflection of the diaphragm by the action of the magnet, constantly indicates the internal condition of things in the dynamo-machine. By bending the glass tube at right angles near the vulcanite cap the instrument may be applied to the side of the magnet. It may seem that the approach of the armature toward the magnet—thereby diminishing the distance between armature and magnet—would involve an error; but the motion of the diaphragm is very slight, and in a large magnet the variation of .02 of an inch in the distance between the armature and magnet is of no account.

The diameter of the diaphragm is 2 inches; the caliber of the glass tube, .02 inch; therefore a very slight motion of the diaphragm is indicated by a considerable movement of the mercury in the tube.

When the repelling force of a magnet is to be exhibited the soft iron armature is replaced by a permanent magnet.

The instrument shown in Fig. 2 may be placed anywhere in the circuit, and will indicate the strength of the current. An increase in electro-motive force results in the drawing in of the iron core and a consequent deflection of the diaphragm and movement of the mercury column.

The Electrical Alarm-Compass.

A short time since Mr. Henry A. Sawtell of Horse Hill, England, brought out an ingenious compass alarm for use on shipboard. Its purpose is to make the compass signal automatically any considerable deviation of the ship from a desired course. Over the compass card are placed two index hands which can be adjusted to any angle; and these hands are so connected with an electric alarm that the moment the compass needle passes the limit of variation prescribed an alarm bell will ring in the captain's office, and continue ringing until the ship's proper course is restored. In this way any departure from the ship's course, as ordered by the officer in command, whether due to the steersman's inattention to duty or to a misunderstanding of the orders given, will be instantly made known. Of course when the officer gives his orders to the steersman he sets the index hands to correspond, and after that the only interval of the necessity of constant observation of the compass to be sure that his order is strictly complied with.

This invention is just now receiving much attention in the steamship and other journals in England; and it is certainly described as novel as well as likely to be useful. Its novelty, however, is open to question. In principle, and apparently in mechanical construction, it is substantially identical with the electro-magnetic attachment to ship's compasses patented in this country by Alfred Fousnet, July 18th, 1820.

The essential part of the claim for this patent was the construction and arrangement of a compass, so that, by reason of any material variation in the route of the vessel, the needle of the same would close an electrical or magnetic circuit and sound an alarm.—*Scientific American.*

Tell-tale Marine Compass.

A very ingenious application of electricity to the purposes of navigation has recently been effected by Mr. Henry A. Severn, of Horse Hill, London, who has succeeded in producing a mariner's compass which enables the navigating officer in charge to befit, by the flagging of a bell, when the vessel is out of the ordered course. In the construction of this compass Mr. Severn has availed himself of the constant properties of the card and the ever-varying position of the ship for the purpose of making and breaking the metallic contact, which causes an electric bell to be sounded, and thus to announce the fact that the vessel is off her course. The whole of the apparatus is carried out in a small box which is easily carried about, and, generally, as a rule, to be placed in the captain's cabin. After the card are two index hands, which can be set to any point, so as allowing of greater or less deflection in steering to either the port or starboard side, according to the captain, so quitting the deck, takes with him instruction to steer the ship on a certain course; he sets the index hands to a point or two right, allowing the steersman a given latitude for deviation either to port or starboard of that course. Instead of having to be constantly watching the compass, as at present, to see that his orders are carried out, the captain leaves the instrument to tell him, by its silence, if they are, and by its sounding if they are not obeyed. Should the ship be steered off her course, beyond the limits allowed on either side, an electric alarm bell rings instantaneously, and, moreover, continues ringing until the right course is resumed. The index hands can be raised away from the card, when the ship requires characteristics, and the compass can be used in the ordinary way. It appears evidently this apparatus is calculated to be of much utility.

The metal point on which the card is hung is insulated from the compass bowl, and to it is attached a wire from one pole of a small battery. About an inch above the card, placed sensitively, is its surface and attached to its metal centre (which is insulated from the needle) is an arm of metal reaching nearly to the edge of the card. This arm is, therefore, in metallic communication with the wire from the battery already referred to. The glass lid of the compass has a short brass rod working within a tube passing through it. These are severally attached to two brass rings placed above the glass lid and to the two movable index hands beneath the glass. These are in metallic contact with the brass rods of the compass, and this with the other pole of the battery. Beneath the outer extremities of the index hands are suspended two pieces of platinum, the short brass rod passing of an inch long. These hands can, by means of the milled heads, be moved round to any position over any point of the card. Hence they admit of being placed on either side and equally distant and otherwise from the end of the metal arm on the card. It will thus be seen that whenever the platinum wires come in contact with the metal arm on the card the circuit is completed. The electric bell being placed in the circuit sounds whenever such contact takes place. The bell is disconnected by simply raising the milled head up half an inch through a sliding tube, and the compass then becomes in all respects an ordinary one. Two bells of different tones are used, and thus the instrument will indicate to the captain whether the deviation to steering is to port or starboard. The arrangement is simple and compact, and the invention promises to subserve a very useful purpose in navigation. By its use the captain will be saved much anxiety, and the knowledge that there is a check upon the careless or unobservant will no doubt give additional security, while in the case of vessels riding at anchor in a port or road this compass will at once give intimation of swinging—a matter of, importance, especially at night, when many vessels are together. In short, the dangers of navigation generally will be considerably lessened by its use.—*London Times.*

The Earth's Magnetism.

THE NEW THEORIES OF THE EARTH'S MAGNETISM.

At a recent meeting of the Philosophical Society, on June 29th, Mr. H. A. Rowland, Prof. of Physics in the John Hopkin's University, Baltimore, pointed out supposed error in the calculations by which Profs. Ayrton and Perry sought to establish their new theory of terrestrial magnetism. At that time, Prof. Rowland had not seen their calculations in full, so that he could not say exactly where the error occurred; but in the *Philosophical Magazine* for August, he, having at length seen their full working out, is able to point out the mistake, which seems owing to him in the sign of an exponent, where + 4 should be — 4. According to the correct results the earth in order to account for its magnetism by the new theory, would require to be electrified to a potential of about 4×10^{11} volts, a charge which would be sufficient to produce a spark in atmospheric air of ordinary density of about 6,000,000 miles. "It was," says Prof. Rowland, "this large quantity which caused me to reject the theory; for I now what an immense effect it would have in planetary perturbations; and I have even imagined to myself the atmosphere flying away, and the lighter bodies on the earth rushing away into space by repulsion. And, doubtless, had not Profs. Ayrton and Perry made some mistake in their calculation, by which the force was diminished 16×10^{22} times, they would have feared like results. For according to Thomson's formula, the force would be equal to a pressure outwards of

$$\frac{1}{8\pi} \frac{\mathrm{F}^2}{\mathrm{K}^2}$$

which amounts to no less than 1,850,000 grammes per square centimetre! or 10,000 kilos. per square inch! Such an electrostatic force as this would undoubtedly tear the earth to pieces, and dissolve its fragments to the uttermost parts of the universe. If the moon were electrified to a like potential, the force of repulsion would be greater than the gravitation attraction to the earth, and it would fly off through space. For these reasons I rejected the theory, and now believe that the magnetism of the earth still remains, as before, one of the great mysteries of the universe, beyond the solution of which we have not yet made the most distant approach."

But what if the earth's magnetism be the resultant of several causes, and the electrostatic charge of the surface, according to Profs. Perry and Ayrton, one of them?

Terrestrial Magnetism and Electricity.

Professors Ayrton and Perry, of the College of Engineering, Tokio, Japan, communicate to the *Philosophical Magazine* a short note, proposing the hypothesis that the phenomena of earth currents, terrestrial magnetism, and atmospheric electricity are due to the fact that the earth is an electrified condenser, whose capacity or potential is continually changing on account of its rotation and annual orbital motion, the successive cooling and warming of the air, the formation of clouds and rain, &c., etc. Thus changes produce electric currents tending always to restore the equilibrium, whence follow the phenomena in question. They suggest that observations of atmospheric electricity may be used to predict atmospheric changes.

Wymp Broun describes, in *Nature*, a new lecture experiment, to show the action of terrestrial magnetism. A rectangular frame of light wood, carrying twenty coils of insulated wire, was suspended in a horizontal position from the pans of a balance, so that the two sides of the rectangle were at right angles to the beam; and mercury connections were arranged at the middle of the short sides, so that a current could be sent through the wire. This apparatus being placed with the long sides of the rectangle perpendicular to the magnetic meridian, when the battery current passed from east to west on the northern side, and from west to east on the southern side, the north side would be attracted, and the south side repelled by the earth currents, both influences combining to deflect the beam of the balance. On reversing the current the deflection was in the opposite direction.

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New Theory of Terrestrial Magnetism.

Professors Perry and Ayrton have proposed the theory that the resultant of the earth's bounds the electrical charge originally and at all times present in the atmosphere may and is sufficient to account for the magnetism of the earth. They have also calculated the matter to a number, and find that the difference of potential between the earth and space necessary to produce a distribution sufficient to produce the observed magnetic effect can be represented by 54,000,000 volts. Professor Perry, according to this theory, that "if the earth be electrified, it must, from its very rotation, quite independently of all other bodies in the universe, be magnetic; and if it consist of a shell of iron, thick or thin, then that the law of distribution of magnetism produced by this electrical charge is mechanical rotation, will be identically that given by Biot; and, lastly, if the earth were wholly of iron, a difference of potentials of about 54,000,000 volts between it and space would be sufficient to produce the necessary amount of charge.—*Pub. Mag.*

New Theory of Terrestrial Magnetism.—The theory lately advanced by Professors Ewing and Ayrton, of Japan, to account for the magnetism of the earth, and which has provoked much discussion, is thus briefly summarized in the *Philosophical Magazine*. They find this cause in the rotation of the earth beneath the electrical charge originally met at the surface of the atmosphere. By calculation, they find that the differences of potentials between the earth and space necessary to produce would be represented by 51,000,000 Daniell cells. And, adds our authority, they prove that "if the earth be electrified, it must, from its very rotation, exhibit independently of all other bodies in the universe, be magnetized; and if it consists of a shell of iron, thick or thin, then that the law of distribution of magnetism produced by the rotation of the charge is mechanical rotation will be identical with that which exists; and lastly, if the earth were wholly of iron, a different law would obtain; the necessary amount of charge."

L'ÉLECTRICITÉ

REVUE SCIENTIFIQUE ILLUSTRÉE

BEAUX-ARTS — INDUSTRIE — MARINE — ART MILITAIRE — MÉDECINE

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ASTRONOMIE ÉLECTRIQUE

De l'origine du magnétisme terrestre

Nous avons rappelé déjà à plusieurs reprises les théories émises par le grand Haustcen, et protesté contre l'oubli dans lequel sont tombées les œuvres de l'archimède de Christiania. Mais il ne suffit pas de faire quelques allusions passagères à des travaux si considérables. Il est temps de leur donner successivement tout le développement que justifie la nature de cette publication.

En effet, malgré l'indifférence systématique d'un grand nombre d'astronomes et de physiciens, des idées analogues, mais bien moins grandioses, se font jour dans les *Comptes-rendus* de notre Académie de Paris et dans les *Mémoires de la Société royale de Londres*.

Pour peu que l'on réfléchisse quelques instants, on se n'étonnera pas que ces questions viennent enfin à l'ordre du jour. Ce qui surprendra, c'est qu'elles n'y soient pas depuis bien des années déjà.

En effet, il est impossible d'échapper à cette idée que la terre dans son ensemble est électrisée. Cette idée s'impose aussi bien que celle qui consiste à la considérer comme conductrice prise également dans son ensemble.

On voit même trois grands phénomènes naturels qui peuvent expliquer la présence de cette électricité primitive.

Le premier est le contact des mers et terres; le second le contact de l'air avec la surface terrestre, d'une part, et la surface océanique, de l'autre; enfin, le troisième l'échauffement produit par le mouvement diurne.

Mais si la terre est électrisée par suite de actions chimiques ou thermiques, est-il raisonnable, d'admettre qu'elle soit seule dans ce cas?

Le bon sens dira non; et les résultats de l'inspection des astres voisins de la terre répondront comme le bon sens.

Nous savons que toutes les planètes ont une atmosphère gazeuse comme la nôtre, que leur surface se compose de terre et de mers plus ou moins analogues à celles que nous connaissons; nous savons que toutes ont un mouvement diurne plus ou moins rapide; nous savons qu'elles sont formées de matière pondérable constituée à l'aide des mêmes éléments chimiques.

Il est donc incontestable que, prises dans leur ensemble, elles sont conductrices de l'électricité et que les mêmes actions chimiques ou thermiques qui se passent à la surface de notre monde ont des analogues dans le monde de Mars, de Jupiter et de Saturne. Il ne saurait en être autrement à la surface des planètes de Mercure, Vénus, etc., etc., plus rapprochées du soleil.

D'après leur plan primitif, Gauss et son élève M. Weber demandaient chaque année à leurs correspondants huit séries de quarante-quatre observations horaires. Mais, l'expérience ne tarda point à montrer que ces observations étaient trop peu fréquentes pour que les perturbations que l'on cherchait à étudier pussent être constatées. Car, des troubles considérables, se produisant dans l'intervalle, échappaient forcément aux observateurs chargés de les constater.

On se décida à les faire toutes les vingt minutes, pendant la durée des huit termes exigée.

Puis, on les rapprocha encore et on les fit de dix en dix minutes. Ces nouveaux intervalles de temps étant encore trop longs, on finit par prendre les lectures de cinq en cinq minutes, sauf à diminuer la longueur des huit termes.

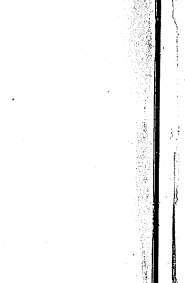
Enfin, l'invention de la photographie permit d'organiser des instruments magnétiques à indications continues, que l'on emploie maintenant dans un grand nombre d'observatoires.

L'histoire du développement de l'observation universelle est parfaitement identique à celui de l'Union magnétique.

PRACTICAL EXPERIMENTS IN MAGNETISM, WITH SPECIAL REFERENCE TO THE DEMAGNETIZATION OF WATCHES.—No. 5.

BY ALFRED M. MAYER.

Experiments which show Something about the Nature of a Magnet.—Take the piece of steel wire, six inches long and one sixteenth of an inch in diameter, mentioned among the articles required in our experiments; score this piece of wire at short distances apart, by filing it around with a sharp file. Now heat the wire to a cherry red, and then plunge it vertically into water. It will now be quite hard, and may be readily made into a magnet by drawing it over the pole of your rat-tail file magnet. Paste a small piece of paper around one of the ends of the steel wire before you magnetize it, and then, if you draw the wire over the N. pole of the magnet, from the papered end to the unpapered end, the papered end of the wire will have north polarity, as may be shown by applying the wire to the magnetometer. The magnetic condition of the wire having been found out, we begin by snapping the wire into small pieces, which is readily done, for the scores on the wire determine where it will break. Place each piece on the table as it is separated from the wire, and with its ends pointing in the same direction which they had when it formed part of the wire.



Examine each of these pieces in succession. They will be found to be perfect magnets, with N. poles turned all one way, their south poles turned in the other direction. This examination may be made by means of the magnetometer. The fact that each piece is a magnet may also be readily shown by rolling it in iron filings, when it will be found that the filings adhere to the ends of the pieces of wire just as they did to the large magnet. See Fig. 11.

Fig. 26 gives a view of the pieces of wire placed end to end just in the position they had when they formed parts of the steel wire. We see that each piece is a perfect magnet, and that the south poles of these pieces all point to the right and their south poles all to the left. But each of these little fragments may be broken into two, and so on; and as far as the unaided eye may be carried, it has been found that each minute fragment is a perfect magnet, with one of its ends a south, and the other a north magnetic pole. In imagination we may conceive of this subdivision carried so far that one of the particles thus reached may be invisible to the unaided eye. Indeed, nothing prevents us from logically assuming that even if a molecule of the steel should be reached it would be found to be a perfect magnet.

An Experiment with a Magnet formed of Steel Filings Packed in a Paper Cylinder, is interesting when studied in connection with the experiments just made, and will serve to give us further information as to the nature of a magnet.

Take a piece of letter paper, and having wrapped it several times around a lead pencil, paste the free edge of the paper on to that wrapped around the pencil. After the paste has dried you may draw out the lead pencil, and you will then have a tube made of paper. Cork one end of this tube, or you may close it by doubling over the paper at its end and gluing. Fill this tube with steel filings, and then close the other end of the tube. This tube, filled with steel particles, may be formed into a magnet by drawing it over the pole of your rat-tail file magnet. After you have performed this operation several times, present the tube to the magnetometer, and you will find one of its ends is a north, while the other is a south pole. Having thus satisfied yourself that it is really a magnet, shake the tube so that the positions of the particles of steel filings are changed. On testing the tube at the magnetometer it will be found that much, probably all, of the magnetism has gone from it. If it has not all disappeared it can be made to do so by repeated shaking of the tube. This experiment shows that not only must each particle or even molecule of a steel bar be a perfect magnet, but it also shows that these magnetized particles must be arranged in a definite order, that is, with all their N. poles pointing in one direction and their south poles in the opposite direction, so that the body, as a whole, may obtain and retain its magnetic polarity. Before the year 1600, when William Gilbert, the physician to Queen Elizabeth, made the celebrated experiment of breaking a magnet into many parts and testing the polarity of each piece, it had been thought that all of the north polar magnetism was contained in one end of the magnet, while the other end of the magnet held the south polar magnetism.

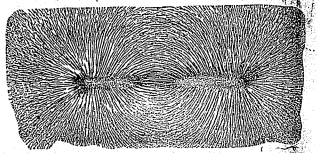


FIG. 24.—MAGNETIC CURVES AS SHOWN BY IRON FILINGS.

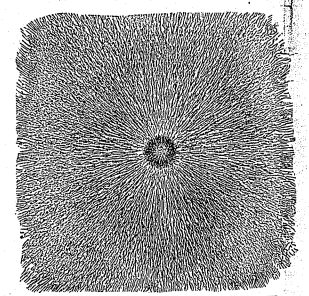


FIG. 25.—ARRANGEMENT OF FILINGS OVER THE END OF A ROUND MAGNET.

Interesting Experiments may be made with magnets acting inductively on a great number of iron grains spread on a surface placed over the magnet. We may thus form an idea of how this magnetic influence extends itself into space.

Take a piece of cardboard about one foot long and six inches broad. Support this at its corners on blocks of wood a little thicker than the diameter of your rat-tail file magnet. Place the latter under the cardboard. Now lift the cardboard off its supports and place it to one side on the table. Through a fine sieve sift soft iron filings evenly, and not too thickly, over the cardboard. Lift it up carefully and place it over the magnet. A slight bebeting of the filings is all that you will observe of the action of the magnet, but on vibrating the cardboard, by tapping it gently with a pencil, you will observe curious motions among the grains of filings. They will finally arrange themselves over the magnet in the curves shown in Fig. 24.

Fig. 25 shows the arrangement taken by the iron filings when they are placed on a card and vibrated over the end of a round magnet, the magnet being held in a vertical position under the cardboard.

Fig. 26 are the lines formed over the end of a magnet. Figs. 27 and 28 respectively show the actions of magnets with their unlike and like poles opposite each other.

Fig. 29 is interesting, showing the arrangement of the lines of filings produced on a surface when under it a magnet, 316 millimeters long and 13 millimeters in diameter, is acting inductively on a cylinder of soft iron, 32 millimeters long and 30 millimeters in diameter. In April, 1871, I published in the *American Journal of Science*, a method I had invented for permanently fixing these lines of iron filings (or *magnetic spectra*, as they are often called) on plates of glass. When thus permanently fixed these plates were used in a course in which a series of photographs were printed, exactly as a photographer prints from an ordinary photographic negative. The admirable engravings of magnetic spectra given in this article were made by a photo-engraving process directly from the glass plates made by me in 1871. These glass plates carrying the magnetic spectra I have also used for several years on slides in the lantern, in order to exhibit them before large audiences and college classes.

The following is the method of permanently attaching these magnetic figures to glass. A clean plate of thin glass is coated with a film of hard varnish by flowing over it the spirit varnish used by photographers in coating their negatives. If this is not handy, then a solution of shellac in alcohol will do nearly as well, only the latter requires more heating to cause the iron filings to adhere to it. The varnish is poured on one end of the plate, and then caused to cover the entire plate with an even film, by tilting and draining the plate just as a photographer does when he coats his plate with collodion. After the varnish has dried to a hard film the plate is placed, varnished side up, over the magnet or magnets, with its ends resting on slips of wood, so that the under surface of the plate just touches the magnet. Fine iron filings obtained from Norway iron, which has been repeatedly annealed, are now sifted uniformly over the plate, and then the magnetic curves are developed by tapping fall on the plate vertically at different points a piece of copper wire.

The vibrations of the plate momentarily detach the filings from its surface, and at these moments the magnet assumes that in obedience to its inductive action on them. The plate is now lifted from the magnet, being careful to keep it always in a horizontal position, and either placed with its ends resting on bricks over a hot stove, or it is heated over a gas stove. The film of varnish is thus rendered fluid, and the filings sticking into it are permanently fixed there after the varnish has cooled. If any filings should remain unattached, they are removed from the plate by letting its edge fall squarely on the table.

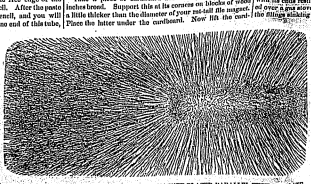


FIG. 26.—LINES FORMED OVER THE END OF BAR MAGNET PLACED PARALLEL WITH ITS PLATE.

The lines forming these magnetic spectra were called "lines of magnetic force" by Faraday. He also devised the term "magnetic field." *A magnetic field may be defined as any space at every point of which exists a finite magnetic force; while a line of magnetic force is a line* drawn through a magnetic field in the direction of the force at each point through which it passes. Before the time of Faraday natural philosophers were satisfied with the mere statement that magnets acted at a distance, and followed generally the same law as ruled in the action

PRACTICAL EXPERIENCES IN MAGNETISM.

SPECIAL REFERENCE TO THE DEMAGNETIZATION OF WATCHES.—No. 1.

BY ALFRED M. MAYER.

The extensive uses now made of electro-magnets in telegraphy, in dynamo-electric machines, and in the many practical applications of electro-magnetism, have greatly increased the risks of damage to watches by their magnetization. I have no doubt that in any one of our larger cities there are scores of watches safely packed away in drawers regarded as past recovery from overdoses of magnetism. They are looked upon by their owners as bullion kept in reserve for "a rainy day."

To be aware of the danger is not a sufficient guard against *accidents*. My own experience is a case in point: I had already allowed one watch, assuming it with magnetism by approaching an electro-magnet in my laboratory which had been allowed to remain in action by the person who had that day used it in his experiments. After purchasing another watch, I always took the precaution to place it on my office table before I approached the large electro-magnet of the Stevens Institute of Technology. I always did this, no matter whether the magnet was or was not in action. But one day I was suddenly called out of the room and detained by a visitor for a half hour or more. I took my watch from the table as I passed out of the room. I returned to my laboratory with my mind entirely engrossed with the experiments I had in hand, walked up to the magnet, rearranged the apparatus, and charged the magnet. My watch at the time was not 3 inches from the pole of this huge magnet! I was *only* aware of my "accident"—and it is, if you will, thoughtlessness about the watch or thoughtfulness about the experiments—when that afternoon I leisurely walked to the station to take a train, and was informed that "it had gone over half an hour." My watch had lost half an hour in about three hours! Persons more cautious than I have had the same experiences, for it is impossible, —most idlecy supervening, to be constantly thinking of a watch. I have also remarked that out of the two or three dozen owners who have had watches apparently ruined by this same large magnet, each one considered "the other fellow" a careless and thoughtless person until his turn came to do the same thing, when he was in a *really thoughtful* mood—about something, *which was not his watch.*

My last magnetic accident turned my thoughts to ways of taking the magnetism out of watches. I have succeeded perfectly, and the process which I have finally adopted as the best is so simple that any one can practice it, and that, if you wish, without even detaching your watch from its chain.

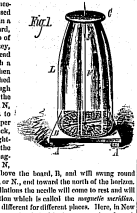
Though the process is simple, yet, of course a knowledge of the elementary facts and laws of magnetism is required to understand how it is done; and I know that every intelligent American mechanic really wishes to understand the reasons for performing the operations that he may be called on in practicing any new process.

To render clear to all the operations used in *demagnetizing* (that is, in taking the magnetism out of) a watch, I will assume that I am addressing those who have little or no practical experience as experimenters in magnetism, and also those who wish to be at the least expense in practicing watch demagnetization. I will, therefore, explain the facts and principles of magnetism on which the operations depend, by describing actual experiments made with apparatus which is so cheap and homely that it can be made by any one with a very little trouble and at a trifling expense.

I will at once proceed to show how to make the simple instruments required in our preliminary experiments and in the demagnetization of a watch.

The Magnet may be made out of a piece of a large rat-tail file. The one I have used is 7 inches long and averages ⅝ of an inch in diameter. There is something either in the quality of the steel or the temper of these files which makes them capable of receiving powerful charges of magnetism. The most powerful magnet I have ever examined is the rat-tail file just spoken of. It lifts several times its own weight. If a large rat-tail file cannot be had, then a piece of Sheffield steel, 10 inches long and ⅝ inch in diameter, must be obtained. This steel rod must be first heated to cherry-red, and then lowered gradually, while in an upright position, into a bucket of water. This will render it hard and capable of receiving and retaining a magnetic charge. The file or steel rod is magnetized either by drawing it over the pole of a powerful electro-magnet, or by wrapping around it insulated copper wire, and passing through the wire a current of electricity from a galvanic battery.

The Magnetometer.—We roll this the small magnetic needle, suspended in a glass shade by a fiber of silk, Fig. 1. It is made thus: Take a No. 4 or 5 needle, and draw it several times, from point to eye, over the N. end of your magnet. This operation will magnetize the needle, and when suspended from its middle, be pointed end will point toward the north. Now, on to a piece of wood, B, which is 3 inches square, glue and screw the slips, A and A, across its grain, so that it cannot warp. Then on its upper side paste a piece of damp white drawing paper. When this has dried it will be tightly stretched across the piece of wood. Draw on the paper a circle slightly less in diameter than the length of the No. 4 needle. Divide one half of the circle off into 180 parts of one degree each; or, if the eye can subdivide, divide the semi-circumference into ninety equal parts of two degrees each. To suspend the needle, you got a skein of floss silk, such as is used in embroidery. This silk is easily twisted, and from it you can readily draw a thread formed of



three or four fibers. Now, with a needle, pass a thread of this silk through the middle of the needle, and then twist it by rolling it between the fingers, until it is very hard and without kink. To suspend the needle, stick a pin through the middle of the wood, B, Fig. 1, and then pass the thread of silk through the eye of the needle, and bend it into the form of a loop, as shown in the figure. Then stick the end of the thread into the wax and work the wax over it with the fingers. The other end of the thread is passed through the eye of a large No. 1 or 2 needle. This needle is then passed through a hole in a piece of cardboard, C, placed on top of the lamp chimney, L. The silk thread must be of such a length that when the needle is pushed downward through the hole in C, the magnetic needle, N, may be brought to rest on the paper covering the block, B. Now, on slightly drawing up the needle, S, the magnetic needle, N, will hang just above the board, B, and will swing round with its pointed, or N., end toward the north of the horizon. After many oscillations the needle will come to rest and will point in a direction which is called the *magnetic meridian.* This direction is different for different places. Here, in New York, it makes an angle of 7° with the true north and south line, and the N. end of the needle points 7° to the west of the true north. This pointing of a suspended needle away from the true N. is called its *magnetic declination*, or magnetic variation. In New York and in vicinity the magnetic declination is 7° west.

In addition to the magnet and magnetometer the experimenter will need the following materials:

Three pieces of soft iron. One piece 12 inches long and ½ inch in diameter; another piece, 9 inches long and ¼ inch in diameter; a third piece, 1½ inch long and ⅜ inch in diameter. These pieces of iron should be made very soft by heating them to bright redness and then allowing them slowly to cool in hot ashes.

A piece of test wire, 6 inches long and ⅛ inch in diameter.

Iron filings, made from soft iron and passed through a fine sieve.

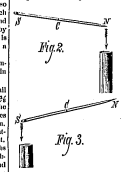
Pieces of window glass. Two 12 inches by 6, and two pieces 6 inches square.

A small bottle of spirit varnish, such as photographers put over their negatives.

Needles, nails, and tacks of various sizes.

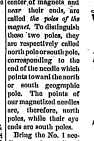
With the above simple and cheap things a great many interesting and beautiful experiments can be made; and we will now show how to obtain from these homely instruments much information that is really sound and useful.

Experiments showing in what a Magnetic Substance differs from a Magnet.—Place the magnetometer on the table and allow the magnetic needle to come to rest. Now take the piece of soft iron 3 inches long and bring it slowly up to the magnetic needle, always keeping the piece of iron pointing toward the point of the needle, as shown in Fig. 2. You will observe that the point of the needle moves toward the iron, bursting around its center, C, in the direction shown by the arrow.



Slowly and steadily draw away the piece of iron. As you do so the needle slowly turns on its center, C, and comes again into the magnetic meridian. Now bring the piece of iron up to the eye end of the needle, and you will see that this end turns toward the iron in the same manner as did the point of the needle in the previous experiment. Thus we find that a piece of soft iron attracts either end of the magnetic needle. Each end moves toward the iron. If this be so, it necessarily follows that if you point the piece of iron directly toward the center of the needle and bring it up to the needle in this position, keeping eyes always to have the length of the piece of iron at right angles to the length of the needle, the needle will not move, but remains steadily pointing in the magnetic meridian. Each end of the needle is equally attracted toward the iron, and as each end tends to turn in the direction shown by the arrows in Fig. 4, it remains at rest under the action of two equal forces tending to rotate the needle in opposite directions.

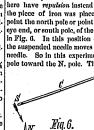
Now we will make some experiments similar to those just described, but differing in this: we use a magnetized No. 1 sewing needle instead of the piece of soft iron. Take a No. 1 sewing needle and draw it from point to eye over the N. end or pole of your rat-tail file magnet. You will, by this operation, have converted the needle into a magnet, and if you now, as before, bring the needle of the magnetometer, you will find that *it points in the magnetic meridian with its point toward the north.* The ends of magnets, or, more accurately speaking, certain points in the



center of magnets and near their ends, are called *the poles of the magnet.* To distinguish these two poles, they are respectively called north pole and south pole, corresponding to the end of the needle which points toward the north or south geographic pole. The points of our magnetized needles are, therefore, north poles, while their eye ends are south poles.

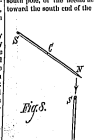
Bring the No. 1 needle up to the needle of the magnetometer, with its point toward the point of the magnetometer needle and with its length always at right angles to the magnetic meridian, as shown in Fig. 5. The N. pole of the needle moves away from the north pole of the No. 1 needle, and we here have repulsion instead of attraction, as we had when the piece of iron was placed in the same position. Now point the north pole or point of the No. 1 needle toward the eye end, or south pole, of the magnetometer needle, as shown in Fig. 6. In this position of No. 1 needle, the S. pole of the suspended needle moves toward the N. pole of the No. 1 needle. So in this experiment we have attraction of the S. pole toward the N. pole. Thus we have found out that the

north poles of magnets repel each other, while the north pole of one magnet attracts the south pole of another magnet. This being the case, it follows that the No. 1 needle, attracting the S. pole of the suspended magnet and repelling its N. pole, must, when pointed at right angles to the suspended needle and directed toward its center, C, cause the suspended needle to rotate, its S. pole moving toward the point of the No. 1 needle, as shown in Fig. 7.



The experimenter must now compare this experiment with the similar one with the piece of iron. The iron when pointed toward the center of the magnetic needle did not rotate it, but when the magnetized needle is placed in the same position the suspended needle rotates and its N. pole moves away from the N. pole of the No. 1 needle.

Let us vary these experiments by pointing the eye end, or south pole, of the needle first toward the N. end and then toward the south end of the magnetometer needle, and then



toward the center of this needle. Figs. 8, 9, and 10 show the results of these experiments. They differ from those of Figs. 6, 7, and 8 in this: the south pole of the magnetized No. 1 needle acts on the suspended needle in place of the north pole. The results are as follows: The S. pole of the No. 1 needle repels the S. pole of the suspended needle and

Testing Iron and Steel by Electro-Magnetism.—Professor Wetten-hofer, of Prague, has devised a mode for measuring the hardness of steel electro-magnetically. The principle is, that the hardness of steel may be determined by its coercitive force. Having inclosed a steel bar to be tested in a magnetizing coil, and magnetized it nearly to one end of a balance-arm, the other end bending obliquely downward and bearing a counted weight, a current is sent through the coil. The coil, being drawn along, is gradually drawn, drawing the bar with it, till the latter breaks away. The inclination of the pointer indicating usually over a number, and index indicates the degree of resistance. The bars to be tested are suspended in a brass holder; position is made against two sudden a recoil.

Comptes Rendus, June 27, 1870.

L'Electricité

Magnétization de l'acier pendant la trempe

M. W. Holtz a eu l'idée d'essayer si en opérant de la sorte on pouvait augmenter la puissance magnétique des aimants. Les résultats, exposés très-longuement par l'auteur dans les *Annales Poggendorf*, numéro de mai, prouvent qu'il n'en est rien. On nous dispensera de suivre l'auteur dans le récit de ses tentatives infructueuses, qui n'offrent aucun intérêt. Nous nous contenterons de mentionner cette exp.rience, afin de donner un exemple des combinaisons bizarres auxquelles peut conduire l'esprit de système.

Pouvoir magnétique de la poudre de fer

Le numéro de juillet des *Annales de Physique et de Chimie* de Wiedemann se confient qu'un article intéressant y utilis sur l'électricité. M. von Waltenhofen a communiqué à l'Académie des Sciences de Vienne un mémoire qui représente à doit le journal extrait deque premier, et dans lequel l'auteur consulte l'effet magnétique de fer pulvérisé.

On fer pulvérisé n'est produit par voie de réduction, à l'aide d'un courant d'hydrogène, ou d'autre toute autre méthode mécanique provenant de la lime.

A parait trouvé par les expériences de M. Waltenhofen que le pouvoir magnétique du fer ainsi préparé est en élevé *quelque croissant*, varies entre douze d'oxalate, de solid du fer massif.

Cette différence considérable tient-elle à ce que le rapport de la surface au poids est immense lorsque le fer est réduit en poudre? Toutefois à ce que la surface sur laquelle on admet que la magnétisme se transporte a subi un commencement d'oxydation? Cest ce qu'il est tout à fait impossible de décider, dans l'état actuel de la science.

Practical Experiments in Magnetism, with Special Reference to the Demagnetization of Watches.

By Alfred M. Mayer.

On the Magnetization and Demagnetization of Steel.—To understand thoroughly our processes of taking the magnetism out of a watch one must be in possession of clear ideas of what is meant by the magnetization and demagnetization of steel. These facts I will now give.

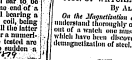


Fig.31.

Let A B, Fig. 31, represent a piece of steel laid on the table. N is the north pole of a bar magnet, which is held vertically over the end, A, of the piece of steel. Bring the pole, N, of the magnet to touch the end, A, of the steel and slide the magnet over the steel, in the direction of the arrow, to the end, B. Slide it off the end, B, and lifting it in the air, again bring N down on A, and repeat the operation. Every time one stroke of the magnet on the steel, the latter will be found to have received a charge of magnetism, which generally increases in strength up to a certain number of strokes of the magnet; after which further strokes of the magnet produce no effect in increasing the magnetic charge in the steel. Or now taking the steel, A B, to the magnetometer and testing for its magnetic conditions, as has already been explained in Figs. 7 and 10, you will find that the end, *bar* magnet, N, strokes the steel from B to A, thereby developing the south magnetic polarity in that end of the steel, A, while it has developed the north end of the steel of S. magnetic polarity at B. If the bar had been used with the end, S, of the piece of steel *forward* which the end of the magnet would have developed polarity in that of the end of the steel, A, which developed the north end of the steel that the magnet should rest on it while it glides over it, hard, the latter may be magnetized by passing the magnet along the length of the needle and at some distance above it, as shown in Fig. 31.

Let N, in Fig. 32, stand for the N. end of a magnet, while A B is a piece of steel which has been brought near to the end, N, of the magnet. If the magnet be strong, and the steel of the quality of soft iron needle steel, that is, not too hard, you will find on testing the steel, A B, at the magnetometer, that the end, A, which is placed the north end of the magnet is of south polarity, while the end, B, is of north polarity. If the piece of steel, A B, had been brought near the south end of the magnet, instead of the north end, then you would have found that the end of the steel which had been nearest the south end of the magnet had north polarity. In other words, when a steel rod is brought near a magnet it is magnetized, and the end of the steel rod nearest the magnet is of a polarity opposite to that of the end of the magnet toward which the rod points.

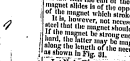


Fig.32.

If, instead of holding the steel rod at a distance from the magnet, we bring it to touch its end, then the magnetic charge given to steel will be greater than in the former experiment. The polarity given to the end of the steel which touches the magnet is opposite to that of the end of the magnet touched.

So much for the magnetization of the steel rod. Its demagnetization consists in taking the magnetism out of it, as has effected by operations similar to those just described in magnetization. These processes we had better describe by the aid of Figs. 31 and 32.

In Fig. 31, let A B be a magnetized rod of steel, with its north pole at A, its south pole at B. We have found that this rod was magnetized, with its poles as just described, by stroking it from A toward B with the north pole of the magnet, N. Now a reverse direction of stroking will demagnetize it, that is, if the north end of the magnet be drawn over A B, from B toward A, then the magnetism will disappear from the rod, A B; and if the operation is repeated after the rod has thus demagnetized we will even remagnetize it and its south pole at A.

It is but necessary, however, that the magnet should touch the steel not exceeding the operation of demagnetization.—It is sufficient, if the magnet be powerful, to pass it over the steel rod at a distance above it and in a direction always opposite to that in which the magnet moved when it magnetized the rod.

In Fig. 32, let A B be a magnetized rod of steel, having north polarity at A and its north pole at B. This condition of magnetism has been given to it by the presence of the north pole of the magnet, N. Now, if we take away the magnet, N, or bring it from lying up to the bar, A B, the south pole of the magnet was removed, that the rod, A B, will be demagnetized. If the rod, A B, be of very hard steel and the magnet not very powerful, it may be necessary for the magnet actually to touch the rod, A B, in order to demagnetize it.

Here it is in order to describe more explicitly the operation of demagnetization. To demagnetize a bar of steel you require as strong a magnetic action as that which was required to give the rod its present magnetic charge. In performing the operations of demagnetization, we should be careful not to give too many reverse strokes to the rod, nor to approach it too near to the demagnetizing magnet. It is better to pass the magnet over the magnetized rod at a short distance above it, and after each operation to test its gradually falling magnetic charge at the magnetometer. The critical point is when the residual charge becomes small; for then the danger is that you will not only demagnetize the rod by the next operation, but will actually remagnetize it, with, of course, its poles reversed.

In the course of my experiments on the demagnetization of watches I made a series of novel experiments on the demagnetization of steel rods placed at right angles to the demagnetizing magnet. The steel subjected to experiment was of the hardness of that of sewing needles. These experiments explain some curious facts in our mode of demagnetizing watches, and therefore form a natural introduction to the practice of our process.

The steel rods used in these experiments in demagnetization were made were formed of pieces of No. 1 rowing needles. The points and eyes of the needles were broken off, thus leaving rods of about two and one-eighth inches long. The rod to be magnetized was placed over the demagnetizing magnet.

The manner of experimenting was as follows: The needle was magnetized by stroking it repeatedly with the end of the magnet. It was then placed pointing toward the center of the magnetometer needle and at right angles to the magnetic meridian. In this position the needle produced a certain angular deflection in the needle of the magnetometer. The needle was now placed in an upright position, as shown at *a a* in Fig. 33. The demagnetizing magnet, *N S*, was

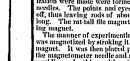


Fig.33.

mounted on a block which slid between guides, so that the magnet, *N S*, could be gradually brought up to the needle, *a a*, and during all the time of its approach the axis of the magnet, *N S*, pointed toward the center of and at right angles to the needle, *a a*. The approach of the magnet to the needle in these circumstances was found to have lowered the magnetic charge of the needle, and this took place even when the greatest care had been taken to have the magnetic axis of the demagnetizing magnet at right angles to the *magnetic center* of the needle, *a a*. The following table will show the manner in which the magnet, *N S*, demagnetizes *a a* when the former approaches the latter.

After the needle was magnetized it deflected the magnetometer..... 25°

After the magnet had been placed 12 in. from needle, 18°

" " " 10 " " 18°

" " " 8 " " 18½°

" " " 6 " " 18½°

" " " 4 " " 18½°

" " " 2 " " 12°

" " " 1 " " 12°

Remarking the above record of the experiments it will be seen that the approach of the magnet to within a distance of an inch of the center of the needle brought down the magnetic charge from 25° to 18°, and that a repetition of this experiment had no further effect in demagnetizing the needle. The same is observed on the repetition of the experiment when the magnet was placed at one eighth and one sixteenth from the needle. In each case the first approach of the south pole of the magnet to the needle had the effect of lowering the magnetic charge of the needle, but had no effect on the magnetometer from 12° to 12° of deflection. Of course it will be understood that in any one series of experiments the end of the needle was always placed at the same distance from the center of the magnetometer needle.

The reader will be careful to observe that I have stated that in these experiments I took every care to have the magnetic axis of the demagnetizing magnet at right angles to the magnetic center (or equator) of the needle. It is clear that in really done it might be a question whether the magnet would have any effect on the needle. Yet, all of our experiments show that it *always* has an effect of demagnetization. For a long time it has been known that for the demagnetization of a magnet it requires a far weaker magnetic action than that of the magnet which gave it its magnetism; now when the magnet is at right angles to the needle, as in Fig. 33, the north pole, *N*, of the magnet acts only on the two poles of the needle, *a a*. It tends to create south magnetism in *a* and north in *a*. But as the north pole of the center of *N* is so far from the needle, its action may be neglected. It is now safe to assert that, in a long series of experiments made according to the method above, with the magnet being magnet two feet long and the needles one quarter inch thick and of six inches long, and inserted to the greatest degree possible before magnetizing them, this large magnet had no effect whatever on the needles after a few strokes, though every care was taken to get the magnetic axis of the demagnetizing magnet truly at right angles to the axis of the needles and pointing toward their centers.

We will now describe another series of experiments in demagnetization in which the needle is rotated before the pole of a magnet, with the center of the needle in a line in the prolongation of the axis of the magnet. In Fig. 34, *N S* is the demagnetizing magnet, and *a a* is the needle operated on. The following description of one of the series of experiments will give an accurate idea of all of the series:

The center of the needle, *a*, was one inch and three quarters from the end of the magnet, *N*. *a*, *a* was placed in the magnetometer and its axis placed opposite the magnetometer, and caused a deflection of 41° in its needle. The needle was then placed in a vertical position at right angles to the magnet, *N S*, and with its center one inch and three quarters distant from the end, *N*, of the magnet. The needle was now turned around its center so that its south pole went through 90°, and approached the north pole, *N*, of the magnet. The magnet was now removed and the needle tested at the magnetometer. As might have been expected it produced the same deflection of 41° as it did before the experiment. The needle was again placed in its odd position, the magnet brought to the same distance from its center and the needle again rotated before the magnet; but this time the north pole of the needle turned nearly 90° toward the north pole of the demagnetizing magnet. After this operation the needle had had its magnetic charge lowered so that it now only produced a deflection of 32.5° in the magnetometer. A repetition of the experiment lowered the magnetic charge to 25°. A third experiment lowered the magnet to 21°, and a fourth to 18°, where a deflection on the magnetometer needle of 18° was produced by only 10° of rotation of the needle before the magnet. By further demagnetizing the needle, then in the magnetometer needle, it was found that the north pole was brought before the magnet (this tended to the magnetize the needle), then the needle's south pole was again brought before the magnet, and the experiment terminated. Thus we see that the magnet first tended to magnetize the needle, then to demagnetize it, and lastly to magnetize it. Notwithstanding that the needle was subjected to a magnetizing influence from the magnet after the demagnetization, it had its magnetism lowered, so much less magnetic force being required to demagnetize than to magnetize a magnet.

In the following series of experiments the needle was placed as in the preceding experiments, and it was rotated through a whole revolution before the pole of the magnet instead of through only a half revolution as in the preceding experiments. Before an experiment was made on the needle it deflected the magnetometer needle 40°. The needle was now rotated before the magnet through a whole revolution, its south pole approaching first the magnet, then passing it and turning over the circumference of the circle till it had made an entire revolution and had come back again to its

Fig. 34.

needle was demagnetized so that its effect in deflecting the magnetometer needle was only 4°, instead of 70°, the deflection which it caused before it was rotated before the magnet. The whole of this demagnetization was caused by the passage of the north pole of the needle across the S. end of the magnet, N. The passage of the S. pole of the needle athwart the N. pole of the magnet could have had no other effect than to magnetize it.

A second rotation similar to the above reduced the deflecting power of the needle on the magnetometer to 5°. A third experiment brought it down to 4°; after which no further rotation had any effect in reducing the magnetic charge of the needle.

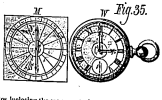
ON THE DEMAGNETIZATION OF WATCHES.

The reader who has made for himself the magnetic experiments, which we have so minutely described, or who has even read the accounts we have here given of them, will have no difficulty in seeing the reasons for the various operations which I will now describe in giving an account of the way to take the magnetism out of a watch.

A watch is formed of a case of gold or silver, and glass inclosing brass or nickel plates, between which are a number of steel arbors forming the axles and pinions of the brass wheels. There is also the spring of steel which uncoils itself in the plane of the watch. The other wanderers in addition a steel chain which uncoils from the fusee on to a brass drum inclosing the mainspring. The hairspring, parts of the balance wheel escapement, stem winding apparatus, etc., are also of steel. So we see that there is abundance of material for magnetization in a watch. Fortunately these parts are formed of steel which is only moderately hard, and, therefore, as we have already seen, easy to demagnetize.

Of these various parts some have their lengths at right angles to the plane of the watch, like the arbors; others, like the teeth and balance wheel springs and the nickel (nickel takes a magnetic charge like steel or iron, only feebler)

Fig. 35.



plates inclosing the movements, have their greatest dimension in the plane of the watch. The position of these bodies determines to a great extent the directions of their magnetic axes. By magnetic axes we mean an imaginary line joining the two poles of a magnet. The arbors will be their magnetic axes in the direction of their lengths, while the plates are most likely to have theirs in the direction of one of their dimensions. But we have already seen that no matter in what direction their magnetic axes are in the watch, all of these bodies (thanks to the facts already shown in our experiments) may be demagnetized *by properly oscillating the watch before the pole of a magnet.* How this is to be done I will now show, and in order to explain what might otherwise be a long story, I will give an account of the process by describing the experiments actually made in the course of demagnetizing an old Yorkshire Fuser watch, which I saturated with magnetism by deliberately placing it on one of the poles of the large magnet of my laboratory in the Stevens Institute of Technology.

We may now regard this watch as a magnet, having the form of a disk, and with its north magnetic pole at the hour XI, and with its south pole at III. o'clock.

This being the information given by our magnetometer, we are in possession of facts which enable us to take the north magnetism out of o'clock and of the south magnetism out of three o'clock.

You have already found, by your experimenting, that when you bring the north pole of one magnet near the north pole of a more powerful magnet, the powerful magnet will take the magnetism out of the weaker one because it tends to make the north pole of the latter a south pole. Similarly the south pole of a powerful magnet will demagnetize the weaker magnet when the south pole of the latter is brought near the south pole of the former.

You have also found out by your experiments that when a small magnet, made of steel not too hard, is vibrated athwart the center in front of the pole of a powerful magnet, the small magnet is demagnetized. Those facts show how we are to proceed in the demagnetization of the watch.

The hour XI is of the strongest north magnetism of any on the dial; therefore we place this hour opposite the north pole of our north-seil file magnet, as shown in Fig. 36. The center of the watch, C, is placed so that the prolongation of the axes of the magnet (shown by the dotted line, X X) passes through it. The watch is now vibrated around an axis passing through it and at right angles to X X. By this operation the watch is successively brought into the positions, A and B, of Fig. 36. After several vibrations of the watch before the north pole of the magnet, I turned the watch around its axis, and each hour on its dial is in succession brought opposite to the center, *c*, of the magnetic needle of the magnetometer.

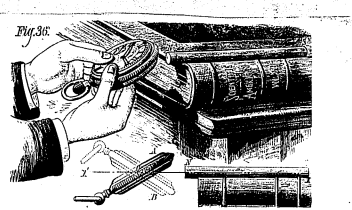
The following were the results of such experiments to ascertain the magnetized watch. We give them in the form of table N° I, and S. indicate the kind of magnetic polarity of each hour, and the angles show the effect in angular deflection on bringing that hour of the dial opposite the center of the magnetometer needle:

TABLE I.

Hour.	Ang. of Deflection of Magnetometer.	Kind of Magnetism.
XII.	20°	N.
I.	6°	N.
II.	18°	S.
III.	72°	S.
IV.	68°	S.
V.	22°	S.
VI.	9°	N.
VII.	7°	N.
VIII.	10°	N.
IX.	16°	N.
X.	20°	N.
XI.	24°	N.

When the hour III. was brought opposite the magnetometer needle the fusee axle and the center of the semicircular steel catch of the inner cover of the works were presented to the magnetometer. The strong south magnetism of hour III. was due to the magnetization of these bodies, which deflected the needle of the magnetometer 72°. The strong north magnetic action of hour XI. was due to the magnetized mainspring.

Fig. 36.



DEMAGNETIZING A WATCH.

nology, and thus purposely obtained a very badly magnetized watch to practice a cure on.

The watch is placed quite close to the magnetometer, and with the center of the thickness of the watch about on a level with the center of the needle of the magnetometer, and with the line, connecting the center of the watch, C, Fig. 35, and the center, *c*, of the needle, at right angles to the magnetic meridian; in other words, at right angles to the direction which the needle has when no magnetic body is near it. The watch is then turned slowly around on its center as an axis, and each hour on its dial is in succession brought opposite to the center, *c*, of the magnetic needle of the magnetometer.

There is certainly a great difference between the magnetometer deflections of Table I. and those of Table II. It is observed at once that the hours III. and XI., which were respectively of strong south and north magnetism in Table I., are in Table II. marked 8°. This result was not attained, however, at one trial, as might be inferred from our description of the experiments, but after each series of vibrations before the pole of the demagnetizing magnet the magnetic condition of hours III. and XI. was tested. Sometimes their magnetism almost disappeared. Then we found it had changed, or rather inverted, so that hour III. had south instead of south polarity, and hour XI. had south instead of north magnetism. When this happened we had to bring hour III. before the north pole of the magnet, and hour XI. before the south pole, and reverse the angles I succeeded in demagnetizing hours III. and XI., so that they produced no action whatever, or 0°, on the needle of the magnetometer.

I now again brought the watch before the magnet, and vibrated its V. o'clock before the south pole till this south magnetism had disappeared; in other words, produced no deflection whatever on the needle of the magnetometer. I then made an examination of the magnetism of the watch before the magnetometer, with the following results:

TABLE II.

Hour.	Ang. of Deflection of Magnetometer.	Kind of Magnetism.
XII.	4°	N.
I.	3°	N.
II.	6°	N.
III.	8°	S.
IV.	5°	S.
V.	0°	S.
VI.	3°	N.
VII.	6°	N.
VIII.	6°	N.
IX.	7°	N.
X.	5°	N.
XI.	8°	S.

I now demagnetized hour VII. of its 6° of north magnetism by vibrating this hour opposite the north pole of the demagnetizing magnet, and after I had succeeded in this I

THE DEMAGNETISATION OF WATCHES

By Professor A. M. Mayer.

IN an account of some practical experiments in magnetism, Professor A. M. Mayer describes a method of demagnetising a watch, which, as it may lead some interest to our readers, we quote from the *Scientific American* :—

A watch is formed of a mass of gold or silver, and plate, including brass or nickel plate, between the jewels of which the pivots of the balance-staff, escape-wheel and pinions of the train, revolve. There is also the spring of steel which vanish itself in the plane of the watch. The older watches have in addition a steel chain which unrolls from the fusee on to a brass barrel when the spring is wound. The balancing-parts of the balance wheel compensated, for heat and cold, are generally of steel, and the hair spring has flat thin coils of extremely fine magnetisable in a watch. Fortunately, these parts are formed of such feeble magnetic sub-stances that, and, therefore, easy to demagnetise.

Of these various parts some have their lengths at right angles to the plane of the watch, like the balance-staff, and the axes of the escape-wheel and pinions, and the watch jewels; others, as magnetic charge this steel or iron, only further, in demagnetising the moments, have their central directions in the plane of the watch. The position of these latter determines the axes of the steel discs positions of their magnetic axes. By magnetic axis of a magnet, I mean the line joining the two poles of a magnet. The ordinary bar magnets have axes in the direction of their lengths, and the poles are most likely to lay in the flat ends or sides of one of their diameters. But we have already seen that no matter in what direction the magnetic axes are in the watch, all of these feeble magnetic forces may be destroyed *by a proper alternating current* may be demagnetised *by proper oscillatory the watch before the pole of a magnet*, and it will be done I will show, and it is easy to describe what might otherwise be a long story, I will give an account of the process by describing the experiments actually made in the course of demagnetising a watch. Fortunately, which I assisted with magnetism by deliberately placing it on one of the poles of the large magnet in the Physical Room of the Stevens Institute of Technology, and I had purposely obtained a very badly magnetised watch to perform a cure on.

The watch is placed quite close to the magnetic pole—only a few millimetres of the thickness of the watch's case on a level with the centre of the needle of the magnetometer, and in a line connecting the centre of the watch, G, and the centre, C, of the needle, at right angles to the magnetic meridian; in other words, at right angles to the direction which the needle has when no magnetising force is present. The watch is then slowly moved on its axis as an axis, and each hour on its dial is in succession brought opposite to the centre of the magnetic needle of the magnetometer.

The following were the results of such experiments on my magnetised watch. We gave them a uniform rate of 24 hours. I determined the line of magnetic polarity at each hour, and the angles which the object in magnetic meridian on bringing that hour of the dial opposite the centre of the magnetometer needle:—

TABLE I.

Hour.	Amp. of Deflection	Kind of Mag-
	of Magnetometer.	netism.
XII.	70°	N.
I.	45°	N.
II.	15°	N.
III.	12°	S.
IV.	15°	S.
V.	12°	S.
VI.	5°	S.
VII.	15°	N.
VIII.	45°	N.
IX.	70°	N.
X.	90°	N.
XI.	90°	N.

When the hour III. was brought opposite the magnetometer needle the force exhibited by the centre of the southernmost steel catch of the main spring of the watch was presented to the magnetometer. The strong south magnetism of hour III. was found to be in a direction diametrically opposite to that of the north magnetism of hour 9, which defended the north magnetic centre of hour XII. was due to its magnetised mainspring.

It may now regard this watch as a magnet, having its form of a disc, and with its north magnetic pole at the hour XI., and with its south at III., of the dial.

This being the interpretation given by our magnetometer, we see it possesses the two conditions necessary to make the north magnetism, and of stores of electricity, and the south magnetism out of these materials.

We have already found, by your experimenting, that when you bring the north pole of one magnet near the south pole of a more powerful magnet, the powerful magnet will take the magnetism out of the weaker one because it tends to make the north pole of the weaker magnet a south pole. Similarly the south pole of a powerful magnet will take the magnetism of a weaker magnet when the south pole of the latter is brought near the south pole of the former.

We have now found out by your experiments that when a small magnet, made of steel and too hard, is vibrated around its centre in front of the poles of a powerful magnet, the small magnet is demagnetised. This is the principle which I have employed in the demagnetisation of the watch.

The hour XI. is of the strongest north magnetism of any on the dial; therefore we place this hour opposite the north pole of our not-tall-like magnet. The centre of the watch is placed so that in the prolongation of the axis of the magnet passes through the centre of the watch. The watch is then slowly moved around its axis at right angles to the axis of the magnet. By this arrangement I successively brought into position, making angles of 15° with the axis of the magnet. After several vibrations of the watch before the north pole of the magnet, I turned the hour III. of strongest south magnetism opposite the north pole of the magnet, and vibrated the watch as in the previous experiment. By these means I found that the lines across the fluxe of magnetic force, and, as we have seen, any magnetism in it thus taken out. After three successive performed on the hours X. and III., the watch was again examined before the magnetometer, and the following table shows the effect of the vibrations before the magnet.

TABLE II.

Hour.	Amp. of Deflection of Magnetometer.	Kind of Magnetism.
XII.	2°	N.
I.	3°	N.
II.	4°	N.
III.	5°	S.
IV.	6°	S.
V.	5°	S.
VI.	3°	S.
VII.	2°	S.
VIII.	3°	N.
IX.	2°	N.
X.	3°	N.
XI.	0°	

There is certainly a great difference between the magnetometer deflections of Table I., and those of Table II. It is observed at once that the hours

III., and XI., which were respectively of strong south and north magnetism in Table I., are in Table II. marked 0°. This result would, I see in however, in one hour, as might be inferred, from our description of the experiments, but after each series of vibrations before the pole of the demagnetising magnet the magnetic condition of the watch was tested, and the magnetic centre of magnetism almost disappeared. Then we found it had changed, or rather had developed hour III., had south instead of north polarity, and hour XI. happened we had to present hour XI. before the south pole of the magnet, the hour XI. before the north pole of the magnet, before I succeeded in demagnetising hours III. and XI., so that they produced no action on the magnetometer, as 0°, as the needle of the magnetometer.

I now again brought the watch before the magnet, and vibrated its V., which before the south pole of this south magnetism had disappeared; in other words, we need no deflecting whatever on the needle of the magnetometer. I then made an examination of the condition of the watch before the magnetometer, with the following results:—

TABLE III.

Hour.	Amp. of Deflection of Magnetometer.	Kind of Magnetism.
XII.	1°	N.
I.	0°	
II.	0°	
III.	0°	
IV.	0°	
V.	2°	S.
VI.	1°	S.
VII.	0°	
VIII.	0°	
IX.	0°	
X.	1°	N.
XI.	0°	

I now demagnetised hour VII. of its 0°, of equal

magnetism to the opposite pole of the magnet, by presenting the north pole of the magnet to the south pole of the watch when presented to the magnet, and after I had found that no hour on the dial affected the magnetometer needle, I demagnetised; in which condition I left the watch, having as good a watch as it did before it was magnetised.

The "sentiment" referred to, I have previously referred, happened to a valued friend, who, with special care by Jones, of Strand, had so strongly magnetised that IV. o'clock on the dial; therefore we place this hour opposite the north pole of our not-tall-like magnet. The centre of the watch is placed so that in the prolongation of the axis of the magnet passes through the centre of the watch. The watch is then slowly moved around its axis at right angles to the axis of the magnet. By this arrangement I successively brought into position, making angles of 15° with the axis of the magnet. After several vibrations of the watch before the north pole of the magnet, I turned the hour III. of strongest south polarity opposite the north pole of the magnet, and vibrated the watch as in the previous experiment. By these means I found that the lines across the fluxe of magnetic force, and, as we have seen, any magnetism in it thus taken out. After three successive performed on the hours X. and III., the watch was again examined before the magnetometer, and the following table shows the effect of the vibrations before the magnet.

TABLE II.

Hour.	Amp. of Deflection of Magnetometer.	Kind of Magnetism.
XII.	2°	N.
I.	3°	N.
II.	4°	N.
III.	5°	S.
IV.	6°	S.
V.	5°	S.
VI.	3°	S.
VII.	2°	S.
VIII.	3°	N.
IX.	2°	N.
X.	3°	N.
XI.	0°	

There is certainly a great difference between the magnetometer deflections of Table I., and those of Table II. It is observed at once that the hours

III., and XI., which were respectively of strong south and north magnetism in Table I., are in Table II. marked 0°. This result would, I see in however, in one hour, as might be inferred, from our description of the experiments, but after each series of vibrations before the pole of the demagnetising magnet the magnetic condition of the watch was tested, and the magnetic centre of magnetism almost disappeared. Then we found it had changed, or rather had developed hour III., had south instead of north polarity, and hour XI. had south instead of north magnetism. After XI. happened we had to present hour XI. before the south pole of the magnet, the hour XI. before the north pole of the magnet, before I succeeded in demagnetising hours III. and XI., so that they produced no action on the magnetometer, as 0°, as the needle of the magnetometer.

I now again brought the watch before the magnet, and vibrated its V., which before the south pole of this south magnetism had disappeared; in other words, we need no deflecting whatever on the needle of the magnetometer. I then made an examination of the condition of the watch before the magnetometer, with the following results:—

TABLE III.

Hour.	Amp. of Deflection of Magnetometer.	Kind of Magnetism.
XII.	1°	N.
I.	0°	
II.	0°	
III.	0°	
IV.	0°	
V.	2°	S.
VI.	1°	S.
VII.	0°	
VIII.	0°	
IX.	0°	
X.	1°	N.
XI.	0°	

I now demagnetised hour VII. of its 0°, of equal

SOCIETY OF TELEGRAPH ENGINEERS.

At the meeting of this society, held in the theatre of the Institution of Civil Engineers, on Wednesday, Feb. 11, after the formal business, a paper, written by T. A. Mckinnaly, was read by the Secretary, on

TELEGRAPHY IN NEW ZEALAND.

It stated that the first attempt to introduce a system of telegraphy into New Zealand was made by the Government of Canterbury in the year 1862, the line first erected being from Christchurch to Lyttelton, a seaport distant eight miles. The next year the Government of Otago placed Invercargill and Bluff in telegraphic communication with each other. The next line was from Dunedin to Port Chalmers, a distance of seven miles, which was completed in the latter part of 1862. The work to connect Dunedin, province of Otago, and Christchurch, province of Canterbury, a distance of 225 miles, was commenced on the 4th October, 1865, and completed on 12th April, 1866. The line was carried on to Nelson, through the gold fields, and completed to that town in 1866.

The laying of the Cook Strait Cable, joining North and Middle Islands, was accomplished in August, 1866. After the laying of this cable communication was quickly established with Auckland, taking in the intermediate stations of Hull, Featherston, Greytown, Carterton, Masterton, Napier, Taupo, Tauranga, Grahamstown, &c., thus with Taranaki on the west. The line from Napier northwards was erected under great difficulties, owing to the hostile character of the natives of the district. The author then proceeded to give a graphic though condensed account of the natural features of the district, and suggested that it would be a good thing to embrace the first opportunity of visiting New Zealand, if only to view these wonderful works of nature.

On June 30th, 1866, there were 699 miles of line erected and 19 stations opened. Now there are in circuit 2,513 miles of line, carrying 8,414 miles of wire, exclusive of works in progress. These latter, when complete, will increase the line mileage to 3,021 miles, with 8,886 miles of wire. During the year ending 30th June last, 1,142,943 messages were transmitted, being an increase of 14 per cent. over the previous year, the cost being £26,301. There are 105 stations equal to the public, and the number of officials in the employ of the department is 201. The "collect" system is in use, but if the receiver refuses to pay, the sender is liable. The tariff is 1s. for ten words and 1d. per word after—address and signature not exceeding ten words free. The press rate is ten words 6d. and 1d. per word after. between 8 a.m. and 5 p.m. Evening papers 3d. per word after. between 8 a.m. and 5 p.m. Evening papers are allowed 1,000 words during the day at the above rates. Delayed telegrams are received—but not taken in at one time but transmitted any time during that day at the convenience of the department and posted at the destination the same night. Half-rates (1s. for postage) are charged for "delayed" messages. Last year 56,721 of these messages were sent. Money orders can be sent by telegraph. The charge is 4d. in the pound sterling, and a commission in addition to the telegraph fee of 1d. per pound. The amount transmitted last year was 261,952 9s., effected by 14,697 orders. Chambers of commerce are entitled to receive oil shipping messages at the rate of 1d. per message, and the engineers of vessels can telegraph to harbour masters at any port to which they may be bound to ascertain the state of bar, wind or tide for the which charge covers reply. The *employés* are mostly young men from the colony, though Englishmen have been sent out. The most substantial character, No. 8 galvanised BBBB wire, carried on poles varying from 20 to 30 feet, were from the heart of the Totara (*Podocarpus*). Poles from 20 to 25 feet are 9 inches by 9 inches at the butt, and 6 inches by 6 inches at the top. The battery in general use is the Daniell. To maintain this battery in circuit requires 1 lb. per cell per annum.

Fuller's bichromate battery has been introduced on some of the longer circuits, and has proved very efficient. The open circuit system is used, and every station is fitted with a battery capacity of 1,000 cells of 6 feet by 3 feet, with shelves containing the line and board. Auckland, the largest town, has 1,000 cells, the latter local batteries, the former consisting of 1,000 cells, the latter of 10 cells. The duplex upon Dr. Lemon's system is worked on No. 1 cable (42 miles), No. 4 cable (42 miles), Wellington to Napier (221 miles), Blenheim to Christ Church (206 miles), Blenheim to Dunedin (461 miles), Christ Church to Dunedin (255 miles), Dunedin to Invercargill (231 miles), Napier to Auckland (346 miles). Quadruplex working is to be introduced as soon as the instruments arrive. The Morse sounder is in general use. There are two cables connecting North and South Islands—No. 1 with three conductors, No. 2 with one conductor.

First-class operators send and receive on an average from 1,000 to 1,500 words per hour, second-class about 750 to 1,000.

The annual conversazione of this Society was held on the evening of Saturday, Feb. 7, in King's College. The Museum of King George III., the Wheatstone Laboratory and other parts of the College were occupied by a fine display of physical apparatus and electrical literature, including numerous relics of Sir Charles Wheatstone. There was a large number of ladies and gentlemen present, and during the evening selections of music were played by the Musical Association of the Royal School of Mines. The apparatus exhibited included the whole range of physical science, and was furnished in part by the College and in part by the various instrument makers and electric engineers of the Telephone Company and the British Telephone Company exhibited telephones and electric Electric Light Company exhibited an ingenious speaking machine. Lamps, and Mr. Fisher exhibited his ingenious speaking machine. Among the various objects on view, we may mention the original Wheatstone telegraphic instruments, the Daniell battery and coolers conferred on Sir Charles Wheatstone, the Bunsen battery and coolers conferred on Sir Charles Wheatstone, the Bunsen battery and coolers conferred on Sir Charles Wheatstone, the Bunsen

MAGNETIC "CURATIVE" APPLIANCES.

Can advertising beautify what is hideous?

It is, we give us any verifiable evidence that it can do work, or produce any physiological effect? We are particularly anxious to obtain information on these points, because both of the letters which, in our issue of the 24th ult., constitute the brief correspondence on *Magnetic Appliances* contain this expression; Mr. J. Wilkinson informing us that "the magnetic current is continuous and most penetrating," and Mr. Harry Lobb—whose name is well known in connection with the medical applications of electricity—positively that "magnetic appliances when worn upon the body produce magnetic currents, which we all know (?) closely resemble, and are intimately allied to, electric currents." *Moreover*, since the date of this correspondence, we have made the acquaintance, through one of its numbers, of what we presume is a contemporary, bearing the title of *The Magnetic Review*; and we have received some half-dozen trade pamphlets, all of which enlarge, in glowing terms, upon the multifarious curative virtues of the "magnetic currents" generated by appliances which, no doubt, may be shown to be more or less magnetic, but in which we should say that the really active agent is decidedly flannel. Our contemporary in question devotes about half his space to advertisements and testimonials relating to one of these appliances, whilst of the other half we can only say that it is devoted to the literary and scientific requirements of probable customers. In the latter portion, an "editorial" informs us that "what is called the luminiferous ether is but another name (*sic*) for Magnetism," that "the currents from the two poles of a horse-shoe magnet rush together" and "constitute a permanent magnetic atmosphere, corresponding in strength to the dimensions of the surfaces from which they emanate" and that "the enormous magnetic force at the poles . . . has contracted the solid earth until our polar diameter is twenty-six miles less than at the equator." But the interest of the paper is not confined to the "leaders." In a communicated article we are told that "in cases of fever the electric equilibrium is always destroyed; there is an excess of positive electricity; the skin is hot, the throat is parched, and the expanded brain refuses to sleep; the instinctive cry is for water; and how grateful is cool water applied to the skin. The electricity of cool water is negative, so that thirst in fever should be fully gratified, and perspiration promoted on the skin, so that the excess of positive electricity may be carried off, and electric equilibrium restored. Cold water in fever conveys a soothing magnetism throughout the whole frame." Nor is the writer in this case satisfied with the mere statement of such important scientific facts; he proceeds to show how the "negative electricity" and "soothing magnetism" of *cold water* may be utilised on a large scale. "An excited *mob suffers* from an excess of positive electricity and morbid heat. Under great excitement they become maniacs in their frenzy. The most instantaneous and effective remedy is a complete saturation with cold water; its negative properties draw away their positive electricity, cool the fever in their blood, and bowling infuriated madmen are converted into rational beings. A few hose pipes attached to vigorous fire-engines would be infinitely more effectual in restoring a mob to reason than snider rifles." And to those whose offspring may suffer from "excess of positive electricity," and may require a "soothing magnetism," the valuable hint is given that "the same rule applies to irritable children; a bath tub is more rational treatment than the birch."

In another part of the same article, we specially note that "all nature is magnetic; every drop of water that comes to us in rain-falls is a perfect magnet." We were under the impression that some bodies in nature, including that of the writer of the article, and particularly the fluid *water*, are diamagnetic, and cannot be made to assume magnetic polarity. But then Faraday was not infallible; and, if there be a little hitch here, it is soon forgotten when we read how beautifully magnetism acts as "the soother and harmoniser of Nature's disturbances." We will conclude our extracts from this article with one more bit of information, explanatory of the effect of *cold water*. "Heat is indispensable to life; but an excess of heat indicates an excess of positive electricity. An excess of cold indicates the opposite or negative condition."

Turning now to the advertisement department, we find, amongst the "special advantages" of the particular appliances therein recommended "their constant generating of electricity without the aid of batteries, metallic plates, chain-bands, or acids." This, too, in addition to a *magnetic current* which "passes readily through an intervening garment!" Can those of our readers who are striving to reduce the inevitable loss which occurs in the conversion of mechanical into electrical energy realise, by an effort, the full value of this wonderful but simple invention? Why, it is nothing less than perpetual motion—the overthrow of the principle of the conservation of energy! Do you refuse to admit this? Do you assert that the electrical effect on the body, if produced, must be attended with an equivalent diminution in the motion of the *blood*? You are wrong. In the first place the lines of fluid particles do not ordinarily move in a direction perpendicular to their length, so as to cut the lines of magnetic force; and in the second place we find, in another of the advertisements in our contemporary, that "by the wearing of magnetic appliances, additional magnetic currents are soothingly [how enticing are this adverb and the corresponding adjective!] infused into the system, thus giving a *better circulation*, [the italics are ours] together with greater purity of the blood and increased nervous action. Are you not now convinced that we have here a case of perpetual motion?

Taking up one of the pamphlets above referred to, we are assured that "When it is fully known that magnetic currents are as healthful as pure air, and as indispensable to the life of man; that they are not confined or local forces, but form a general principle, pervading all material things; when it is understood that man himself is truly magnetic, [*how could* Faraday make him diamagnetic?] *then* the employment of this powerful agent in the cure of disease will become general." Surely, in presence of evidence such as that laid before us, the period anticipated cannot be very long in arriving. In this *brochure*, and in one or two of the others, we find the statement, put forward on the authority of a Dr. James Chapman, that "During the last visitation of cholera it was noticed that telegraph clerks and those who were continually brought within the sphere of *magnetic* influence were exempt from cholerine attacks—the close proximity of the magnetic element doubtless neutralising the subtle effects of the earth's disturbed magnetism." Some of our telegraphic readers will rejoice, no doubt, at being favoured by circumstances with such immunity; whilst few, we think, will have the perversity to omit to magnetise their pocket-knives and brace-buckles, since magnetism in homœopathic doses is evidently protective of the most beneficial effects. In another pamphlet, the writer asserts, as a fact within his own knowledge, that "the 'magnetic currents' can be controlled, varied, reversed, or removed at the pleasure of the wearer," and that "invalids can localise a 'magnetic current,' or make a complete circuit at will." Unfortunately, our own appreciation of these important statements is marred by the fact that we do not know what a magnetic current is. With the magneto-static circuit, and with some of its laws, we are tolerably familiar; but as to the magneto-dynamic circuit, we have to confess our total ignorance. Will some of our readers enlighten us?

It is remarkable that, from the evidence before us, magnetism would appear to be much more efficacious in homœopathic than in allopathic doses. From powerful steel magnets carried about on the person, and from still more powerful electro-magnets kept in proximity to the body for several hours, we have never been able to observe the slightest effect. Our experience is that even those persons who are termed "magnetic sensitives" are totally unable to perceive, through any physiological effect, when the circuit of a strong electro-magnet is completed and when it is broken. That this is the case was fully shown in some experiments with two renowned "sensitives"—Miss Tilley and Miss Mansell—which were carried out in our presence some years ago. The following statement by Dr. Pereira, referring to some experiments by Faraday, is of interest in this connection:—"As all substances are under the influence of the magnetic force, it might be expected that the vital functions would suffer some modification from the action of magnetism on organised bodies; but hitherto no conclusive and unequivocal evidence on this point has been obtained. Various phenomena have been ascribed to it, but the inconstancy of their occurrence throws great doubt over the opinion that they are really the effects of the magnetic force. The failure of their production in persons on whose statements confidence can be placed, and their occurrence chiefly in females, and in those called nervous, are reasons for suspecting some error or fallacy in the statements of practitioners who advocate the influence of magnetism on the vital functions. Dr. Faraday does not appear to be sensible of the magnetic force; for some years ago he allowed Dr. Keil to try, in a variety of ways, the influence of powerful magnets on him, but no perceptible effects were produced (*Lancet* for 1835-36, vol. 1, p. 716), and he informs me that he was never sensible of any effect produced on him by the powerful magnets which he used in his recent experimental investigations on magnetism (see *Phil. Trans.* for 1846), although he purposely submitted various parts of his body to their influence, and tried in all imaginable ways to obtain some evidence of their effect."

Dr. Pereira nevertheless describes some modes of using magnets for curative purposes. "The toothache," he says, "*a simple straight bar magnet*, sometimes called a *magnetic staff*, is used. It is first made warm, and its *north pole* applied to the tooth; if the pain be not relieved, the *south pole* should then be substituted." Unfortunately, Dr. Pereira does not tell us what is to be done if the south pole is equally ineffective, an omission which has been fatal to success whenever the process has been tried in our presence.

We wish clearly to define our position in relation to magnetic curative appliances in general, and such things as *Shewanna, Augsterion, Magnetico, Magnetico, Magnetico*, and magnetic *lung or nerve Invigorators* in particular. We have no intention or occasion to occupy illogical and dangerous ground by stating an absolute negative. We do not assert that under no circumstances can magnetism have any effect upon the complicated and delicate functions of the animal organism; but we do say that it has not been shown either that it performs any physical work or exerts any physiological effect whatever, even under conditions in which the magnetic force is intensified almost to the highest degree practicable. In regard to any alleged psychological effect, we can only say that it is altogether outside our province, and that, to be admitted, it must be susceptible of experimental verification. In regard to that portion of the question which is more particularly within our province, we are bound to go even beyond the position we have above taken up. A magnet is a mass, most frequently of steel, up to which is stored up a certain quantity of magnetic energy, viz., just sufficient to do the work of completing its own circuit, since when a perfect magnetic circuit is formed all energy disappears. It is therefore impossible that a magnet can do any physical work unless (*a*) the mass undergoes a chemical or mechanical change, (*b*) the magnetic energy varies, or (*c*) energy is supplied from without. Lastly, in regard to any physiological effect, it is now established that the most powerful magnet can affect the irritability of nerve, the contractility of muscle, or the circulation of the blood as shown in the frog's foot under the microscope. Under these circumstances, an expression of the opinion that the various "magnetic" appliances are absolutely without any curative efficacy cannot be correctly termed "dogmatic." We are aware that the popular belief and the public, consequent trade in such appliances are assuming very extended dimensions, and that testimonials *ad libitum* are

PRACTICAL EXPERIMENTS IN MAGNETISM, WITH SPECIAL REFERENCE TO THE DEMAGNETIZATION OF WATCHES.

By ALFRED M. MAYER.

THE extensive use now made of electro-magnets in telegraphy, in dynamo-electric machines, and in the many practical applications of electro-magnetism, have greatly increased the risk of damage to watches by their magnetization. I have no doubt that in any one of our larger cities there are scores of watches which have been ruined, or more expensive as past recovery from overdoses of magnetism. They are locked upon by their owners as bullion kept in reserve for "a rainy day."

To be assured of the danger is not a sufficient guard against accidents. My own experience is a case in point. I had already attended one watch, saturating it with magnetism by approaching an electro-magnet in my laboratory, when I had been allowed a certain latitude by the person who had that day used it in his experiments. After purchasing another watch, I determined to take the precaution to place it on my office table before I approached the large electro magnet of the Stevens Institute of Technology. I always did this, so much for whether the magnet was or was not in action. But one day I was suddenly called out of the room and detained by a visitor for a half hour or more. I took my watch from the table as I passed out of the room. I returned to my laboratory with my mind entirely engrossed with the experiments I had in hand, walked up to the magnet, rearranged the apparatus, and charged the magnet. My watch came in time was not three inches from the pole of the large magnet! I was only aware of my "accident"—call it, if you will, thoughtlessness about that watch or thoughtfulness about the experiments—when that afternoon I leisurely walked to the station to take a train, and was informed that it had gone over half an hour." My watch had lost half an hour in about three hours! Nothing more continuous than I have had the same experience, for it is impossible, without idiocy supervening, to be constantly thinking of a watch. I have also remarked that out of the two or three dozen owners who have had watches apparently ruined by this same large magnet, each one considered "the other fellow" a careless and thoughtless person really to turn to do the same thing, when he was in a hasty, thoughtful mood—about something, which was not his watch.

My last magnetic accident turned my thoughts to ways of taking the magnetism out of watches. I have succeeded perfectly, and the process which I have finally adopted as the best is so simple that any one can practice it, and that, if you wish, without even detaching your watch from its chain.

Though the process is simple, yet, of course, a knowledge of the elementary facts and laws of magnetism is required to understand how it is done; and I know that every intelligent American mechanic will be willing to undertake the easy task for performing the few operations that he may be called on in practicing my new process.

To render clear to all the operations used in *demagnetizing* (that is, in taking the magnetism out of a watch), I will assume that I am addressing those who have little or no practical experience as experimenters in magnetism, and also in demagnetization. I will therefore, explain the facts and principles of magnetism in which the operations depend, by describing actual experiments made with apparatus which (I very little trouble and at a trifling expense.

I will also proceed slowly when we come to make the simple instruments required in our preliminary experiments and in the demagnetization of a watch.

The Magnet may be made out of a piece of a large rat-tail file. The one I have used is 7 inches long and averages ¼ of an inch in diameter. There is something, either in the quality of the steel or the temper of these files which makes them capable of receiving powerful charges of magnetism. The most powerful magnet I have ever examined is from a rat-tail file just spoken of. If this several inches in length, steel, 16 inches long and ¼ inch in diameter, must be obtained. This steel must be well tempered, that is, obtained by heating it to a cherry red, and then lowered gradually into a bucket of water. This will render it hard and capable of receiving and retaining a magnetic charge. The file or steel rod is magnetized either by drawing it over the pole of a powerful electro-magnet, or by wrapping around it insulated copper wire, and passing through the wire a current of electricity from a galvanic battery.

You have already found, by your own experiments, that when you bring the north pole of one magnet

The Magnetometer.—We call thus the small magnetic needle suspended in a glass shade by a fiber of silk. Fig. 1. It is made thus:—Take a No. 1 or 2 needle, and draw it several times, from point to eye, over the N. end of your magnet. This operation will magnetize their needle, and when suspended from its middle, its pointed end will point toward the north. Now, on to a piece of wood, B, which is 2 inches

Fig. 1.

square, glue and screw the slips, L and L, across to guide so that it cannot warp. Then on its upper side paste a piece of damp white drawing paper. When this has dried it will be tightly stretched on the piece of wood. Draw on the paper a circle slightly larger in diameter than the length of the No. 1" each; or, if that be too tedious, divide the semi-

circumference into ninety equal parts of 2° each. To suspend the needle, you get a skein of floss silk, such as is used in embroidery. This silk is untwisted, and from it you can readily draw a thread formed of a few fibers, which is very delicate and without the slightest twist or tension in it. To suspend the needle, stick in its middle a small dot of wax. The wax over-coat it, with the fingers. The other end of the thread is passed through the eye of a large No. 1 sewing needle, board, C, placed on top of the lamp chimney, L. The sewing needle is then passed downward through the hole in C, the needle is swelled, N, may be brought to rest on the paper covering the magnetic needle, S, will hang just above the Board, B, and will swing to and with its pointed, or N., end toward the north of the horizon. After many oscillations the needle will come to rest and will point in a direction which is parallel to *the magnetic meridian*. This direction is different for different places. Here, in New York, it makes an angle of 7° with the true north and south line, and the N. end of the needle points 7° to the west of the true north. This pointing of a *magnetic declination*, or magnetic variation. In New York and its vicinity the magnetic declination is 7° west.

In addition to the magnet and magnetometer the experimenter will need the following materials:—

Three pieces of soft iron. One piece 12 inches long and ½ inch in diameter; another piece, 7 inches long and ¼ inch in diameter; a third piece, 1½ inch long and ¼ inch in diameter. These pieces of iron should be made very soft by heating them to bright redness and then allowing them slowly to cool in hot ashes.

A piece of steel wire, 6 inches long and ⅛ inch in diameter.

Iron filings, made from soft iron and passed through a fine sieve.

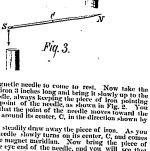
Pieces of window glass. Two 12 inches by 6, and two pieces 6 inches square.

A small bottle of spirit varnish, such as photographers put over their negatives.

Needles, nails, and tacks of various sizes.

With the above simple articles cheap things a great many interesting and beautiful experiments can be made; and we will now show how to obtain from these homely instruments much information that is really sound and useful.

Experiments showing in what a Magnetic Substance differs from a Magnet.—Place the magnetometer on the table and



allow the magnetic needle to come to rest. Now take the piece of soft iron 1 inches long and bring it slowly up to the magnetic needle, always keeping the piece of iron pointing toward the point of the needle, as shown in Fig. 2. You will observe that the point of the needle moves toward the iron, turning around its center, C, in the direction shown by the arrow.

Gently and steadily draw away the piece of iron. As you do so the needle slowly turns on its center, C, and comes again into the magnetic meridian. Now bring the piece of iron up to the eye end of the needle, and in such a way that this end turns toward the iron in the same manner that the point of the needle in the previous experiment. Thus we find that a piece of soft iron attracts either end of the magnetic needle. Each end moves toward the iron. If this be so, it necessarily follows that if you point the piece of iron toward the center of the needle and bring it up to the needle in the position shown, keeping care always to have the length of the piece of iron at right angles to the length of the needle, the needle will not move, remaining steadily resting in the magnetic meridian. Each end of the needle is equally attracted toward the iron, and as each end tends to turn in the direction shown by the arrows in Fig. 4, it remains at rest under the action of two equal forces tending to rotate the needle in opposite directions.

Now we will make some experiments similar to those just described, but differing in this: we use a magnetized No. 1 sewing needle instead of the piece of soft iron. Take a No. 1 sewing needle and draw it from point to eye over the N. end or pole of your rat-tail file magnet. You will, by this operation, have converted the needle into a magnet, and if you suspend it, as I with you now to do, like the needle of your magnetometer, you will find that *it points in the magnetic meridian with the point toward the north.* The ends of magnets, or, more accurately speaking, certain points in the center of magnets and near their ends, are called *the poles of the magnet.* To distinguish these two poles, they are respectively called north pole or south pole, corresponding to the end of the needle which points toward the north or south geographic pole. The points of our magnetized needles are, therefore, north poles, while their eye ends are south poles.

Bring the No. 1 needle up to the needle of the magnetometer, with its point toward the point of the magnetometer needle and with its length always at right angles to the magnetic meridian, as shown in Fig. 5. The N. pole of the needle moves away from the north pole of the No. 1 needle, and we here have *repulsion* instead of attraction, as we had when the piece of iron was placed in the same position. Now point the north pole or point of the No. 1 needle toward the eye end, or south pole, of the magnetometer needle, as shown in Fig. 6. In this position of No. 1 needle, the S. pole of the suspended needle moves toward the N. pole of the No. 1

A New Form of Electric Lamp.—Carbon pencils of steel and borings of brass, with a MIXTURE OF SALTS, are used in a lamp has been invented by MR. ERNST WOLFF, of Berlin, Germany. The mixed materials are put into a leaden cylinder or drum, to which the brass and steel adhere, while the copper and brass fall into a special reservoir below. There are two hollow cylinders rotating in the same direction, so that the iron which escapes from the first cylinder is retained by the second. The surface of the cylinder is formed by flat bands or strips of soft iron alternating with strips of copper, and each of the iron bands is in contact with a row of horseshoe magnets. The adherent metal is removed by revolving brushes.

EDISON'S MAGNETIC ORE-SEPARATOR.—WASHINGTON, June 1, 1880.—Thomas A. Edison, of Menlo Park, N. J., was to-day granted a patent for a magnetic ore-separator, which allows magnetic and non-magnetic substances to fall together, and then, by magnetic attraction, allows or causes the trajectory of the falling magnetic substance without stopping its fall.

ON SOME POINTS CONNECTED WITH TERRESTRIAL MAGNETISM.

I HAVE to make further remarks on the various points brought forward some of the various points which are here grouped together. These points are three in number.

(a) Regarding the sustaining power of the earth's magnetism.

(β) Regarding the diurnal and other changes of the same.

(γ) Regarding earth currents and auroras.

I may state at once that this only professes to be a working hypothesis.

(α) Regarding the Sustaining Power of the Earth's Magnetism.—I do not here intend to discuss the cause of the earth's magnetism, but I would ask in the first place if it is not possible that this cause may be something small and one which (assuming it to continue at the present moment) we may not readily perceive. If we assume this cause or magnetic nucleus to be small it is not possible to imagine that there is a machinery which acts upon this nucleus (just as we have in certain magneto-electric engines) so as to swell up the magnetism of the earth ultimately to saturation.[1]

May not this machinery be the great convection currents, the anti-trades, that go from the equator to the poles in the upper regions of the earth's atmosphere, and which may be looked on as conductors moving across lines of magnetic force?

It would appear to me that the tendency of such currents will be to swell up and sustain the magnetism of the earth.

(β) Regarding the Diurnal and other Changes of Terrestrial Magnetism.—It will of course be natural, entertaining the views now enunciated, to regard the diurnal changes of the convection currents of the earth's atmosphere, as these are manifested in the upper regions, to be the cause of the diurnal changes of terrestrial magnetism.

If this view be taken it might be argued that solar changes in these upper regions should also produce magnetic variations. The reply is that apparently they do. In conjunction with Mr. Mortabha Hirzaka I have compared together the simultaneous records of magnetic declination taken at Kew and at Trevandrum, and I find evidence of a progress of things from west to east, so that on the whole a particular magnetic change phenomenon occurs at Kew 27 days before it occurs at Trevandrum. Again, I have attempted to show, in conjunction with Mr. Dodgson, that a particular magnetic phenomenon occurs at Kew one day before it occurs at Prague.

It would thus appear that there is a progress of magnetic phenomena from west to east, just as we know there is a progress of meteorological phenomena. As, however, the meteorological phenomena which we can examine occur in the *lower* atmospheric regions, while the magnetic phenomena are, according to this hypothesis, associated with currents in the *higher* regions, it does not follow that magnetic and meteorological phenomena should travel from west to east at the same rate. I may also mention that we have reason to believe that magnetic changes lag behind corresponding solar changes just as meteorological changes would do.

It is manifest that it will be comparatively easy to settle the fact of a progress from west to east of magnetic vexation, and that if such exists it will most readily ally itself with the hypothesis above mentioned.

In the next place, if we regard these changes in the convection-currents of the earth which depend on the year we have reason to imagine that such are most pronounced at the equinoxes. It is also well known that magnetic disturbances are most frequent at these times.

Let us next proceed to regard the secular change of the earth's magnetism. To account for this magneticians have felt the need of something movable, and the hypothesis of a "little earth," a solid nucleus moving within the recesses of our planet, has found much support. But is it not more likely that the result may be caused by a secular variation in the distribution of the convection-currents of the earth? If the question be asked, What reason have we for imagining the existence of such a variation, the answer will be, A much better reason than we have for entertaining the conception of a "little earth." For there is some reason, at any rate, for imagining the power of the sun to be subject to a complicated series of periodicities. Now a secular variation in the power of the sun would produce a secular change not only in the intensity, but in the direction of the convection-currents of the earth, and, according to the above hypothesis, these in their turn would produce a secular magnetic change.

(γ) Regarding Earth Currents and Auroræ.—I have for some considerable time looked on the earth as a Rohmkorff's coil with a magnetic nucleus. Above this nucleus we may suppose that we have the primary rocks, which are non-conductors, while above these we have the moist or comparatively moist surface of the earth, which is a conductor. Above this, again, we have the lower strata of the atmosphere, which are non-conductors, while above this we have the upper strata, which are conductors.

Now suppose that a small but abrupt change of the earth's magnetism takes place, no matter how. We need not enter into the causes of such.

We have thus two secondary coils, if I may use the expression: (1) the moist surface of the earth, (2) the upper regions of the atmosphere; and both of these will be animated with secondary currents, on account of the abrupt change of the earth's magnetism. These secondary currents will be in one direction for a magnetic change of one kind, and in the opposite direction for a magnetic change of the opposite kind.

Now whenever there are magnetic storms, that is to say, when there are small but abrupt changes of the earth's magnetism, it is well known from the Greenwich records that we have violent earth currents, which are alternately positive and negative, and that we have also auroral displays in the upper regions of the earth's atmosphere. We cannot examine the auroral displays as we can the earth currents. But with regard to earth currents I would remark that the *form* of the phenomena they display is entirely against the supposition that such currents are the main cause of the changes in terrestrial magnetism, and in favour of that which maintains that they are secondary currents induced by magnetic changes.

In conclusion I would guard against its being supposed that all luminous appearances in the atmosphere are due to the same cause. I only hold that certain appearances which occur at times of magnetic perturbation and simultaneously throughout a large portion of the earth have the origin now mentioned.

B. STEWART

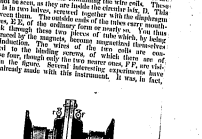
[1] If I am not mistaken, Sir W. Thomson is inclined to regard the earth as a magneto-electric engine.

bursing of which their brittleness is diminished, and the re-
quisite elasticity imparted. If they are to be very hard, but
a small portion of the casting is allowed to harden off; but, if
softer, it may be allowed to harden until it goes out. If the
objects are of greater or less uniform strength, as many
springs, the blasting off is repeated upon the whole object,
or on portions of it until the desired uniform degree of hard-
ness results. Gunlock springs are sometimes tempered by
boiling in oil, by which a very uniform temperature for all
portions is secured, and the thinner portions do not suffer
from the continued heat of blasting off.

DUPLEX TELEPHONE.

The principle is that of soldering a single diaphragm
to the action of a magnet and coil on each side of it, and
the two, to affect two separate circuits with their coils by the one
diaphragm. The instrument as constructed is shown in the
cut.

A A are the north and south poles of a horse-shoe magnet,
are laminated out so as to embrace short pieces of soft iron
into useful coil B. On the ends of these pieces of soft iron
slipped the usual bobbins containing the wire coils. These
fastened in two hollows, screwed together with the diaphragm
between them. The outside ends of the tubes carry mouth-
pieces, E E, of the ordinary form or nearly so. You thus
speak through the one piece and hear with the other, by being
connected by the two circuits, because suggested in the
inverted to the binding screws of which there are our
course four, through only the two shown, F F are, of
ble in the figure. Several interesting experiments have
been already made with this instrument. It was in fact,



NEW DUPLEX TELEPHONE.

with this that the phonograph was used as described in my
former letter, though not quite in the present form.

If one magnet and coil be properly coupled up to the
other so as to bring both into unison, the sound will be
much greater than when only one is used. Indeed, it is found that if two persons speak or sing simultaneously, one into
each mouthpiece, the diaphragm will vibrate responsively, so into
of vibrations, that both voices will be repeated by both coils of the
telephone, so that both persons will be heard at the distant
received from the single diaphragm. Even two near sounds
Again, by coupling an ordinary telephone, A, with one
end of the "duplex," and another, B, with the other coil
ends of A and B, a circuit is thus established between the
wires A and B. This would be naturally carried on
the diaphragm receives and "draws on" the vibrations, but
Melodeon. It hums at first sight rather odd.—*English*

MANIFOLD USES OF PRESSED PAPER LETTERS AND ORNAMENTS.

BENTZEN suggests that mentitude of applications might be
made in many directions of the letters and ornaments of
pressed paper which he had made with such success and
Thus pulpboard, he said, is easily worked, and ornamental
own plates for printing, which little trouble, and so cheap,
the letters, not printing them, as usual, by arranging
using external clichés, but by setting up the desired text
ing the letters and ornaments upon the pulpboard sheet
sizes from 0·02 to 0·12 inch. The pulpboard sheet upon
covered with the glazed paper from the block, upon which
whole with a proper cover. Old type may be used, and
ipate spaces, leads, and quads, which are also made
ments can not only be readily and cheaply produced from
such articles as pulpboard, but also more quickly than
the market. Thus, for example, a card of visiting or
ornaments formed by gluing the letters on a suitable piece
state.

Dr. HOPE has recently instituted a comparison between
the indicator that "the velocity of the wind and its pressure
wheel is inversely proportional to the number of
penetrating rays," and the relation of the latter
view that the former is due to the least action of
of heat rays, which "is confirmed by the
water," says Dr. Hoff, "to penetrate the glass is due to an action
layers of light. A new plate has been made, having a mechani-
with full light. It is a long time before the opening a mechani-
quickly closed by the action of a spring. The velocity with
by means of wires sewed to the bottom of the
the bottle and the other with a small metallic plate beneath
stopper. Turning the crank is said to stop a vicious
horse instantly.

APPLICATION OF ELECTRICITY TO CHRONOMETRICAL MEASURE.—M. HIPPOLYTE FONTAINE, of Paris, has recently invented an apparatus for obtaining by means of electricity, so-called electrical machine consists essentially of a wheel, the axle of the crank within reach, the poles of which are set, with by means of wires sewed to the bottle and pass, one with the stopper. Turning the crank is said to stop a vicious horse instantly.

the magnet has been removed from it. This difference in the after effects of induction on soft iron and steel is best observed in the following experiment:

Take a piece of the softest iron, and having ascertained that it is entirely free of magnetism, draw it repeatedly over the end of the magnet; if the iron is really soft, you will find that even repeated stroking on the magnet confers upon it no power of attracting the filings. However, passed over the iron will retain a slight, though often very slight, amount of magnetism, and will cause a few particles of filings to adhere to it. Now perform the same experiment with a large sewing needle, and observe how powerful a magnetic charge has been given to it. When rolled in the filings large tufts adhere to the needle, surprising those who have never before how strong a magnet may be thus made of a large sewing needle.

The retention of a magnetic charge by steel enables us to readily fashion magnets of any size or form. If steel are some other easily worked body had not this property we would be obliged to construct our magnets of compound pieces out of the hard and brittle cementite or lonsdalene. Indeed, it would be difficult to select from the whole range of the especial properties of matter one more valuable to man, or more necessary to its present high and widely spread civilization, than this one of the capability of steel to receive and retain the properties of the lonsdalene.

Further Experiments in Magnetic Induction.—Let us, by means of other simple experiments, examine more minutely into the nature of this magnetic induction.

Take two pieces of very soft iron wire and suspend them by silk fibers, as shown in Fig. 19. Hold the ends of the fibers separated, between the thumb and forefinger, and the wires may hang a quarter of an inch or so apart. Now bring them slowly down toward the N. end of the magnet, as shown in Fig. 19. They now no longer hang parallel to each other,

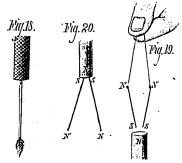


Fig. 19.

but are inclined, the upper ends of the wires repelling each other, so that the two suspending threads are forced outward and no longer hang vertically. This repulsion between the upper ends of the soft iron wires is caused by the magnetism that the ends have received. We have already seen that like poles mutually repel. (See experiments described, in Fig. 1, as to the N. poles of the magnets.) Again, by reversing the experiment described in Fig. 19, then the lower ends of the suspended iron wires are N. polarity and their upper ends assume north polarity.

The experiment just described may be modified by simply

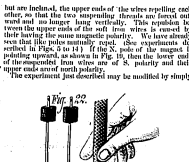


Fig. 20.

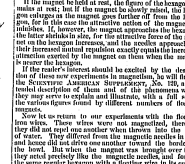


Fig. 19.

Fig. 21.

holding the two wires parallel to each other between the thumb and forefinger and bringing their ends to touch the end of the magnet. They will adhere to the magnet, and on reflection it will be observed that the lower ends of the wires will at once fly apart, from their mutual repulsion, as shown in Fig. 20.

Take seven pieces of iron wire, each about 1 inch long, and run them through a small cork, about ¼ of an inch long and ¼ inch in diameter. Throw these pieces of wire into a tumbler of water and they will float upon the surface, the cork resting on the water, and the wires projecting downward. Now bring the N. pole of a magnet near the tumbler. The wires will be attracted toward the magnet, and after many unsuccessful endeavors, they at last take up the definite position shown in Fig. 21.

This beautiful illustration of magnetic induction, and this experiment tells the whole story when viewed in the light which another glass, and which we have so described before awakening further of the one just made.

Take seven sewing needles (Milward's No. 4 tapersare good for this experiment. At the N. Y. Cork Cutting Co., 48 Fulton street, New York, you may buy a gross of corks, of ¾ inch in length and ¾ inch in diameter, for 40 cents. Magnetize each needle by drawing it from the eye end over the N. end of your small bar magnet. Push one each needle through the center of a cork, using for this one of the corks just described. In other words, push the corks which will float three needles on 1½ inch long and ¼ inch in diameter. Now throw these needles in the bowl of water. They repel one another, and if close enough together will at once fly to the edge of the bowl and will arrange themselves at equal distances apart around the border of the water. They are in a measure wire floating upon their like poles are opposed to each other, as shown in Fig. 22, and these like poles mutually repel.

We add the needles remain on the border of the water in the bowl, as long as they float upon the surface. Now take hold of the long sewing needle, with its N. pole pointing downward. The magnetic needles at once move from the middle of the bowl, and after moving about each other for a while, they end by forming themselves into a regular geometric figure of the seven, with 2 needles in the center, as happened in the experiment with the floating iron wires, shown in Fig. 21. In the experiment with the magnetic needles we know the exact magnetic conditions of the experiment. We know that the needles are magnetized, and that their south poles are pointing upward and their north poles are pointing downward. The like poles of these needles being strongly and mutually repel, and keep apart till the N. end of the magnet has been brought over them; then the strong north pole attracts the upper or south poles of the needles, and they draw toward the N. pole of the magnet. In other words, the attraction existing between the N. pole of the magnet and the south poles of the needles is stronger than the repulsive force existing between the needles. The needles therefore move toward the magnet and approach one another till their mutual repulsion activates keeping them apart just balances the attraction of the magnet which tends to bring them together.

If the magnet be held at rest, the figure of the hexagon remains at rest; but if the magnet be slowly raised, the hexagon enlarges as the magnet goes further off from the hexagon, for in this case the attractive action of the magnet diminishes. If, however, the magnet approaches the hexagon, the latter also shrinks, for the attractive force of the magnet on the hexagon increases, and the needles approach till their increased mutual repulsion exactly equalizes the increased attraction exerted by the magnet on them when the magnet is nearer the hexagon.

If the reader's interest should be excited by the description of these new experiments in magnetism, he will find in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 122, an extended description of them and of the phenomena which they may serve to explain and illustrate, with a full set of the various figures found by different members of floating magnets.

Now let us return to our experiments with the floating iron wires. These wires were not magnetized, therefore they did not repel one another when thrown into the bowl of water. They differed from the magnetic needles in this, and hence did not drive one another toward the border of the bowl. But when the magnet was brought over them they acted precisely like the magnetic needles, and formed the same regular hexagon with a floating wire in its center. The force acting on the wires and the needles was the same. It was the N. pole of the magnet. We know that the needles were magnetized, and that the N. pole of the magnet threw their south poles upward and their north poles downward. In the water we could not find the latter, but we therefore have a right to assume that such was the case. The N. pole of the magnet kept upper ends were made south poles by the inductive action of the magnet, and their lower ends under the water, were made north poles by the same action.

We can now understand the condition of the polarity in the magnetic chain formed by the suspended nails, brads, etc., in the experiment shown in Fig. 17. To the N. pole of the magnet is attached a nail. The end of the nail touching the magnet is made its south pole by induction, while its other end is made its north pole. This nail now acts just like the magnet which magnetized it, and the nail in turn magnetizes by induction nail No. 2, and this nail No. 3, and so on to the end of the magnetic chain, which is terminated by the magnetized iron filings.

Experiments which show Something about the Nature of a Magnet.—Take the piece of steel wire, six inches long and one-sixteenth of an inch in diameter, mentioned among the articles required in our experiments, screw this piece of wire at a short distance apart, by filing it some with a sharp file. Now heat the wire to a cherry red, and then plunge it vertically into water. It will now be quite hard, and may be readily made into a magnet, by drawing it over the poles of your magnet. Lay the wire upon a piece of paper and scatter around one of the ends of the steel a few pins, needles, or nails, and you will find that the one over the N. pole of the magnet, from the paper, and the other will have north polarity, as may the general end of the wire will have north polarity, as may be shown by applying the wire to the magnetometer. The magnetic condition of the wire having been found out, we begin by snapping the wire into small pieces, which are readily done, for the spores on the wire determine where it will break. Place each piece on its side in the same direction from the wire and with its north pole in the same direction as the wire, and you will have a perfect row of the wire. Examine each of these pieces by means of the magnetometer. They will be found to be magnets, with N. poles turned all one way, their south poles turned in the other direction. This experimentation may be made by means of the magnetometer, but it can be more readily and easily made by means of iron filings, shown by rolling it in iron filings, when it will be found that the filings adhere to the ends of the piece of wire just as they did to the large magnet. See Fig. 11.

In Fig. 23 is given a view of the pieces of wire placed end to end just in the position they had when they formed parts of the steel wire. We see that each piece is a perfect magnet, and that the north poles of these pieces all point to the right and their south poles to the left. But each of these little fragments may be broken into two, and so on; and as far as the subdivision may be carried, it has been found that each minute fragment is a perfect magnet, with one of its ends a south, and the other a north pole. Experiments in imagination was my constant aid in the exhibition carried on in the following manner, and reached may be invisible to the unaided eye. Indeed, nothing prevents us from logically assuming that even if a molecule of the steel should be reached it would be found to be a perfect magnet.

An Experiment with a Magnet formed of Steel Filings Rolled in a Paper Cylinder. is interesting when studied in connection with the experiments just made, and will serve to give us further information as to the nature of a magnet.

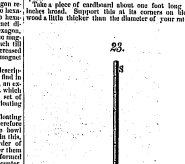


Fig. 22.

Take a piece of letter paper, and having wrapped it several times around a lead pencil, pass the free edge of the paper on to that wrapped around the pencil. After the paste has dried you may draw out the lead pencil, and you will then have a tube made of paper. Cork one end of this tube, or you may close it by doubling over the paper at its end and gluing. Fill this tube with steel filings, and close also the other end of the tube. This tube, filled with steel filings, will now form a good bar magnet. After you have magnetized the tube (operation several times, present the tube to the magnetometer, and you will find one of its ends is a north, while the other is a south pole. Having thus satisfied yourself that it is really a magnet, open the tube as before, and the positions of the particles of steel filings are changed. On testing the tube at the magnetometer it will be found that, strange to say, the magnetism has gone from it. If it has not all disappeared it has been reduced to so low a potential as to be of no practical use. This experiment shows that not only must each particle or even molecule of a steel bar be a perfect magnet, but it also shows that these magnetized particles must be arranged in a definite order, that is, with all their N. poles pointing in one direction and their south poles in the opposite direction, so that the body, as a whole, may obtain and retain its magnetic polarity. Before the year 1600, when William Gilbert, Elizabeth's physician in Colchester, made the celebrated experiment of forming a magnet into many parts and testing each of these parts, and then use of its ends is a north, while the other is a south pole. Having thus satisfied yourself that it is really a magnet, open the tube as before, and the positions of the particles of steel filings are changed. On testing the tube at the magnetometer it will be found that, strange to say, the magnetism has gone from it. If it has not all disappeared it has been reduced to so low a potential as to be of no practical use. This experiment shows that not only must each particle or even molecule of a steel bar be a perfect magnet, but it also shows that these magnetized particles must be arranged in a definite order, that is, with all their N. poles pointing in one direction and their south poles in the opposite direction, so that the body, as a whole, may obtain and retain its magnetic polarity. Before the year 1600, when William Gilbert, Elizabeth's physician in Colchester, made the celebrated experiment of forming a magnet into many parts and testing each of these parts, and then use of its ends is a

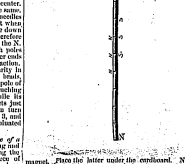


Fig. 23.

magnet. Place the latter under the cardboard. Now lift the cardboard off the magnetic parts and place it to one side on the table. Through a fine sieve sift soft iron filings evenly, and not too thickly, over the cardboard. Lift it up carefully and place it over the magnet. A slight bebedling of the filings at all times will discover the general direction of the magnetic lines as they are forming the cardboard, by letting fall very gently a few pieces of iron filings. Should it gently tap the cardboard, you will observe certain motions among the grains of filings. They will finally arrange themselves over the magnet in the form shown in Fig. 24.

Fig. 25 shows the arrangement taken by the iron filings when they are placed on a card and vibrated over the ends of a round magnet, the magnet being held in a vertical position under the cardboard.

Fig. 26 are the lines formed over the end of a magnet; Fig. 27 and 28 respectively show the position of magnets with their saddle and like poles opposite each other.

The effect of the magnetic arrangement of the lines of filings produced on a surface when under is a magnet, and filings have long and attracted by it gently tapping the surface, is represented in a cylinder of soft iron, 12 millimeters long and 10 millimeters in diameter. In April, 1871, I exhibited this piece in the *America*. A piece of Sweden I had invented for permanently fixing the lines of force of any magnetic centre, and they are shown on plates of glass. When these permanently attached lines are required, a sheet of paper from which a series of plates were printed, exactly as a photographer prints from a negative, is placed over the magnet. The sensitized varnish of magnetic spectra given in this article were made by a photo engraving process closely from the glass plates made by me in 1871. These glass plates carrying the magnetic spectra I have also used for several years as slides in the lantern, in order to exhibit them before large audiences and college classes.

The following is the method of permanently attaching these magnetic figures to glass. A clean plate of this glass is coated with a film of hard varnish by flowing over it the varnish used for photographers in coating their negatives. If this is not handy, then a solution of shellac in alcohol will do nearly as well, only the latter requires more coating to cause the iron filings to adhere to it. The varnish is poured on one end of the plate, and then caused to

Why the magnetic needle points to the north is thus explained by *Prof. C. T. Patterson, of the United States Coast Survey*:

"The needle does not point to the true north, but at present it points to the northwest. The magnetic north is not found to be affected by the action of the sun in a manner not yet understood. The magnetic poles of the earth are not in the same position as the geographical poles, but make an angle with them of nearly 20°. The magnetic pole at present time the northern magnetic pole is near the Arctic circle, on the meridian of Dundas, and, from the nature of the case, the pole may better be described as a region rather than a fixed point. The needle does not point to the magnetic pole, but to some astronomical north, but varies within certain limits. At San Francisco it points 17 degrees east of north, and the variation is annually to the west. At the northern magnetic pole a balanced needle points with its north end downward in a plumb line; at San Francisco it dips about 60 degrees, and at the southern magnetic pole the south end points downward. The action of the earth upon a magnetic needle at its center is much about the same force as that of a hard steel magnet forty miles from the needle suspended, at a distance of one foot. It is very probable that a study of dynamo-electric machines, now so much used in electric illumination, will soon reveal some far-reaching truths regarding magnetism in general."

EDISON'S ORE SEPARATOR.

THE annexed sketch, [illegible] as illustrative of the principle on which Mr. Edison, of Menlo Park, proposes to construct a magnetic ore separator. The device is intended for working tailings which are now thrown away as being too poor to pay for working by any of the processes now in use. The machine is simple in the extreme. The sand is fed in a cone of the form shown, over the magnet. The magnetic attraction changes the trajectory of the falling magnetic sand without stopping its fall, so that while the

silicious sand, gold, and other non-magnetic substances fall straight down into one compartment of the receiving hopper, the trajectory of the magnetic sand is changed, so that it falls into another compartment of the receiving hopper. By this means the separation of the black sand is rapidly and completely effected with the expenditure of very little power. It is not clear how it is that the magnetic attraction, which decreases so rapidly with increase of distance between things magnetic, attracts the particles when at a greater distance than that at which it lets them go.

EDISON'S ORE SEPARATOR.

Electrician

In our "Report" for last week we quoted an American statement to the effect that an apparatus identical with Edison's vaunted ore separator had been in use in that country for some years. It is satisfactory to find that the Americans have thoroughfares found out the ancient character of that latest bantling from Menlo Park. But the same device has been before the world in France for the last twenty years at least in Fremont's machine for separating magnetic oxide from copper ore. Fremont is the well-known mechanical electrician of Paris, and his apparatus consists of a hopper, through which the ore was poured, and a powerful electro-magnet, which was placed underneath so as to attenet the magnetic particles of sand aside from the rest of the nonmagnetic copper ore. The contrivance is, in fact, essentially the same as Edison's. No doubt there are several English patents describing the same arrangement; but Fremont's is, so far as we are aware, the first instrument of its kind.

A similar device has been used for some years in America for extracting the bits of wire left in gouia from the wire bands of the binding machines so commonly employed by American farmers. In fact, magnetism has been applied in the same way to a great variety of purposes.

The ore separator which was to cover Mr. Edison with the wealth of Eldorado, and transform him into a rival of Mr. Mackay, the owner of the "Big Bonanza" mine, is an old affair refurbished up, and though it may make the New York interviewers gape, and tickle the sensation palate of omnivorous Yankees, it will, weimagine, hardly pay for its own manipulation in gold extracting. The proportion of "black sand" or magnetic oxide in gold "tailings" is, we are assured by an experienced gold miner, so very small, that its separation from the rest of the ore will make hardly any appreciable difference in the expense of extracting the small percentage of gold from the residue by washing over mercury. Had the black sand formed a considerable proportion of the whole "tailings" there might have been some value in the magnetic separator. As it is the game is not worth the candle.

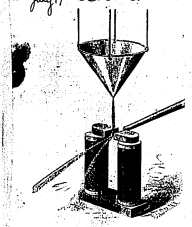
M. BECQUEREL finds that in the case of the diamagnetic gases, protoxide of nitrogen, carbonic acid, nitrogen, and olefiant gas, the amount of magnetic rotatory polarization which rays of light undergo in traversing them in the same direction as the magnetic force rolls in the case of the ores lengths is for nonmagnetic bodies. Oxygen, a magnetic gas, acts differently, for red rays it gives a rotation which is a little above the green rays; in the case of the diamagnetic gases the reverse is the case, the maxima for green as compared with red being as 10 is to 8.5.—*Comptes Rendus*, lxxvii., 1873.

EDISON'S ORE SEPARATOR.

The *Scientific American* of June [illegible] contains an illustration of the new invention of Mr. Edison for extracting gold from the refuse "tailings" of a placer. This remarkable contrivance which the "sensation heading" writer of the *New York Herald* dubbed "Edison's Big Bonanza," turns out to be nothing more than a wooden funnel through which the "tailings" are poured in a stream past the poles of a powerful electro-magnet, which has the effect of deflecting the "black sand" or magnetic particles in a branch stream towards it, and leaving the barren sands and non-magnetic gold to fall vertically downwards into a separate receptacle.

NEW ORE SEPARATOR.

In one of our recent issues we described a device invented by Mr. Edison for separating magnetic sands from the non-magnetic particles of ore by altering the trajectory of the



EDISON'S ORE SEPARATOR.

falling magnetic substance by means of an electro-magnet. We now give an engraving of another magnetic ore separator recently invented by Mr. Edison, which operates on an entirely different principle, and effects a still further concentration of the ore by the separation of the metallic from the non-metallic part by diamagnetism.

The auriferous sands are placed in the hopper and allowed to fall between the poles of a powerful electro-magnet, and a blast of air is directed at right angles against the falling stream of sand just as the latter passes between the poles of the magnet. The non-metallic substances are readily blown away, while the metallic portions are retarded by diamagnetism, so that the blast of air has less effect on them than it has on the non-metallic substances. The concentration of this operation is that the sands are divided into two heaps, one containing a large percentage of metal, the other containing a very small percentage, or none at all.

CURIOUS MAGNETIC EXPERIMENTS.

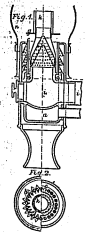
Mr. Obalski has made some curious experiments in relation to the French Academy's experiment, in which needles are suspended over water by the attraction of two magnets, similar poles attracting each other by an almost imperceptible and even distant force, each of mutual attraction; but rather than the sum of their radii of mutual attraction; water is gradually brought up over them by means of the tube of caoutchouc connected with the vessel and wound on a drum. When immersion commences, the needles approach each other by their inner and outer third or fourth and when the immersion has reached a little over half of the needles' length, they touch together. The explanation seems to be, that what hindered the approximation of the needles was their own weight; and the force of gravity being surmounted by the immersion, the magnetic forces become manifest. If the needles are suspended by their poles of the same name, a corresponding though opposite phenomenon is witnessed.

THE *Journal of Gas Lighting* says:—Considerable importance was formerly given by English and French papers to the fact that the Paris *Salon* was to be lighted by electricity, and the assumed superiority of this light over gas for the illumination of paintings was accepted unquestioned by those who were too indifferent or too prejudiced to inquire very closely into the matter. We find, however, that a class of persons who must be admitted to have some slight knowledge of what is a good and what a bad light for a picture—the artists themselves—have protested against the use of the electric light at the *Salon*, this being stated to be the most unfavorable kind of illumination for effectively showing off their productions. The protest, however, comes rather too late. The agreement entered into with the Jablochkoff Company for the supply of the electric light has been carried out, and this system will, we suppose, remain in use until the end of the season, artistic protests notwithstanding. Again, when asked, right-thinking people are inclined to express a doubt as to the perceptible superiority of the electric light by the exhibitors at Paris who had been so ready to make use of it as a novel and attractive, that is, as a money-getting kind of advertisement, their feelings were not spared by the worshippers of the rising Company with all the impertinent contempt usually manifested towards opponents by converts to a new faith. Yet what do we find? The *Figaro*, whose office in the Rue Drouot was one of the first buildings to be illuminated exclusively by means of the electric light, has positively abandoned that system, and substituted for it two gas lamps similar to those used by the Paris Gas Company in the Rue du Quatre Septembre, where, by the way, only half the original number of burners are now lighted, and yet the general illumination of the thoroughfare is, we learn, if anything, a trifle better than that of the neighbouring Avenue de l'Opéra, where the electric light still reigns supreme."

THE Influence of Magnetization on the Tenacity of Iron has been lately studied by Signor Pizzoli. Iron wires were hung between two hooks and ruptured by pouring water into a vessel suspended from them. They were about 350 mm. long, and were inclosed in a spiral with four windings one over another, which were either all traversed by a current in one direction, or two by a current in one direction, and two by an equal opposite current, so that in both cases the wires were equally strongly heated by the spiral; but in one case they were magnetized, in the other not. The weights applied to break wires annealed in charcoal—weight of one metre, G = 0·299—were, during magnetization, P = 1266·5906; without magnetization, P = 1213·1276. In the case of wires annealed in carbonic oxide—where G = 0·48 g—P = 1732·4·1742·7; P' = 1707·62, 1710·87. In the case of wires annealed in hydrogen P = 1289·5·1310·1; P'=1163·1197·7. In each separate series accordingly the difference, P − P' was frequently less than the difference between the highest and lowest weights required for rupture of apparently identical wires; still, the mean values in each of the fourteen series were from about 1 to 3 per cent greater for the magnetised than for the unmagnetised wires, showing that the tenacity of iron increases on magnetization.

THE Annealing Process of Steel.—It has been proved by Hermes Stroinal and Reese (*Wied. Ann.* No. 13, 1880), from experiments in which steel wire was treated so as to show all degrees of hardness between the glass-hard and annealed state, that the thermo-electric and galvanic properties of steel vary with the degree of hardness in a perfectly regular manner. Their researches throw some useful light on the nature of the annealing process, and on the magnetic behaviour of steel in relation to its hardness and other properties.

1861. Lampe! F. Siemens, Dresden. (Gb. 11 Sept.)—The subject of this patent is a lamp having currents of air passing from the flame through a second regenerative chamber within the annular burner of the lamp, while the air required for combustion is passed through the space in the regenerative chamber surrounding the burner of the lamp. The annular burner carries a number of small vertical tubes, which are open at the top, and communicate with the gas being admitted into the chamber a (fig. 1), and the products of combustion of a row of small tubes, lateral, the air for supporting combustion is passed through the regenerator c, and being partly caused to flow by the action of the ring of tubes will exist in combination with the gas, and form a mixture which will burn at the upper surface of the plate e. In a few seconds a tube placed immediately above the lamp-tool shown in the figures will become heated and will have the effect of increasing the draught. The products of combustion, such as exist so as to form a certain current of electricity, in consequence of the suction thus produced, a portion of the products of combustion will proceed from the flame through the regenerative chamber from which it derives its heat, through into the tube above the lamp. The products of combustion between the chimney a and the tube, by means of a throttle-valve, will above, in the figures, the bulk of the products of combustion will be conducted through the tube b into the regenerative chamber c. This heat will be imparted partly by radiation and partly by conduction to the regenerative chamber c and gas inlet. The products of combustion will then pass through the tube, thus producing a greatly increased draught, and being thereby reduced air deficient, shown at g and h which are formed by the passage of small currents impinging on each side of the flame, as described in Specification 2153, 1860. The cylinder f is made of fireclay, or other suitable material, and the upper part of the lamp is drawn downward over the edge, the height of the cylinder will determine the height of the flame. In some cases the regenerative hollow perforated annex to the regenerative chamber c may be dispensed with, and the tube f may, if convenient, be connected with the chimney instead of reaching straight instead of to the chimney for above the lamp. In a modification the combined



products of combustion from two or more such lamps pass to-gether at the lower central part of the stove in which the lamps are placed, and the regenerative hollow being provided with a gas inlet for producing the requisite draught. The invention is described as applied to a lamp with open flame.—Sealed 16, 1861.

Curious Experiment in Magnetism.—The following experiment is described by M. Oberbeck, in communication to the Academie des Sciences: "Two magnetic needles are hung vertically by fine threads, their upper poles being opposite one another. Below them is a vessel containing water, its surface not quite touching the lower needle. They are hung so far apart as not to move toward one another. The surface of the water, blown quickly aside by bellows, forms quantity of flow in from below. As soon as the water covers the lower ends of the needles they begin to approach one another, and when they are nearly immersed they rush together. This effect appears to be due to the fact that the gravitation force downwards is counteracted by the upward hydrostatic pressure, due to immersion, the magnetic force, being relatively greater, is able to assert itself.

magnétique ayant été mesuré au moyen d'un compas à miroir, on compensa l'action déterminée par l'hélice précédente au moyen d'une seconde hélice, et le barreau fut ensuite chauffé de 20° à 140° C., au moyen de courants d'huile chaude. Après une première aimantation, on rétablit successivement l'intensité du courant au moyen de résistances croissantes, introduites dans le circuit, afin de pouvoir mesurer le magnétisme rémanent, et on achèvera de démagnétiser au moyen de courants alternatifs plus faibles. On répéta l'expérience aux trois autres barreaux avec des actions magnétisantes moins énergiques, et on arriva aux conclusions suivantes :

1° Le maximum d'aimantation d'un barreau correspond à sa température la plus élevée, et cet effet est d'autant plus caractérisé que la force magnétisante est moindre. A 140° le maximum est de 3 o/o plus petit.

2° Si les courbes de magnétisation aux températures $t = 20°$ et $t' = 140° - 150°$, sont déterminées en prenant les moments magnétiques comme abscisses, et les forces magnétisantes comme ordonnées, l'abscisse du maximum correspondant au point très près les trois quarts de sorte qu'il existe un degré d'échauffement qui correspond au maximum d'aimantation.

3° En chauffant et refroidissant lentement à plusieurs reprises le barreau, les courbes de magnétisation pour les températures basses vont en s'élevant, et en s'abaissent pour des températures élevées, sation pour les températures basses vont en s'élecorrespond au maximum d'aimantation.

Ce travail est un peu maigre, et nous engagerons ceux de nos lecteurs que cette question intéresse, de se reporter aux travaux de M. Gaugain que nous avons analysés dans le tome II de ce journal, p. 365 et 489. On y verra que ces conclusions avaient été déjà formulées par lui, et on y trouvera même l'indication des deux effets inverses qui viennent d'être signalés. Voici, en effet, ce qu'il dit à cet égard : « Si on élève graduellement la température du barreau, jusqu'à ce qu'il prenne la teinte bleue, *on constate que l'aimantation grandit d'abord, atteint un maximum, puis subit une rétrogradation.* » Il discute ces effets d'une manière bien autrement intéressante que le physicien allemand, et nous sommes étonnés que des savants aussi sérieux, aient étudié les travaux recherches, n'aient pas mentionné travaux plus complets que tout ce qui a été fait jusqu'à présent.

Influence de la température sur la distribution du magnétisme dans un aimant permanent.

Ce que nous venons de dire précédemment, relativement au mémoire de M. Weinhold, qui conclut, qu'un aimant cylindrique de 80 centim. de longueur, sur 0,5 mm. de diamètre, chauffé plusieurs fois à la température de 250° C. et ensuite refroidi à la température ambiante, ne présente pas la même distribution magnétique avant et après le chauffage, et qu'à 14 ou 15 centimètres du pôle nord, la puissance magnétique est plus forte qu'à 28 centimètres, etc. M. Gaugain a mieux précisé les faits, car il montre que des aimants qui ont subi plusieurs alternatives de chauffage et de refroidissement, subissent deux sortes de modifications, l'une permanente, l'autre passagère. (Voir t. II, de ce journal, p. 489.)

Bibliotheca Phil. Journal Jan 1 1824

On the Permanent Magnetism of Hard Steel, and the Influence of Concussion.—II. Eight hard pieces of steel were permanently magnetized and the decrease of the permanent magnetism was observed on their being submitted to concussion. The same process was repeated three times. The magnetism was never inverted as is the case with soft iron. The decrease is less smaller the greater the original magnetism. Soft iron behaves in a manner exactly opposite.

Menlo Park Scrapbook, Cat. 1025

No. 17. "Magneto Electric Generators"

This scrapbook covers the years 1873-1881, but most of the clippings are for 1879. The material relates primarily to generators. There are also a few clippings relating to the electric light. The book contains 133 numbered pages.

Blank pages not filmed: 49-50.

Magnets Electric General 1025

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ELECTRICITY AS A MOTOR.

NEW YORK, August 27, 1880.

TO THE EDITOR OF THE HERALD:—

Professor Paget Higgs, author of the communication on "Electricity as a Motor," printed in this morning's HERALD, is well known as a distinguished scientist who has compiled from the various newspaper and other publications several most interesting and valuable works on electric lighting and electro-dynamics in particular, and his opinion, therefore, has more weight than attaches to that of the professional gentlemen who endeavor to upset the teachings of practical by narrating the visions of theoretical electricity. I make these observations because Professor Higgs is not so well known here as in England, and might, consequently, owing to the fact that his specialty is not electricity, but another branch of science, be classed among the many gentlemen of other professions in this country who take to electricity and the solution of its most difficult problems as naturally as the average humanity to H2 O.

Probably the most advanced work on theoretical and practical electricity in existence is that of Professor Sprague, a careful, conscientious investigator, whose researches and deductions are of incalculable value to science; and yet there are few works less widely known and understood. That portion of his masterly production which relates to the conversion of power into electricity and electricity into power sets forth with great clearness the conditions and actual facts of such conversions. Any person who will study this work so as to comprehend it will find it entirely in accord with my own assertions, based upon practical experiments, and the fuller his comprehension of the facts and ideas set forth by Sprague the greater will be his respect for the author's ability and the clearer his conception of enthusiasts and "amateur professors," whose chimerical announcements tend to degrade this science to the level of perpetual motion and Keely-motorism. I merely refer to Sprague because I know you have not the space to spare for the extensive quotations necessary to elucidate this subject and because his "Theory and Practice of Electricity" is obtainable at the leading importers of foreign publications in New York.

I adhere to all I have heretofore stated regarding the employment of electricity as a motor and accept Professor Higgs' conclusion that I must either modify my statements or deny the possible accuracy of the gentlemen opposed to me, but not their veracity. Erroneous premises and apparent results have been accepted as actual, and hence a long list of mistakes. If, instead of resorting to abstruse algebraic calculations, which will never satisfy the general mind, the converters and reconverters will take a steam engine and a pump and, keeping the steam pressure and speed constant, will demonstrate how many gallons of water can be raised so many feet high in a given time—say six hours—and if, then, they will attach the steam engine to a dynamo-electric machine and connect this generator with another dynamo machine and attach the latter to the same pump, and, keeping the pressure and speed the same, demonstrate how many feet high the same quantity of water will now be raised in the same time, they will do something the public will comprehend and acknowledge as conclusive. There will be room neither for cavil nor for deception. Such a test would show exactly the loss in power, and I would offer to make it myself, with my own generators, were it not that inefficiency of machines would beyond doubt be urged as a reason for failure to recover more than twenty-five per cent of the power in the second machine. I may be wrong in this, but will venture the prediction that not one of the gentlemen affected will accept this proposition for a public test and by competent engineers, they to use any steam engine and pump whatever, any dynamo machine to generate the current and any dynamo machine or simple electro motor to recover the power converted into electricity by the first machine. Nor should there be any restrictions as to the manner of gearing, belting or otherwise connecting the different apparatus. And if the second dynamo machine will raise more than twenty-five per cent of the water that the steam engine will raise to a given height when the latter is attached directly to the pump, I will engage in some other profession, for it will then be apparent that this one is too much for me.

Professor Higgs is doubtless correct in his view that much (some would say all) of the energy of a steam locomotive is applied in moving it. I never had any very grave doubts upon that point. It is well known that weight in the locomotive is usually proportioned to the train mass it must move, and it is curious sometimes to observe the antics of a light engine in moving a heavy train. To obtain the same traction on the rail it is difficult to understand how any electric engine can be much lighter than a steam locomotive, and therefore how its inertia would be more readily overcome. The tax upon the power of the steam locomotive to move its tender might be left out of the account in view of that required to move the entire mass of locomotive, tender and train. It would certainly fall short of the loss of electricity occasioned by rapidly changing and imperfect points of contact.

In concluding his communication Professor Higgs states that he has had "not the least difficulty in transmitting ninety-eight horse power a distance of nearly three miles at a higher rate of efficiency than fifty per cent—*i. e.*, recovering more than forty-nine horse power—on a conductor of one-quarter inch diameter." It would be interesting to know how this was done, and if the Professor will kindly furnish a few of the data he will be conferring a favor on the public. The data I would suggest as pertinent to the case are:—

First—The style and size of generator used by him; the size of wire on the armature; the resistance of the armature coils and the resistance of the coils of the field of force magnets, and the size of the wire on the magnets.

Second—The same of the dynamo machine used to reconvert the electricity into power.

Third—The actual distance the power was transmitted and resistance of the one-quarter inch connecting wire, and whether he employed ground connections or a metallic circuit; and if he employed ground connections, the surface of the same exposed to the earth at each end?

Of course Professor Higgs will not hesitate to furnish these data, because their possession by the HERALD might lead to a speedy demolition of the arguments advanced against any such recovery of power.

W. E. SAWYER.

THE TELEGRAPHIC JOURNAL.

(VOL. V.—No. 102.)

BATTERIES *VERSUS* MAGNETO-ELECTRIC CURRENT MACHINES.

THE relative values of batteries and magneto-electric current machines for telegraphic and manufacturing purposes is a question which has excited considerable difference of opinion in the electrical world.

The word "battery," although it does not convey a definite idea to the unscientific mind, nevertheless is well understood by electricians and telegraphists to signify an arrangement for generating electricity by means of chemical action, whilst the expression "magneto-electric machine" is understood to represent the idea of an apparatus for generating electricity by mechanical force.

As regards the telegraph system, so long as the employment of the telegraph was limited, and the number of instruments in an office was consequently also limited, the annual cost of maintenance of batteries formed but a comparatively small item in the general working expenses of the establishment; but, at the present time, when the number of instruments at head offices may be numbered almost by hundreds, the substitution of mechanical for chemical power becomes a question which may not be passed over without consideration.

The question, when carefully considered, resolves itself into one of £ *s. d.* Can electricity, for working telegraph instruments, be produced the more economically by batteries, or by magneto machines? To answer this query, several points must be considered. Setting aside the employment of magneto machines at small offices, we will confine our attention to their use at large offices, where some hundreds of battery cells are employed.

To work a number of instruments properly, we must have the means of varying the electric power according to the requirements of each circuit, the shorter circuits requiring obviously less power than the longer ones; climatic considerations may alter conditions, and we may require to add power to the circuits should their insulation fall low.

In order to adjust the current for various circuits we must either have a particular machine for each circuit, or a machine for a set of circuits whose working capacity would be about the same, or, lastly, one large machine to work the whole number of circuits, with an arrangement of resistances to equalise the power, so that the short circuits may not draw off too much of the current from those of a longer length.

Now, to employ a machine for each circuit would involve a heavy expense, as regards prime cost compared with the cost of batteries. Supposing an engine was employed to drive them all, this means expensive shafting and driving bands; and, again, this must be so arranged that the speed of any particular machine can be increased should the power for the circuit to which it is attached be required to be increased. If the machines be adapted to sets of circuits, a fault giving earth on one circuit would be sufficient to stop all the others. This objection would hold still more if one machine were employed to work all the circuits. The possibility of a break-down of a machine where one or only a few were used would be a very serious matter, as it would mean the stoppage of a large number of circuits. When a battery is employed for each instrument the chances of stoppages of several circuits are very small, and these can always be provided against by spare batteries, which can be applied to any particular circuit which may require them.

With reference to the application of electric power to manufacturing purposes, such as electro-plating, the purification of sugar, the electric light, the transmission of power to a distance, &c., where a very strong and steady current is required to work through a low resistance, there can be but little doubt but that magneto machines have an overwhelming advantage over batteries (as at present constructed), but this advantage may, at some future day, go the other way, as it seems likely that an enormous source of electric power may be found in the waste chemical products which are at present so difficult to get rid of.

Tel Journal
Feb 15 78

3187. "Magneto-dynamo electric machine."—PAUL JABLOCHKOFF, Paris. Dated August 22. 6d. The principal feature of this machine consists in making the armature consist of two soft iron discs, or mounted on an iron axis, with the coil between, so that the core takes the form of two iron cheeks, connected by the bar of the axle. These cheeks are caused to revolve, and the coil remains stationary or revolves with them. The cheeks are magnetised by external magnets inductively, so that each cheek is polar at its centre and circumference. To facilitate this inductive magnetisation, the periphery of each disc is formed into tooth-like projections which are attracted by the poles of the magnets. A tooth of one cheek is situated so as to come between two teeth of the other.

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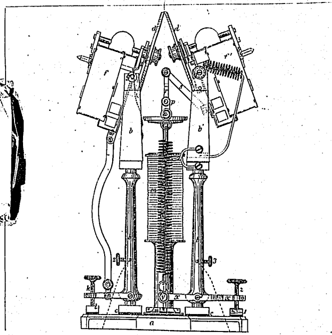
telegraphist may at pleasure send the currents so as to transform into positive pole either the pole on the right or that to the left of the electro-magnet, the south pole of the small bar A may at the will of the operator travel either to the right or to the left, and consequently touch either the spring G, or that, F. The small bar A being in metallic contact with the fork B by the intermediary of the small block or small blocks of steel, the fork B being in connection with one of the poles of a local pile, the spring F with the electro-magnet *a* (see fig. 5), the spring G with the other electro-magnet of the other interrupting relay, which is not seen in fig. 5, and these two electro-magnets being in connection with the other pole of the same local pile, the result is, that when the south pole of the small bar A touches the spring F the armature *b* is attracted and the spring *c* touches the button or stud *d*, and when the south pole of the piece A touches the spring G the same manœuvre is produced upon the other interrupting relay. Now the knob or stud *d* being in connection with the terminal *l*, which is itself in connection with the electro-magnet H by the intermediary of a terminal (see figures 5 and 6), the spring *c* being in connection by means of the terminals *k* and *r* with one of the poles of a second local pile, and the other pole of this pile being in connection with the electro-magnet H, the result is, that at each contact between the spring *c* and the knob or stud *d* the armature K is attracted, and the spur wheel L prints a red dot upon the strip of paper.

(*To be continued.*)



THE REGNIER ELECTRIC LIGHT LAMP.

THIS ingenious form of lamp, of which we give an illustration, possesses very distinct points of novelty from those which have been previously designed. Abandoning the carbon points, M. Regnier employs two circular discs of carbon, inclined towards one another, so that the voltaic arc passes between their edges. By keeping the discs in slow but continuous rotation, fresh portions of the edges are presented

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Tel Journal Feb 1st 78

270. "Improvements in apparatus for generating electricity."—CROMWELL F. VARLEY, dated Jan. 10, 1877. 8d. This invention has for its object the production of electricity, by which electrostatic discharges and dynamic currents of sufficient potential to generate ozone, produce chemical decomposition, the electric light, and other electrical effects, can be obtained and maintained when desired, as in the production of the electric light. It consists of a magneto-electric machine for generating currents, and an improvement on the author's machine (described in Patent No. 206, 1860), by which accumulating charges are stored upon inductive surfaces and on rotatory dielectrics so as to enable sparks of considerable length to be obtained. These sparks are employed in the electric light to re-establish the circuit between the carbon points when accidentally or momentarily interrupted. The magneto-electric machine and electrostatic multiplier are employed together in producing the electric light. The machine gives rise to an electric arc between the carbon points, and the multiplier renders it constant by placing its poles close to the carbon holders so that a stream of sparks may pass to them constantly so long as the light is being maintained. The high tension electricity, which in this manner is caused to pass between the carbon points, maintains the magneto-electric discharge.

Tel. Jnl Feb. 1. 78.

At the meeting on Tuesday, Jan. 22nd, Mr. BATEMAN, President, in the chair, the paper read was on "Some Recent Improvements in Dynamo-electric Apparatus," by Dr. HIGGS, Assoc. Inst. C.E., and Mr. BRITTLE, Assoc. Inst. C.E.

The authors commenced with a brief review of the rise and progress of this branch of electricity.

A description was then given of the latest construction of Siemens' Dynamo-Electric Machine and Electric Lamp, the latter devised specially for lighthouse illumination, and similar lamps were about to be supplied for the Lizard Lighthouses. The dimensions, weights, number of revolutions made by the cylinder, light equivalent in normal candles, and H. P. required for driving were, for three sizes of machines—

Dimensions in Inches.			Weight in lbs.	Revolutions of Cylinder.	Candles Light.	H.P.
Length.	Width.	Height.				
25	21	8·8	298	1,1000	1,000	1½ to 2
29	26	9·5	419	850	4,000	3 to 3½
44	28·3	12·6	1,279	480	14,800	9 to 10

In the application to lighting purposes the improvements in the present dynamo machines were very great. Thus, with a cost 10 times, with a weight 14 times, and a volume 25 times that of the latest construction, the old form of the machine produced one-fifth of the light, with an expenditure of practically the same driving power.

The results of experiments with the Electric Light Apparatus by Capt. ABNEY, R.E., at Fort Monkton, in July, 1875, were given.

An important factor in the light efficiency of a given machine was the resistance of the circuit leading to the lamps. Experiment indicated that, to obtain a maximum of light, the resistance of the conducting wires should be proportioned to that of the machine.

Much excitement had been evinced as to the probable competition between gas and electricity, as sources of light power. Although, under certain circumstances, these two agents undoubtedly came into competition, they had two separate fields. Hitherto gas had been employed for lighting spaces of both large and small dimensions, because a better source of light for large spaces had not been procurable with economy. But for lighting large spaces not subdivided by opaque objects or screens, it was a want of economy to employ gas. Assuming light power proportional to H.P. expended, 100 H.P. would give 150,000 candles' light; distributed from three points, the cost would not be more than £1 2s. 6d. per hour, each light-centre giving an illumination which would enable small print to be read at a distance of a quarter mile from the light. A burner giving the light of 20 candles consumed 6 cubic feet of gas per hour, which might be manufactured at a cost of 2s. per 1,000 cubic feet. This gave 7,500 burners' light only, and 45,000 cubic feet of gas at a cost £4. 5s. per hour, a ratio of 4 to 1 in favour of electric lighting. The economical ratios differed greatly, being dependent chiefly upon the price of gas and of the motor power employed. For large spaces the cost of electric lighting was about one-fourth or even one-fifth that of gas-lighting, when steam had been used as power, and wear and tear were reckoned.

At Messrs. Siemens Brothers' Telegraph Works the economy was as 2 to 1 in favour of electric lighting. If, however, the ratio of light-intensities were adopted as the ratio of efficiency, the advantage would be considerably higher (20 to 1) in favour of electric lighting. It might be laid down as proved by experience, that for lighting large spaces, not too much subdivided, the advantage was greatly in favour of the electric light; but that where numerous light-centres of small intensity were required, or where the space was much subdivided, the advantage was in favour of gas. This advantage would cease when a practical method of subdividing the electric light was obtained.

The limit set by distance to the transmission of power, by means at present adopted, had been comparatively narrow. Hydraulic power had been the most adaptable, with, however, several important disadvantages. Although electricity as a means of transmission was also limited by the distance to be traversed, the limit was in this case much more extensible, and under favourable instances practically disappeared.

The employment of the currents of magneto-electric machines for electrotyping and electroplating had long superseded the voltaic current. It was, however, only on a large scale that the current from a dynamo machine could be used with advantage. For small electro separations, or depositions, magneto-electric machines had been constructed. For the deposition of large quantities of metal, where by changing baths in succession little change was made in the total circuit resistance, the dynamo machine gave much greater economy. With one of these machines, and a proper succession of vats, as much as three tons of copper had been deposited daily.

Electrical news July 1. 1875.

Journal de Physique, May, 1875.

On Currents of Mechanical Origin.—M. Bouty.—The author has shown that the intensity I of a current, produced by expenditure of *r* kilogrammetres per second, in a circuit of total resistance, R is represented by the formula

$$I = \sqrt{\frac{r}{R}}$$

Some of M. Rossetti's recent experiments with the Holtz machine seem in contradiction with this. M. Bouty seeks to prove that they are not really so. The mode of production of energy generating the current of the Holtz machine is quite different from that in batteries. In the latter, the charge produced per unit of electricity transported is constant, and this is why Ohm's law applies: in the former, the energy expended per unit of time is fixed, and Ohm's law has to be replaced by the formula above, along with another, viz., $r = \phi(I\nu) + RI^2$: $\phi(I\nu)$, being a function of the intensity of the current and the speed of rotation.

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Tel Jnl Apl. 78

THE ACCUMULATION BY REACTIVE PRINCIPLE OF DYNAMO-ELECTRIC CURRENTS has been the subject of a recent controversy in the columns of one of our contemporaries. From this discussion it appears that the principle of accumulating electricity in magneto-electric machines by echoing the electricity excited in the revolving armature in turn to intensify the exciting electro-magnets has been almost simultaneously applied by Dr. Werner Siemens, Professor Wheatstone, and Mr. S. A. Varley. Mr. Robert Sabine has summed up the respective claims of these gentlemen in the following words:—"The date when an undeveloped idea of making any machine first occurs to an inventor is of very little comparative importance, unless the idea be productive of some evidence of its being, without which one would certainly be inclined to suspect that memory might alter the lapse of years by a little treacherous. Who had the first happy inspiration of a reaction machine no one scarcely expect to know now. Of its fruits we have better evidence, and I venture to think that the claims of the three inventors in question stand then—Professor Wheatstone was the first to complete and try the reaction machine; Mr. S. A. Varley was the first to put the machine officially on record in a provisional specification dated Dec. 24, 1866, which was therefore not published till July, 1867; Dr. Werner Siemens was the first to call public attention to the machine in a paper read before the Berlin Academy on the 17th of January, 1867." In connection with this subject our attention has been called to a forgotten English patent, No. 2198, of the year 1854, and in the name of Moses Ugarth, Copenhagen. This patent clearly sets forth the mutual accumulation principle of magneto-electric machines as will be seen from the following extract:—"The main feature of this battery consists in applying one, two, or several permanent magnets of cast iron, and shaped as above, in connection with an equal number or more electro-magnets, shaped as indicated in drawing, in such a manner that the currents induced in the coils of the revolving armatures are allowed to pass round the electro-magnets; consequently, the more the electro-magnets are excited in the said manner, the more will the armatures be excited, and more electricity of course induced in the respective coilings; and while a mutual and accelerating force is thus produced in this manner between the electro-magnets and the armatures, an additional or secondary current is at the same time induced in the coiling of the electro-magnets by the motion of the armatures, the said current flowing in the same direction as that of the primary current after having passed the commutator." This important patent evoked provisional protection only, because notice to proceed was not given in the time prescribed by the Act.

Tel Jnl Feb-1878

492. "An improved apparatus for generating electricity and motive power."—PAUL JABLOCHKOFF, Paris, dated Feb. 5, 1877. 6d. This consists in a novel form of voltaic battery, in which the current is produced by the reaction of fused nitrates upon carbon and zinc rods, the latter constituting the negative pole, and the former the positive pole. The gas generated is the result of combustion, and is utilized as a source of motive power by conducting them in a closed pipe from the cells to a reservoir. There, gases are similar in their nature to those produced by the explosion of gunpowder.

Tel Jour Dec 1. 73

Regulating, and Directing Electric Light, part of which is Applicable to other Purposes. Dated February 19, 1873. My invention consists, firstly, in improvements in the electro-magnetic induction machine described in the specification of No. 841 (1867). In the present improvement the bobbins in which the currents are induced, instead of being wound round the armatures, are coiled round the extremities of the iron cores of the electro-magnets, which are prolonged for that purpose, or have iron cores fixed thereto, and an iron yoke, or keep, the periphery of which is divided into as many segments as there are electro-magnets in each series, serves to receive between the circles of stationary electro-magnets and coils for the purpose of generating electric currents. My invention consists, secondly, in improvements in the apparatus for regulating the apparent of the carbons used for producing the electric light as they are consumed by the current. In this improvement the carbons are made to approach and to separate from each other by means of a right and left handed screw, connected with the carbon holders. Each of the screws, with its carbon holder, can be actuated independently of the other. My invention consists, thirdly, in apparatus for directing and projecting the electric light upon distant objects. In this improvement the light is concentrated into a single beam by means of a bull's-eye, or double reflector mounted on a pedestal, on which is also placed the regulator above described. The whole apparatus retains whatever position is given to it both horizontally and vertically without the use of any locking movement.

Tel Jour Nov 15, 76

Professor W. A. Anthony, in the course of a recent series of experiments with an electro-magnetic machine of the Gramme pattern, made the following interesting observations:—The electric machine was driven by a five-horse Hayden petroleum oil-engine. The engine consumed a little over six-and-a-half lbs. of crude petroleum per hour. The lamp used in the engine, by which the explosive mixture is fired, had a one-inch flat wich, and consumed 278 grammes (450 grains) of oil per hour. The power resulting from the motion of the engine, when applied to the electric machine, produced a stream of electricity or electric light having an illuminating power equal to that of 234 of the lamps mentioned, showing that three times more light may be produced from a given quantity of oil, if its energy is converted first into mechanical power and then into electricity, than if the oil is directly burned in a lamp.

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JULY 15, 1878.] THE TELEGRAPHIC JOURNAL.

THE ELECTRIC LIGHT AT NOTTINGHAM.

LAST night at 10 o'clock, in accordance with the arrangements made by the borough engineer, Mr. Tarbottom, Messrs. Siemens Bros., exhibited the electric light at the Health Committee's Wharf in the East Croft, London Road. The light was similar to that exhibited in the Market Place and at the Castle on Wednesday. The effect in and adjoining the wharf was satisfactory, every point being clearly illuminated. A number of gentlemen had been invited to attend on the occasion. Amongst those present we noticed Mr Councillor Lindley (ex-Sheriff), Mr. Ald. Lambert, Mr. Ald. Woodward, Mr. Ald Ford (Chairman of the Health Committee), Mr. Councillor Walker, Mr. Councillor Tutin, Dr. Benton (Medical Officer of Health), Mr. W. Richards (Chief Sanitary Inspector of Nottingham). After the electric light had been exhibited for some time, those present retired to an adjacent office, when Mr. Tarbottom stated that originally it was intended that Messrs. Hall & Co. should illuminate, by means of their light which had been used by the French and English Governments. Large manufactories in Paris had been illuminated by electric lights, and it had been considered advantageous to apply it to those premises in order to see the effect of the application, in consequence of the results which had been produced in Paris. Messrs. Hall and Co., however failed to come forward, but fortunately the promotery managed to fall back on the firm of Siemens Bros., who made the necessary arrangements there in 18 hours. One of the lights was exhibited in the Market Place, and another at the Castle on Wednesday night, but those present had been invited to inspect the light as it was exhibited at the Works of the Health Committee.—*Nottingham Daily Express.*

We may remark that the apparatus employed by the English Government is the same as that exhibited at Nottingham, namely, Siemens' apparatus; and that several manufactories in England now employ Siemens' electric light in preference to gas.

REPORT OF THE AMERICAN COMMITTEE ON DYNAMO-ELECTRIC MACHINES.

THE Board of Managers of the Franklin Institute having empowered its Committee on Instruction to purchase a Dynamo-Electric Machine, it was deemed advisable to examine into the merits of, and to test, the various machines offered for sale. This was undertaken partly as a guide in making a selection for purchase, and also to obtain reliable data regarding the adaptability of such machines to the production of light.

In view of the scientific importance of the work, the Committee on Instruction, which consists of five members of the Board of Managers, availed themselves of the services of four other members of the same, who, by request, assisted in the investigations, and now join in this report.

The work was divided among sub-committees as follows:

1. On Photometric Measurements, Messrs. Briggs, Profs. Rogers and Chase. On Electric Measurements, Profs. Houston, Thomson, and Mr. Rand. (Mr. Rand's business engagements prevented his taking active part in the work of this sub-committee.) On Dynamical Measurements, Messrs. Jones, Bartain and Haight.

The source of power for the experiments was an upright steam-engine belonging to the Institute. It has 6" bore of cylinder, and 8" stroke, heavy fly-wheel 30" diameter, and governor so adjusted as to give speeds from 100 to 230 revolutions per minute.

The machines submitted to examination were as follows:—Their dimensions are given in Table I: A Gramme machine (similar in form to that given on page 191, Vol. V. of the *Telegraphic Journal*). A large and small Brush machine, which each have for their magnetic fields two horse-shoe electro-magnets, with their like poles facing each other, at a suitable distance apart, the circular armature rotating between them.

In each machine the currents are generated in coils of copper wire, wound upon an iron ring, constituting the armature. This ring is not entirely covered by the coils, as in the Gramme armature, but the alternate uncovered spaces between the coils are almost completely filled by iron extensions from the ring, these exposing large surfaces of the armature ring for the dissipation of heat, due to its constantly changing magnetism, as in the Pacinotti machine.

The ring revolves between the poles of two large field magnets, the two positive poles of which are at the same extremity of the diameter of the armature, and the two negative poles at the opposite extremity, each pair constituting practically consequent poles of opposite character.

The coils on the armature ring are eight in number, opposite ones being connected end to end, and the terminals carried out to the commutator. In order to place the commutator in a convenient position, the terminal wires are carried through the centre of the shaft, to a point outside the bearings.

The commutators are so arranged, that, at any instant, three pairs of coils are interposed in the circuit of the machine, working, as it were, in multiple arc, the remaining pair being cut out at the neutral point; while in the Gramme machine, the numerous armature coils being connected end to end throughout, and connections being made to the metal strips constituting the commutator, two sets of coils in multiple arc are at one time interposed in the circuit, each set constituting one-half of the coils on the armature.

The commutator consists of segments of brass, secured to a ring of non-conducting material, carried on the shaft. These segments are divided into two thicknesses, the inner being permanently secured to the non-conducting material, the outer ones, which take all the wear, are fastened to the inner in such a manner that they can be easily removed when required.

The commutator brushes, which are composed of strips of hard brass, joined together at their outer ends, are inexpensive and easily renewed. The high speed at which these machines are run, together with the form of the armature, save the rotation of the latter to be considerably resisted by the air, and producing a humming sound, but otherwise they run smoothly; the heating of the armature being inconsiderable, not exceeding 120° Fahr.

by drawing a down, breaks the earth connection. The cups which contain the mercury are formed by small portions of test tubes, the rounded bottom being slightly softened by heat, and pressed inwards by a suitable point, so as to form a hole of the proper dimensions. This forms the top of the cup, which resembles somewhat the top of a *soft-boiled egg*. The bottom of the tube is open and is cemented into a brass cup, as shown in fig. 2. Not only does this form of cup circumscribe any possible splutterings of the mercury, but the level of the mercury is also seen through the glass, and, since the sides of the instrument case are of glass, adjustments may be made without removing the cover. When, however, this is necessary, in order to fill the cups and fix the balance, it is readily done by removing the screws *g g*, when the cover, together with the plate *e*, may be taken off.

Although such a modification will materially reduce the efficiency of the discharger, it is evident that by varying the connections, and putting *A* in line and *a* to earth, *or vice versâ*, the balance, when attracted, forms a bridge between the two. By employing the mercury cups, however, the contact with earth is not always perfect, but there is less danger of the wires being fused together, as is not unfrequently the case with the ordinary *pistol discharger*. Moreover, as the instrument is dust-tight and firmly screwed down, the mercury contacts, when once adjusted, need furnish no source of inconvenience.

GRAMME'S ALTERNATING CURRENT MACHINE.

By ALF. NIAUDET.

It will be remembered that M. Jablochkoff endeavoured during several months to kindle his electric candles by means of currents from a battery, or from the ordinary Gramme machine. He succeeded in placing six candles in one continuous circuit, but could not get them to burn alight for more than twenty minutes at a time, owing to the unequal wasting of the carbons, and he therefore had recourse to alternating currents, which transferred the carbons alternately in opposite directions and wasted them equally, a plan which was a practical success.

This new demand obliged M. Gramme to produce a alternating current machine; and here it may be remarked that the invention of a continuous current machine is very difficult, and there are only two or three of them which are truly original; but the production of an alternating current machine is relatively easy.

M. Gramme, before arriving at the crowning invention which made his reputation, had patented a host of machines giving reverse currents, some of which are very interesting. He was therefore provided to furnish M. Jablochkoff the machine which he required.

Before entering on the description of this machine, it should remind our readers that the power of an electro-magnet is easily rendered much greater than that of a permanent magnet. Given equal volumes of machine with electro-magnets is much more energetic than one with steel magnets. M. Gramme, therefore, adopted electro-magnets for the new machine, although their use involved the employment of a special Gramme machine to supply the continuous currents necessary to magnetise them, since the alternating machine itself did not generate continuous currents. The alternating apparatus at now made consists, then, of two machines, the Exciter, as it is called, which excites the electro-magnets of the other, and is relatively small, and the Distributor, which furnishes the alternating currents in one or more circuits.

Of the Exciter we need say nothing here; it is simply the well-known continuous current Gramme. The Distributor is represented in end elevation and plan by figs. 1 and 2. A large "Gramme ring" fig. 1, is placed at the periphery. It will be remembered that this organ is composed of a soft iron ring, on which are wound, parallel to its axis, coils of cotton-covered copper wire. Whilst the ring of the ordinary Gramme machine is acted upon by induction from the outside, the ring in question is subjected to induction from within by eight electro-magnets which are fixed round an axis. The cores of these electromagnets are placed parallel to the axis, and radiate from the axis; and the wire is wound upon these cores parallel to the axis. The outer or inner poles of these electro-magnets are expanded so as to act on a larger extent of the outer ring. They are all excited by a continuous current from the Exciter in such a manner that the alternate poles are of opposite name, thus N, S, N, S, and so on. Now, when the system of electro-magnets is rotated round the axis in the centre of the fixed outer ring, each of the wires crossing the inside of the said ring, finds itself placed alternately between a north pole and the iron of the ring, and then between a south pole and the iron of the ring, that is, under contrary inductive influences. All these wires wound round the ring being fixed, they can be connected in different ways; but in actual practice they are arranged so as to make 9 sections, marked *a, b, c, d, e, f, g, h, i*, &c., as shown in the figure. These sections are connected in four groups, each of 8 sections or elements; the first being composed of all the sections marked *a*; the second of all those marked *b*, and so on. It will be easily seen from the figure that the 8 elements *a a* placed in the same position relatively to the eight poles of the multiple electro-magnet, which turn in the middle; and from this it will be seen that these 8 elements are grouped together because at each instant they are traversed by currents of equal intensity. It will be seen, too, that it would be easy to divide the eight parts of the 4 sets (*a, b, c, d*) into more than four sections; for example into eight sections, thus giving eight instead of four distinct currents. The dimensions given are in millimetres.

The intensity of these alternating currents of course varies with the intensity of the electro-magnets and the speed of rotation of the central armature. For large machines, feeding 16 or 20 candles, the speed amounts to 600 turns per minute, and consequently there are 600 by 8, or 4,800 reversals of currents per minute.

In small machines, feeding four candles, the speed

NEW CONTINUOUS CURRENT MAGNETO-ELECTRIC MACHINE.

By ALFRED NIAUDET.

I HAVE explained Gramme's machine to the readers of *La Nature* in the numbers for the 1st November, 1877, and 30th January, 1875. If you refer back to these two articles, and to a pamphlet which I have published on the same subject, you will perceive that the invention of Gramme comprehends two distinct parts.

The first relates to a new method of producing magneto-electric currents, and I have clearly shown in what points this machine differs from that of Pixii or of Clarke. I have stated that there at present exist two classes of magneto-electric machines, those of the type of Pixii better known by the name of Clarke, and those of the type of Gramme.

The second part of the invention consists in a new method of collecting the currents, or, in other words, in a combination which takes the place of the commutator in the old machines. This chief distinction in two points of the invention of Gramme is so far established that M. Worms, of Romilly, could conceive the first without the second, as you can see from the communication made by him to the academy, following that of M. Gramme.

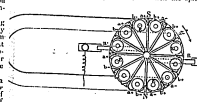
"This division once thoroughly established, it is natural to ask oneself if you cannot apply to a machine of the Clarke type the same method of collection which we find in the Gramme's machine? I have been thus brought to realise a new magneto-electric machine, giving continuous currents. This machine has been thought of by several persons; but I think I am able to say that I was the first to take up the idea, for we have, on the 12th January, 1872, a patent taken out, which every one can read, in the report published by the Minister of Commerce.

"These machines were constructed about this time, and we have had occasion to exhibit them before a great number of persons."

DESCRIPTION OF THE RUDIMENTARY APPARATUS.

On the circular plate, PP, perpendicularly to its plane, are placed at equal intervals around the axis AA, a series of straight electro magnets. This system is placed with respect to the poles, N O S, as shown in the figure, and is movable around the axis. The apparatus can be regarded as a Clarke's machine, sextupled, as this machine consists, as a rule, of a magnet and a system of two movable bobbins. The bobbins of the electro magnets are all connected one with the other, the inside end of one being joined to the outside end of the other, exactly the same as a series of galvanic elements would be joined together to form a battery, that is to say, the positive pole of one element to the negative pole of the next.

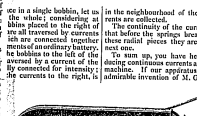
When the plate turns in the direction of the arrows, this is what takes place in each of the bobbins: In proportion as the distance of the bobbin from the North Pole, N, increases, a current is developed, the positive pole of which is at the east side end, a+, and the negative pole on the inside end, b—, and this current remains the same whilst the bobbin travels from the pole N to the pole S. As for the approaching the pole S has the same



ce in a single bobbin, let us in the neighborhood of the axis, where the cur- the whole; considering as rents are collected.

bbins placed to the right of The continuity of the current results from this; are all traversed by currents that from before the springs touch contact with one of ents of an ordinary battery, these radial pieces they are in contact with the ts bobbins to the left of the next one.

To sum up, you have here an apparatus producing continuous currents analogous to Gramme's machine. If our apparatus, proceeding from the admirable invention of M. Gramme, does not pos-



sum of the currents to the ative bobbins may be com- of six elements each, with ut, or if the two extremities connected with the points elements are opposed, it is urrents of the two batteries, d up for quantity.

The currents developed in ave described, it is necessary to fix springs which touch the points connecting the several bobbins together, at the instant they pass the line of the poles.

If the same reasons which guided Gramme in the construction of his machine, we have placed pieces of metal radiating from the centre, which communicate with the points of junction of the bobbins, on which the springs R are made to rub

sess much originality, it will, perhaps, have the advantage of explaining more clearly the working, which is difficult enough to understand from the machine used by him as a model.

Certain reasons, which it is difficult to explain here, will show that Gramme's machine is superior to ours. It is not impossible, however, that the latter would be employed in cases where a great tension and very little quantity is required. When you wish to establish telegraphic communication

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VARLEY'S MAGNETO-ELECTRIC MACHINE.

The principle and chief features of novelty in this machine mainly consists in employing natural or permanent magnets, in combination with the electro-magnetic armatures. The magnets are the poles of the revolving magnets. The magnets are surrounded by bobbins, and upon rotating the armature the electro-magnetic current induced in the armature or electro-inducing coil is sent, by means of a commutator, through the coils of the magnets, and simultaneously, direct communication with armature or electro-inducing coil is established, so that the currents induced in the armature, when raised and rendered powerful by the combined magnetic action of the magnets, part of the current is sent through the coils of the magnets, and part through the line wire, or other circuit, in which the latter are placed. The armature or electro-inducing coil is wound in the machine in connection with the magnets, so that every part or coil of work does its full share of duty.

The machine on this principle, has been placed opposite one another, and with two armatures placed between them, so that the magnetic poles of each magnet face their poles. This two armatures, one of the cores, and the two south poles are together, while the two north poles are together. The armatures, which are fixed parts of the apparatus, have a commutator, which is fixed to the spindle, and which is automatic, which places it first in contact or nearly in contact with one armature, and then with the other, transfers it to a corresponding position in respect to the other armature, and then back again, and so on, in such a manner as to bring the armatures into proximity, and leave them at the proper moment, so that the attraction of the magnets on the armature may also be made double, so that the poles of the magnets may be placed at a greater distance apart. The attraction of the magnet for the two armatures is thus made to act in the same direction, and by a screw adjustment the surfaces of the armatures may be brought very near to the poles of the magnets, without giving rise to friction. In place of the commutator, a reciprocating armature may be employed, or a tuning fork may be employed to connect and disconnect the work

pole of one magnet with the south pole of the other, and as it rotates to couple the poles alternately.

In Figure 1, N and S² are horse-shoe magnets; permanent magnets are represented but electro-magnets are also available. Between the magnets and in with them are two cores of soft iron wound with coils of insulated wire C, C¹; they form part of the circuit or circuits in which the electricity generated by the apparatus is transmitted. S, S, and S¹, S¹, mark the poles of the magnets N and S². O, O, are guides made of gun metal in which the rod B is free to slide to and fro; it has upon it the armature of soft iron marked A. A reciprocating movement may be communicated to the armature between the guides O by connecting the rod B directly or indirectly with a steam engine or other motor. It will be observed that in this arrangement the reversal of the magnetism in the armature A takes place.

Figure 2 is an end view of the armature A shewing how it is grooved into the horns of the permanent magnets N, S². Figure 3 shows the rotating armature arrangement. The armature is mounted upon a rotating axis B, and as it revolves it alternately closes the pole N with S¹ and S² with S. In this arrangement the reversal of the magnetism in the armature A takes place.

FIG 1

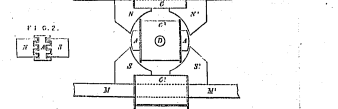

FIG 3.

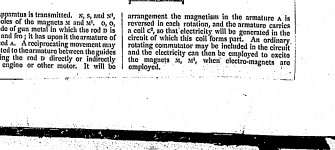

FIG 2.

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4748. "Magneto-electric Machines."—E. Weston, New York, U.S. Dated December 14, 1877. 6d. This consists in improvements in Wheatstone machines, described in a prior patent, No. 4280, of 1876. These are the combination with a commutator of two levers attached to a pivoted disc, whose axis coincides with the axis of the commutator studs, the disc being provided with one or more set screws, whereby it may be clamped in variable positions, for the purpose of regulating the strength of the current. Also a device for automatically closing and breaking the circuit, by means of a disc attached to a studs, which has its bearing in the end of a pillar, and is rotated by means of a belt from the shaft of the machine. The disc contains two radial slots, each of which contains a sliding switch block, which is pressed inward toward the axis of the disc by an adjustable spiral spring. These blocks rest against a metal link, when they yield to the action of the springs. When the speed of the machine falls below a certain rate, the switch blocks form an electrical contact with the hub, and the current from the machine is short circuited. On the contrary, when the desired rate of speed is attained, the current is sent through the line into the electro-typing vats, &c.

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162. "Producing and applying magneto-electricity."—W. R. Lake (communicated by James J. McTighe, Pittsburgh, Penn., U.S.) Dated January 12, 1878. 6d. This invention consists in producing currents of magneto-electricity in coils by the vibratory motion of one or more magnetic poles in the vicinity. These vibratory currents can be utilised to reproduce vibratory motion or for telephonic purposes. One mode of producing the currents is to set upon a thin magnetic pole by a toothed wheel so as to set it in vibration when it generates undulatory currents in the coil beside it. The vibrations of the voice or the force of a steam jet may also be used to vibrate the thin pole, which can be made in the form of a vibrating diaphragm. Economy of power is claimed for this method, as it will not be necessary, for the production of intense currents, to whirl large masses of iron. A speaking telephone, consisting of a tubular magnet bent into a horseshoe form and having the coil between its poles is also described. One end of the tube is an open mouthpiece, the other end is closed by a vibrating iron diaphragm, which vibrates before the coil, the latter being fixed to the other pole.

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On Freak Improvements upon Magneto-Electric Machines.—J. T. Graham.—Compared with his model of 1872 his new model for this year possesses many advantages. This galvanoplastic machine has now only one central ring instead of two, and two bar electro-magnets instead of four. Its weight is 177 kilogrms., that of the copper ring and the electro-magnet bars 50 kilogrms. The dimensions are—0·53 m. wide, 0·60 m. high. In comparison with his 1872 model this last one possesses the following advantages:—(1.) Half the size. (2.) One-seventeen the weight. (3.) The copper used in its construction reduced to three-quarters. (4.) The motive force necessary to work it is much reduced. Three improvements are obtained by the suppression of the rheitor habitually by putting the electro-magnet in the circuit itself of the current; by a better arrangement of the copper portions of the electro-magnet bars; and by a slight increase of speed. "The electro-magnet setting, which I used to make with round wire, is now formed of a band of copper half the width of a bar magnet. The arrangement of putting the electro-magnet in the circuit has given rise to a change of pole, which I have been obliged to enact. When the machine are in motion, and the circuit closed by metallic baths, the poles remain the same; but as soon as a catch or a stoppage takes place, accidentally or by design, the poles change, so that if the machine be again put in motion without re-arranging the conductors as *inverse* work will be performed. For telephonic purposes, of alternating the objects for the baths, it will be observed. To obviate this inconvenience I cause the machine to be put in motion initially as soon as the machine stations, and thus establish galvanic currents, which alone constitute these pole reversals. Similar improvements in construction, and very considerable reductions in weight and size, have also been effected in electro-magnetic lighting machines, whether for lighting gas-lights or lighthouses."

THE TELEGRAPHIC JOURNAL.
VOL. VI.—NO. 136.

THE OUTLOOK OF ELECTRICITY.

It has often been remarked that of all the sciences there is none which has been of more vigorous and rapid development than electricity. Long hidden in the dark womb of nature, like a spellbound genii, or a faculty asleep in the soul, it has within these latter generations sprung into quick existence, growing like a plant, and doing a giant's work. With all its practical power there is a brilliancy about its marvellous effects, which renders it a most fascinating pursuit, the most fascinating science of all perhaps. And this very shining quality has had an untold effect in furthering its own increase. The minds of men, however philosophical they may be, are ever fascinated by the miraculous and lured by beauty. What wonder then that electricity, whose effects are so beautiful, and withal so miraculous that to the uninitiated they seem to be creations of the magician, should number among its admirers and votaries all kinds and conditions of men. It has been said that a science progresses by the compound interest law, but electricity, at least, is an exception to this rule. The recent burst of electric invention, indeed, points to a more complex order of development than can be expressed by any known formula. Human genius, an altogether incalculable thing, must be taken into account in science, even as it is taken into account in poetry. The telephone and the microphone are pregnant factors in the advance of electrical science, corresponding to cataclysms in the uniform process of evolution. They have of late carried the science forward by a jump, and it is natural now to pause and view the outlook ahead.

The Victorian era will be ever memorable in history as the nurse of the steam-engine, of gas lighting, and of the electric telegraph. But it does not require a prophet's eye to foresee that ere long electricity will supersede both gas and steam. Men uses first those resources of nature which are nearest to him, then seeks out and utilises those which lie deeper. He hunts the wild animal crossing his path, then herds it on the ground, then tills the surface soil, then digs up coal and metals from the bowels of the earth, and at last when these palpable resources begin to fail his mind and sense, he looks into the secret store-room of matter with the eye of intellect, and discovers new mines of power even richer than the old. At present we are consuming one hundred and fifty million tons of coal per annum, and this waste cannot go on for ever. Our coal fields will inevitably become exhausted. But shall it then be necessary to buy our coal from other countries, say from our more prosperous "sister beyond the sea," as Mr. Gladstone poetically calls our American cousins, who doubtless in the shabby future which that fermenting patriot gratuitously depicts for his countrymen, will despise their impoverished relative and, at the same time, grow fat upon his poverty. Perhaps not. Perhaps the electro-motor will worthily replace the supermannered steam-engine, and the restless waves which ring our rocky coasts, the cascades which flow from our highland fells will relieve us from the necessity of filling the Yankee purse, and carrying the wherewithal to keep us warm, and turn our mills, and lighten our darkness, over two thousand miles of stormy sea. The electric light is now fairly equipped as a formidable rival of coal gas. For large works and public squares, where a few light centres suffice, it is in every way superior to gas, at a smaller cost; and if it could be distributed with less loss of energy, and at smaller expense, it would speedily take the place of gas for street lighting also. It is certain to become a dangerous competitor against coal gas, and unless the latter is improved in quality and reduced in cost, its employment will by no means be so universal as it is at present.

The possible applications of electricity are indeed, legion. Every day sees a new one. Its great mission is manifestly that of a vehicle of energy, and it appears to be capable of reproducing all modes of motion. If it is true that all the known forms of energy are mutually convertible, then electricity will probably be the practical channel of this transformation. We have seen during the latter years how magnetism, heat, and sound, can be transported into space by the electric current. In the future, near or remote, it will in all likelihood bring the shafts of light, and as sure now hear by telegraph, so will they see. Nerve force is merely a form of physical energy too; and with the fair prospect which we have before us, it is "only reasonable" to anticipate the time when the sensation itself may be transformed into electricity and pain and pleasure sent by wire.

THE MAGNETO-ELECTRIC MACHINE OF M. DE MÉRITENS.

By TH. DU MONCEL.

The commercial and industrial field, opened up lately by the electric light given by magneto-electric induction machines, has led, on all sides, to researches and improvements which have considerably advanced the problem of electric lighting. Everyone now knows the beautiful machines which MM. Siemens, Gramme and Lontin con-

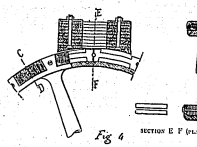

FIG. 4 SECTION E F (PLATES REMOVED).

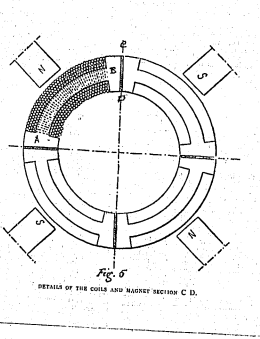

FIG. 5

DETAILS OF THE COILS AND MAGNET SECTION C D.

The system of charging the condenser through the joint-thread of course be made unless one end of the core is at hand to which to attach one pole of the battery.

When a joint is made in a cable core at sea neither end can be got at. The resistance, however, could be measured by arranging with the shore, before the joint is made, that at a certain time the end of the cable shall be put to earth. The rate at which the charged condenser would discharge itself through the joint could then be observed, and the resistance estimated from the rapidity thereof.

To enable the tests for fall of charge to be made readily with the condenser and resistance are not in use, as in a cable, the connections may be made as shown by fig. 20.

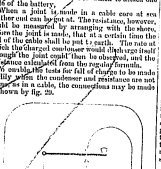

FIG. 20.

The plug switch S has one of its plugs placed in the left hand hole permanently. Another plug is placed in the bottom hole, and the key being pressed down so as to charge the condenser, the "discharge" trigger is pressed, and the condenser commences to discharge itself through the resistance R. After a noted time the key is again pressed, but only far enough to hitch it on to the "insulate" trigger.

The plug is then removed from the bottom to the top hole in the switch, and the "discharge" trigger being pressed the discharge deflection (V) is obtained on the galvanometer.

When testing a joint on board ship the terminal of the switch, which is joined to one end of the resistance in the Fig., would be attached to the metal plate in the testing trough, and the wire attached to the other end of the resistance would be put to earth.

GRAMME'S MAGNETO-ELECTRIC MACHINES.

By ALFRED NIAUDET-BREGUET.

(Concluded from page 190.)

LIGHTING MACHINES.

THE first machine of this description weighed 1,000 kilogrammes, and gave a light equal to 800 burners. It had a ring and electro-magnets. One of the rings excited the electro-magnet, whilst the other two supplied the lighting current. The copper twined round the electro-magnets weighed 250 kilogrammes; that round the 3 rings 15 kilogrammes. Its measurement was 60 centimetres in width; 1·25 metre high. This apparatus, for a long time used in experiments on Westminster Tower, grew warm when in action, and resulted sparks between the metallic brushes and the bundle of conductors upon which the current accumulates. However, for two years, it gave rise to no serious inconvenience.

Mower, Gramme endeavoured to eliminate the sparks and the heating of the machine; and, as the intensity of the light demanded by various governments did not exceed 200 burners, he was impressed to reduce the dimensions of the first machine, as shown by Figure 6. This instrument still had 6 electro-magnets, but, instead of being grouped in straight lines, they form triangles: the total current from both rings may be used into the magnets, or one only, or lastly, the whole of it may be made to produce two separate lights. Its statistics are:—

Weight	700 kilogrammes.
Height	1·20 centimetres.
Width	65 "
Copper on electro-magnets..	120 kilogrammes.
" two rings	28 "
Normal light ..	200 burners
Light from great speed	1000 "
Sparks and heating..	nil.

The latest type is shown by Figure 8, and embodies vast improvements on all previous machines of this class.

Its form is of the same character as that of the electroplating apparatus. Its weight is 180 kilogrammes; requires but 47 kilogrammes of copper for the ring, and the same quantity for the electro-magnets. Length, 35 centimetres; width, 80 centimetres, and height 60 centimetres. Normal power about 200 burners, but it will reach much more.

The following are the mean results of six series of experiments:—

Number of Turns.	Number of Burners.	Remarks.
630	77	No heat nor sparks.
840	153	" "
970	200	" "
1020	240	" "
1035	280	Slight heat, no sparks.
1053	300	Heat and sparks.

Among the improvements introduced into this machine may be mentioned the construction of the central ring, according to the "double" principle already referred to; an arrangement whereby the sparks disappear. By suitable means it can be joined up for "intensity" or "quantity," or it may be used to produce two distinct lights instead of one only. The capacity for one machine to produce two lights is of practical benefit for the reason

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N° Electricité
nov 8.78.

183367 : 29 mars 1878. — *Machine dynamo-électrique*, par MM. Siemens et Halske.

La disque mandrine est construit en fil de fer, tôle de fer ou bien en fer massif, recouvert entièrement de fils de cuivre; il est maintenu en mouvement de rotation entre un certain nombre de pôles d'aimants, disposés par paires sur ses deux faces, de telle sorte que ceux placés en regard les uns des autres présentent toujours des pôles de même nom alors que ceux juxtaposés ont des pôles contraires, le tout dans le but de produire des courants intermittents ou autos sens, et cela dans un ou plusieurs circuits.

introduced by M. Gramme are so original and so important that they constitute in themselves a work able, so to speak, to revolutionize a host of industries. We therefore give this subject prominent notice, although we may recapitulate what has already appeared in our columns.

The discovery of magneto-electric induction currents by *Faraday*, in 1832, opened a new field of study to physicists and inventors. Hall, maker of scientific instruments at Paris, was the first to construct an instrument furnishing practical induction currents; his apparatus, successively improved by Saxton, Clarke, Wheatstone, Wilde, Siemens, and Ladd, has bestowed immense service upon science and industry. Singularly, this invention of Pixii is best known by the name of Clarke's machine, although Clarke, of all the persons just mentioned, introduced the least important improvement. The Nollet machine, generally known as the *Alliance*, is but a particular arrangement of a group of Clarke's instruments.

Gramme's machine is not, however, a mere or less fortunate modification of Hall's apparatus; it is the first of its kind, as the following explanation will clearly show.

PRINCIPLE OF THE MACHINE.

To understand its principle it will be advisable to describe the most simple magneto-electric induction experiment which it is possible to make.

Contemplate a magnetic bar A B (Fig. 1) one metre long, and a spiral of conducting wire, in reciprocal movement. If the helix, starting from the position N, is made to approach the bar, an induced current is set up in the helix. Such is the sum and substance of the phenomenon, and three explanations as a rule stop; but let us proceed further and examine more closely what is the result in properties as the bar enters into the helix by a series of successive and equally spaced movements—5 centimetres for example.

It will be observed that an inducet current corresponds to each of these movements, and that these currents are in the same direction until the helix surrounds the neutral line M of the bar A B: and that the currents are in the opposite direction if the movement continues beyond that line.

Thus in the entire course of the helix over the magnet two definite periods are observed: in the first half of the movement the currents are *direct*, in the second they are *inverse*.

If, in place of motion from left to right, the movement is effected from right to left, the results

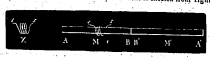

FIG. 1.

the *Revue Industrielle* and the *Chroniques de l'Industrie* have already especially referred to the admirable invention of magneto-electric continuous-current machines; but the modifications recently

* Several articles and abstracts from *Comptes Rendus*, &c. on Gramme's machines, have been from time to time appeared in our pages.—Ed. T. J.

are the same, but the currents are in opposite directions.

Let us now investigate a more complex case still represented by figure 1. Two magnets, A B and B' A', are placed end to end, in contact by poles of similar names, B and B'. The whole becomes a single magnet with a consequent point in the middle.

If the spiral is moved in accordance with this

system, it is clearly seen from the preceding explanation that it is traversed by a positive current during the first quarter of its movement (between A and M); by a negative current in the second quarter (from M to B); again by a negative current in the third quarter (from B' to M'); and lastly by a positive current during the last quarter of the bar (from M' to A'). It will be soon hereafter how this very simple explanation gives the key to the production of currents in the machines about to be described.

DESCRIPTION OF THE APPARATUS.

The essential portion of the machine is the "ring" (Fig. 2), which turns around its centre between the poles of a magnet. It is an electro magnet of particular form. It may be conceived as a straight electro-magnet, bent into a circle and soldered together at its extremities, iron with iron, and wire with wire.

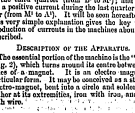

FIG. 2.

The wire is distributed upon the "ring" as in straight electro-magnets, notably those of powerful induction coils. It is rolled into distinct bobbins, which are then placed side by side, as shown in Fig. 2. These coils constitute the elements of the

machine, just as voltaic couples form the elements of a voltaic battery. To render its construction intelligible, the engraving represents the "ring" complete in one part only; in another part the coils are figured by ones or twos; and in another portion the iron ring is exposed bare and out.

This ring of soft iron is magnetized by the magnet N S (*Fig.* 3), and the magnetism becomes distributed in the following manner. At B and A are the poles, whilst at M and M' (at right angles to the poles) are the neutral points. During the movement of the ring, this distribution of magnetism does not change, or at least it is invariable in position on account of the want of coercive force in soft iron. Hence, the result of turning the soft iron ring is just as if the circular iron upon which the coils are mounted was stationary, and as if those bobbins alone moved upon it as a magnetic bar.

The ring may be considered as composed of two magnets B A and A B joined by their poles of similar names. If any particular coil is followed in its movement throughout the complete circle it will be observed by referring back to fig. 1, and to the explanations already given that the developed current remains of the same character during the time the coil passes from A to M; it becomes inverse from M to B and from B to M'; again changing to direct from M' to A.*

In other words, the current set up in a coil continues in the same direction from one neutral point to the other; if it is direct above that line, it is indirect below it. The line M M' may be called the *line of division*, and it is perpendicular to the line of the exciting magnet's pole NS. The line of division in Clarke's machine is that of the magnet's poles.

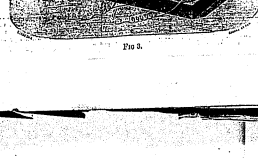

FIG 3.

* To thoroughly understand that the direction of the current from M to M' is the same as that from M' to M, it must be remembered that the direction of a current is reversed when the bobbin is turned round, as represented by dotted circles on the "Plan of the Machine" in the upper part of Fig. 3; if the bobbin pass first from N to A and afterwards from MM' to M', the two circles thus indicated will oppose themselves.

Spring Dynamometers

IN a former brief communication of mine on the subject of dynamometers (NATURE, vol. xiii. p. 383), suggested by an incidental remark made by Mr. Bottomley, I observed that "about three years ago Prof. Ball when introducing the C. G. S. system of units into the course of mechanics in this College had a series of dynamometers in students museum specially constructed for him." In reference to this statement, Dr. Ball's successor in the Professorship of Applied Mechanics has sent, in a letter to NATURE (vol. xiii. p. 466), that "this system is not employed in nor that referred to by your correspondent. I generally employ the kilogram, metre, and second, and accordingly have the foot, pound, and second, to measure a dynam or unit of force." It is, however, evident that the few words in my former letter did not question the merits of any particular system, or unit; whether the use of a united system of kilogram-metres and foot-pounds be an improvement upon a system now generally coming into use is a matter of opinion. And though the subject can hardly be one of much interest to your readers, I may, perhaps, remark that so far as my statement concerns Dr. Ball it is perfectly accurate; he was in the habit of using the C. G. S. system in his classes here, and I was aware no change had been made in this respect, the following statement occurring in Prof. Hennessy's own syllabus for the present as well as last session:—"The unit of force employed is the 'dyne,' or that force which, acting uniformly upon one gramme for one second, will give it a velocity of one centimetre a second." Even if Dr. Ball's syllabus had been made to Prof. Hennessy, one would naturally have concluded that the printed syllabus, authorised by the Department, was the one actually employed."

Passing on to Dr. Ball's statement, Prof. Hennessy remarks that "they cannot be depended upon to results within the tenth of a kilogramme"—how reading when a closer result could, no doubt, be taken by the eye, but that is really a matter of indifference for the makers, and the special purpose for which these instruments were designed: then follows the strong assertion that "spring dynamometers are totally unfit for measuring units on the C. G. S. system." As several instruments of precision depending on the tension of a spring occur to one's mind, instruments that only require proper precautions to yield extremely delicate and trustworthy results, it would be interesting to know upon what grounds Prof. Hennessy bases his emphatic and reiterated assertion. If it be merely a question of individual opinion, upon this subject hardly any authorities that could be quoted would carry much weight as Sir W. Thomson and Prof. G. Tait, who speak thus in their treatise on "Natural Philosophy," p. 122. "Spring balances we believe to be capable of carefully constructed, of rivalling the ordinary balance in accuracy, even for men, sophisticians they far surpass it in sensibility and quickness."

Royal College of Science, Dublin W. F. BARRETT

[2096.] — Magneto-Electric Machine. — No doubt a Jar could be discovered, but may be the smallest of this species which the Electrical Machine would require. To observe effects of the Electric Jar, by a longer discharge than the Spark, would be done by connecting one ball to the outside of the Jar coating, and the other ball to the inside coating.—

quées au bénéfice de cette statue vivante qui éternisera son nom malgré ses envieux, et qui est le système télégraphique de prévision du temps.

MACHINE MAGNÉTO-ÉLECTRIQUE

de M. de Méritens

Le débouché commercial et industriel qu'a ouvert dans ces derniers temps la lumière électrique aux machines d'induction électro-magnétiques, a provoqué de toutes parts des recherches et des perfectionnements qui ont fait avancer considérablement le problème de l'éclairage par l'électricité. Tout le monde connaît aujourd'hui les belles machines que MM. Siemens, Gramme et Lontin construisent, et on croirait en les voyant qu'il serait difficile de les perfectionner davantage. Toutefois nous croyons que la solution définitive du problème n'est pas encore atteinte, et il est probable qu'd'ici à peu de temps nous verrons mieux encore. Déjà la machine que vient de construire M. de Méritens est un pas considérable fait en avant dans cette voie, et je suis autorisé à croire que cette machine, qui a déjà étonné ceux qui l'ont vue fonctionner, n'a pas encore dit son dernier mot.

Pour nous, qui avons suivi dès le début les progrès de ces machines, qui avons nous-même contribué aux premiers perfectionnements qui leur ont été apportés, nous voyons avec un véritable plaisir cette marche progressive de cette industrie qui est en quelque sorte née en France. Mais tout en les admirant, nous ne devons pas oublier que c'est à la compagnie l'*Alliance* et à son habile ingénieur M. J. Van Malderem que nous devons cette magnifique application de l'électricité.

A ce propos, nous croyons qu'il ne sera pas sans intérêt pour nos lecteurs de raconter brièvement l'histoire de ces machines.

En 1859 M. Nollet, constructeur belge, avait construit pour la galvanoplastie de grandes machines magnéto-électriques du système de Clarke qui donnaient déjà d'assez importants résultats pour provoquer la formation d'une compagnie qui voulut les exploiter dans le but d'extraire le gaz de l'eau. Cette idée était insensée, mais précisément à cause de cela, elle trouva des adhérents, et ce fut cette compagnie qui, sous le nom de l'*Alliance*, installa dès 1860 dans des bâtiments attenant à l'hôtel des Invalides, les premières grandes machines magnéto-électriques connues en Europe. Naturellement les résultats obtenus furent déplorables, et en 1870 la compagnie fut obligée de liquider.

Elle se réorganisa ensuite en 1872, et après avoir nommé pour son directeur, M. Berlier, elle chercha à tirer parti du matériel considérable qui avait été créé; ce fut alors que je fus consulté et que j'indiquai à M. Berlier les applications qu'il pouvait en faire à la lumière électrique et à la galvanoplastie; mais pour y parvenir, bien des perfectionnements devaient être introduits dans ces machines, et tous les électriciens de l'époque apportèrent chacun leur pierre à l'édifice.

Parmi ces perfectionnements, il en est un suggéré par M. Masson, alors professeur de physique à l'École centrale et que j'avais amené voir ces machines, qui permit instantanément de doubler les effets obtenus. Ce fut de supprimer le commutateur jusque-là employé dans toutes ces machines. Tous ces perfectionnements admirablement interprétés par M. J. Van Malderem, permirent, conjointement avec ceux qu'il y apporta lui-même, de faire arriver ces machines à une perfection qu'on n'aurait guère osé espérer dans l'origine, et qu'on croyait bien ne pas pouvoir être dépassée. Ce fut alors qu'on songea à en tirer parti pour l'éclairage des phares et pour l'illumination de la marche des navires; des expériences furent alors tentées conjointement avec MM. Reynaud et Degraud, et bientôt, en 1863, les phares de la Hève purent être éclairés de cette manière.

En même temps, on faisait pour l'application à la navigation des expériences qui n'eurent pas d'abord tout le succès qu'on pouvait en espérer, surtout à cause du mauvais vouloir qu'on rencontre dans la marine, mais qui devaient fournir plus tard des résultats dont on put apprécier l'importance. Ce fut la France qui précéda les autres nations dans cette double voie, comme c'est elle qui les précède encore pour l'éclairage public. Mais nous devons dire que c'est grâce à la compagnie l'*Alliance* et à la courageuse initiative de son intelligent directeur, M. Berlier, que le monde civilisé doit ces belles applications de l'électricité.

Ce tribut d'hommages rendu à une compagnie dont la fortune ne seconda pas les efforts, nous allons examiner les progrès accomplis dans ces derniers temps en dehors d'elle.

La machine l'Alliance était une machine magnéto-électrique, c'est-à-dire une machine composée d'aimants persistants et de bobines d'induction. Dans son dernier modèle, elle mettait à contribution 48 aimants et quatre couleaux mus chacun de 16 bobines d'induction; elle fournissait des courants alternativement renversés, et pouvait alimenter trois bougies Jablochkoff; elle employait comme force motrice environ trois chevaux, et marchait à une vitesse de 400 tours par minute. Aucun échauffement n'était produit dans la machine, et la force qu'elle fournissait était très-régulière.

Dans des conditions tout à fait exceptionnelles, ce rendement a été très-augmenté, et on a même parlé d'une machine pouvant alimenter six bougies; mais les machines ordinaires sont loin de fournir de pareils résultats. Or, la machine dont nous allons maintenant parler peut, avec huit aimants seulement (aimants de même grandeur que ceux de l'Alliance), illuminer de trois à quatre bougies Jablochkoff et fournir également les courants renversés qu'on regarde, avec raison, comme un élément favorable pour l'éclairage public!

Il est vrai que la vitesse de la machine est plus grande, car elle accomplit sept cents tours par minute; mais elle ne dépense, m'a-t-on assuré, que soixante dix-huit kilogrammètres de force motrice, c'est-à-dire un peu plus de un cheval vapeur, et ne s'échauffe presque pas. Ses dimensions sont très-petites, et les éléments de sa construction sont simples et faciles d'ajustement et de construction.

Les effets avantageux de ce genre de machines résultent de ce qu'aux courants d'induction déterminés dans l'anneau des machines Gramme, sont ajoutés ceux qui se produisent dans les machines magnéto-électriques ordinaires.

Pour qu'on puisse les comprendre, imaginons-

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Account of Experiments undertaken for the Determination of the Work Performed by the Magneto-Electric Machines of M. Gramme, used for the Production of Light in the Establishment of MM. Sautter and Lemonnier.—M. Tresca.—As regards the relative expense of different modes of lighting the following figures may have a certain interest:—1850 Carcel burners would require a consumption of 1850×0·040 kilo. of oil = 71 kilos. of oil per hour; or of 1850×0·105 cubic metre of gas = 194 cubic metres; or of 7·56×4 kilos. of coal (used in furnishing power for the Gramme machine) = 30·24 kilos. of coal. Under these circumstances the outlay in fuel does not represent more than the one-hundredth part of the cost of oil, or the fiftieth part of the cost of gas, taking Paris prices. The applications of the magneto-electric machine for lighting are multiplying.

E. M. oct 74

[20365.]—Commutator.—I think "T. T. D." will find what he requires in my next article, probably appearing with this reply. The simplest form consists of a cylinder of wood or ebonite fixed upon the revolving shaft of the armature; on this is secured the two halves of a metal cylinder, each connected to one end of the wire; a spring on each side the shaft makes contact with each alternately and takes up the current. The line of break or division of the cylinder must be a little in advance of the line of the poles; the exact point will depend upon the quality of iron and the rate of revolution intended to be worked at. I cannot answer the other question absolutely; I should think about No. 18 wire.—SIGMA.

Gramme's Magneto-Electric Company.—This company has been formed to utilise for industrial purposes Gramme's Magneto-Electric Machine. Amongst the important objects which the promoters have in view are the application of the machine to the production of light, the electro-deposition of metals, and to metallurgy and chemical manufactures. Most successful experimental results have been obtained, and useful as the invention will prove for industrial purposes, it possesses still higher value from a scientific point of view, being based on new principles. The capital of the company is to be £250,000 in 25,000 shares of £10 each, 14,000 of which are now offered for subscription. The share lists will close on Thursday, February 4, for London, and Friday, February 5, for country applications.

[32610.]—Dynamo-Electric Machine.—The Weston machine at present is arranged only for producing currents adapted to electro-depositing, and is not adapted for lighting purposes. No doubt some modifications would easily render it suitable for this purpose. A few numbers back, just before my article on the Weston appeared, there were given descriptions of some half a dozen different machines for the purpose, from which "Prometheus" could select one to try his hand at.—SIGMA.

NEW DYNAMO-MAGNETIC PHENOMENON.

MM. TREVE and DURASSIER. Jan 77

LET there be a horse-shoe magnet, of any length, covered upon one side with varnish, or, better, with a plate of glass. If there is laid upon the neutral part a cylinder of soft iron, it is seen to move towards the poles, which it reaches in a time which is a function of the weight of the cylinder and of the coercitive force of the magnet. Hence there results a new method of estimating the magnetic force by the mechanical work which it effects.

DYNAMOMETERS AND BRAKES.

*On Dynamometers, Friction Brakes, and other Testing Apparatus belonging to the Royal Agricultural Society of England.**

By MR. WILLIAM E. RICH, of London.

(Concluded from page 63.)

To an institution such as this it is well to notice the blemishes which have, of course, manifested themselves in this instrument, the first of its kind, during its useful life of twenty years, as many of them may easily be avoided in future integrating dynamometers. In the first place, the wrought-iron frame is not stiff enough transversely, and twists slightly, occasionally increasing the friction of the draught bar and the parallel bar above it in their bearings. The number of bearings (six) which these two connected

* Paper read before the Institution of Mechanical Engineers.

bars take in the frame and oil cylinder increases this tendency, and these bearings cannot be made slack, as any angular motion vertically of the lower bar moves the integrating disc, which is so far above it, horizontally on the large disc face. The arrangement of spiral springs in compression makes it almost a necessity that there shall be some initial strain on them, thus leading to the false zero adjustment and the more complicated formulæ and coefficients described above.

The smallness of range of the springs and integrating disc (about 2 in.) is also undesirable, as the average compression should seldom exceed about one-half the maximum, and any slackness or imperfect adjustment anywhere may tell seriously on results, when the mean spring compression and disc travel is only about 1 in.

The integrating disc requires a ready means of horizontal adjustment, and the oil cylinder has recently been noticed to have a defect common to the same detail in all these instruments, namely, that it could not work when absolutely full of oil, in consequence of the smaller displacement at the piston-rod end of the cylinder. The rod should be carried through both ends of the cylinder, or some other arrangement made to obviate this.

The changing of springs is a tedious operation, as half of the working parts must be dismantled and re-adjusted afterwards, and the new springs must be tested, which is no easy matter in an implement trial field. Probably future editions of the instrument would be better with spiral springs in tension, and drawn directly from their centres.

The Horse Dynamometer (so called partly to distinguish it in name from other instruments, and also because it mechanically represents a harnessed cart horse in any implement or vehicle to be tested) was designed primarily for testing carts, wagons, and other wheeled vehicles having shafts, at the Bedford Meeting of the Royal Agricultural Society in 1874. It was used again last year, at the Taunton Meeting, for testing mowing machines, and will again come into requisition next August for testing the reaping machines which are being selected for trial at the present Show. It is now at the Exhibition of Scientific Apparatus at South Kensington.

This instrument* was designed by Mr. W. Anderson and the author in 1874, and was made at the Erith Iron Works. It is the most perfect integrating instrument belonging to the Society, every care having been taken to avoid sources of weakness and irregularity which had been noticed in the working of previous instruments.

The general principle of this dynamometer is, that it shall occupy the same position as a powerful cart horse in any wheeled vehicle to be tested, that it shall draw the vehicle on any sinuous course by means of harness attached to the shafts in the usual way; and that in doing this it shall register the most important strains which a horse would have to exert in drawing it.

To determine in the first place the leading dimensions, a 16-hand cart horse was harnessed into an agricultural wagon, and subsequently into a two-wheeled cart, and his action in drawing these along straight and sinuous courses was narrowly watched. The carter was also closely questioned on the practice of harnessing horses into such vehicles, the proper height for shafts, back weight, &c. The adjustment of back weight to varying circumstances seems to be an important point with carters; they consider it desirable to have between ½ cwt. and 1 cwt. on the back of a cart horse, and for carting up hill they further increase this by shifting the load, no doubt to add to the horse's gripping power. It was noticed that the shafts were materially wider than the horse's body, and that the draught chains expanded outwards from the attachments on the collar to the hooks on the shafts, and generally inclined downwards at the same time. In virtue of this arrangement it appeared that there was very little horizontal vibration of the shafts, and the horse was able to turn round moderate curves, without causing the shafts to rub at all sideways against his shoulders. The heights and positions horizontally of the collar chains, back saddle, breeching, &c., were measured, and the design was then proceeded with.

All the instrumental parts are self-contained on a small bed-plate, mounted upon a carriage frame of wood and iron, resting upon four broad and heavy cast-iron wheels, which add to its stability by lowering the centre of gravity. The hind wheels are placed at 4 ft. 8 in. apart between centres, the wheel base being narrow, so that vehicles which are to be tested on soft ground may not have to follow on beaten tracks previously made by the instrument. The front wheels are narrower still, being placed at 2 ft. 9 in. between centres, and carried in a wrought-iron locking frame, with a pair of ordinary wagon shafts for drawing it. Some vertical slackness on the locking pin is permitted in this frame, and this, combined with the narrow front wheel base, insures both the hind wheels always bearing on uneven ground, this being a necessity, as one of them drives the speed-registering apparatus.

Referring now to the instrumental parts, the pair of draught springs are of untempered steel; they are of uniform width, with planed edges, and are jointed with one accurately fitted pin at one end, and two such pins with a short link at the other end. This arrangement prevents any tendency to parallel-ruler motion, as would be the case if there were links at both ends, and at the same time permits each bar freely to assume its own shape and length, when under strain, which could not be the case if the springs were attached immediately to one another at both ends. The longitudinal section of the springs is approximately parabolic, the bases being at the centre eye in each case; their proportions were determined from statistics afforded by the late Professor Rankine, in his work on "Machinery and Millwork."

* The horse dynamometer here referred to was fully illustrated by us on page 22 of our eighteenth volume, and on pages 23 and 39 of the same volume we gave an account of the results obtained with it at Bedford.—ED. E.

There are three pairs of these springs, which are readily interchangeable, two pairs being 4 ft. long between end centres, and suited for maximum pulls of 600 lb. and 1000 lb., and the third pair 5 ft. long, will work up to 1600 lb. pull. The lightest pair of these springs is laid on the table for inspection. The centre eye of the front spring is held by an accurately turned pin carried in a fork cast on the front end of the bed-plate; the eye of the other spring is similarly carried in a fork on the end of the turned draught bow, which is very stiff transversely, and is carried only in two bearings, namely, one just behind the fork end, and the oil cylinder at the back of the bed-plate.

Behind the first-named bearing the draught bar is flattened, and the triangular draught plate is here jointed to it with washers above and below, to insure great freedom of motion horizontally. This draught plate is a very important detail, and represents a horse's shoulders and collar. Attached to the draught bar at its front end by a pin, the corners are supported on easy-running castors, which move freely in any direction on the top surface of the bed-plate. To these corners, beyond the castors, and considerably behind the centre pin, are attached the draught chains, which are hooked to the shafts of the vehicle which is to be tested. The height of these chain attachments, and their width apart on the draught plate, are very nearly identical with the height and width of the similar attachments on the collar hames of a 16-hand horse; and in virtue of this arrangement the dynamometer will draw a vehicle behind it round a considerable bend, always keeping both draught chains strained, and inclining the vehicle to follow in its track, without bearing materially against the inside of either of its shafts. The shafts really seem to float horizontally, rarely touching the sides of the instrument, and the tendency of the draught plate is always to right itself, like a stable floating body, as soon as possible whenever it is moved from its central position. The castors eliminate all vertical components of pull, so that only the direct horizontal components which are effective for doing work are communicated to the springs.

Above the oil cylinder a wrought-iron chain saddle representing that carried by a horse in cart harness, is suspended from one end of the lever, the other end of which is held by a Salter's balance at the rear of the carriage. Over the saddle the ordinary shaft chains are passed, and the shafts being adjusted to their proper height by means of it, the weight carried on the saddle in any experiment can be read off readily on the dial referred to. Breeching chains are attached to the side frames, for restraining implements behind the instrument, when going down hill. At the rear end of the carriage, arrangements are made for testing any pair of springs readily in the field by means of a long-ended bell-crank lever, the short arm of which can be linked when necessary to the back end of the piston rod, while to the long horizontal arm at its outer end known weights are suspended.

The registering and integrating apparatus are similar in principle to that in the plough dynamometer previously described; important improvements have however been made in the details. The distance counter and large disc are worked by means of bevel gear and shafts from the hind shaft of the carriage, which is keyed into one travelling wheel, while the other runs loosely upon it; a clutch and handle serve to disconnect or connect the gear readily. The motion of the draught bar is trebled on to the integrating disc by means of a lever, which has its fulcrum self-contained on the bed-plate, and at its upper end is connected by a link to a small gun-metal sliding frame which rests in two easy fitting bearings, and contains in itself the integrating disc, with its shaft and a simple and easily read counter worked by it, for recording the number of revolutions of the disc. The front end of the slide also, beyond its bearing, carries a pointer for indicating to an observer the variations of draught and the maximum draught on a clearly figured scale of loads.

The distance register is kept on an equally clear counter behind the large disc, and worked by toothed wheels off the driving shaft. The maximum range of motion of the slide and integrading disc is in this instrument 8 in., and the disc can always be adjusted to the centre of the large one by means of the right-and-left-handed screws and nut on the link. In this instrument, too, there is extremely little longitudinal friction either in the draught bar or slide, each of which is carried in two bearings only, which cannot twist relatively to one another. The springs also will always adjust themselves exactly to a passive position when unloaded, if the draught bar is slightly shaken by taps of a mallet on the side of it. This does away with all necessity for the complicated formulæ and corrections of readings, necessary with the plough dynamometer. Any pair of springs can be introduced, adjusted, and tested in a very short space of time, and the formulæ for the coefficient with any pair of springs $C = \frac{W\,d}{n}$, is found always to be approximately uniform, whatever the effective load on the draught bar. Really C should increase very slightly when the springs are at their maximum range and curvature, but the irregularity is so small as to be inappreciable. The most important blemish which the writer recognises in it is the oil cylinder, which, as in the plough dynamometer, has different displacements at its ends; but this defect can easily be obviated now it is seen, and really in practice it has not been found necessary to fill the cylinder with oil, the range and inertia of the springs and other working parts apparently absorbing most of the violent shocks brought upon them. Room and other provisions have been made on the front end of the instrument frame for adding a paper cylinder at any time for taking diagrams, with a pencil attached to the front end of the counter slide, but up to the present time this has not been required.

When mowing and reaping machines are to be tested, a very narrow wheel base is essential, as otherwise the standing crop would be injured, so the hind wheels are then replaced by a smaller pair, fixed at the same width apart as the front wheels; then also a horizontal bar at the rear end of the carriage supports the pole of the mowing machine, which projects under the carriage; and the side thrust of the pole can be read off, on a horizontal Salter's balance, suitably attached to the carriage there. Then, too, a long iron whippletree bar is generally bolted across the draught plate, and the implements are drawn by long chains from the ends of the whippletrees.

At various times other draught-testing instruments have been arranged for the Society's trials, and notably among these were a hydraulic cylinder for testing pulls on steam plough ropes, and an elaborate integrating dynamometer for a similar purpose. These instruments, however, did not give good results, and have, therefore, been discarded, and in the last steam plough trials at Wolverhampton, in 1871, the total expenditure of work in foot-pounds per pound weight of earth moved was determined approximately from indicator diagrams taken from the engine cylinders.

The Friction Brake Dynamometer, which absorbs the available energy of any prime mover by the friction of a strap on a pulley, and measures its amount at the same time, was invented by M. Prony; but the instruments belonging to the Society possess important modifications and improvements, which were introduced by Mr. C. E. Amos, and the late Mr. Appold, who as an amateur engineer always took great interest in the Agricultural Society's trials and testing instruments.

In its present shape it is by far the simplest type of dynamometer, and at the same time the most delicately accurate in its testing powers.

Three of these instruments were made for the Society in the years 1848, 1852, and 1854 respectively, all being of one size, and suited for a maximum of about 20 horse power, at 120 revolutions per minute. Originally each of them was mounted with one driving pulley, for receiving the power from the engine by means of a belt, and one brake pulley on the same shaft, for absorbing the power; but latterly two of them have been altered to drive with universal coupling shafts, direct from the engine crankshafts, and the belt pulleys have consequently been removed. The reason for this change is obvious, as the tension of a belt on both sides of the pulley, as formerly arranged, absorbed additional power in journal friction, and this loss was proportional to the tightness of the belt. The slipping of the belt, both by apparent sliding on the pulley and also from the difference of elasticity at its tight and slack sides, caused other irregularities which it was impossible to account for in recording results.

The largest brake belonging to the Society is on exactly the same principle as those above referred to, but much larger, having three brake pulleys on the same shaft, instead of one only, as in the smaller ones. It was made in 1871, for testing the largest ploughing and traction engines which were presented for trial at Wolverhampton in that year; and as Messrs. John Fowler and Co. had entered 20 horse power engines, one of which actually worked up to 143 indicated horse power during short intervals in the plough fields, it was thought prudent to proportion the brake for a maximum of 100 horse power, at 100 revolutions per minute.

The instrument consists primarily of a cast-iron carriage and A frames, supported on wheels and axles, so as to be suited for running on rails in a long trial shed, opposite to which the several engines to be tested should be parked. Two well-fitted 5 in. bearings on the A frames carry the main shaft, on which three brake pulleys, each 5 ft. diameter and 7 in. wide, are keyed, two of these being situated between the bearings, and the third on an extension of the shaft beyond them. To the other end of the shaft a universal coupling shaft is keyed. Any engine to be tested adjusts its crankshaft as nearly as possible to the same height and direction as the brake-shaft, and then couples on to the other end of the shaft with similar fork couplings, one of the forks being arranged to slide on the shaft so as to adjust the length exactly, and avoid risks of end friction on any of the journal collars of either engine or brake. Each of the three brake pulleys constitutes a complete brake in itself, and for moderate powers it is sometimes desirable to run with only one or two of them at work, the straps in that case being removed from the others. The brake also can be driven by a belt over one of these pulleys, if it is inconvenient to use the universal coupling shaft.

Looking at the cross section of the instrument at any brake pulley there will be seen a pair of straps of strong hoop iron passed round the pulley and screwed down to nine wood blocks, which are fitted to the slightly rounded outside rim of the pulley. Gun-metal side guides are screwed to the sides of the blocks to keep them in position laterally. On one side eyes are formed in the straps, and to these the testing weights are suspended by means of a rod. On the opposite side of the pulley the straps are cut, and connected again by means of the right-and-left-hand screw for adjusting the degree of tightness by hand.

At its lowest point the strap is severed again, and the ends are connected by pins to a pendulum sometimes called the differential lever. This connexion is an ingenious mechanical contrivance, though very simple in its details and easy to understand. Its object is to maintain a uniform frictional resistance on the brake by keeping the weight attachment in one vertical position, and this it does with extreme delicacy in the following manner. The pendulum consists of two links suspended from joints on standards at each side of the pulley. Their length may be adjusted by nuts at their top ends, and by means of the joints in the standards they are free to move through angles of moderate extent on each side of their vertical position. The first is essential with this pendulum is that its length shall be less than the radius of the brake pulley, and the second is that the ends of the strap on the weight side of the brake shall be jointed to it at a lower point or greater radius from its centre of suspension than the strap ends on the opposite side. A pointer on a standard marks the proper position for the joint, and the effect of the pendulum regulating apparatus is that if from any cause the friction of the brake blocks increases, and lifts the joint above the pointer, thus circling the whole strap slightly round the pulley, the pendulum will incline towards the weight and slacken the strap in that direction to a greater extent than it tightens it in the opposite direction, in proportion as the radius of the one joint is greater than that of the other. The result is that the point of weight attachment will return nearly to its proper level, and if from continued actions of this kind it should move materially from this its normal position, the strap must be slackened by the hand-screw till this result is obtained. A similar but directly opposite action takes place if the point of weight suspension falls below its proper level from the strap being too slack. The weight rod carries at its bottom end a disc, which is a very easy fit in an open-topped cylinder or dash pot, which is filled with water when the brake is in use. The weights are of different sizes, and are slipped on to the rod above a disc which is screwed to it for supporting them at such a level as to be well above the top of the dash pot, when the instrument is in use; but so that they can rest on the top flange of the dash pot, when the brake is at rest, without pushing the pendulum very far over in the opposite direction.

The revolutions of the brake are registered on a counter placed on a standard opposite one end of the shaft, and connected or disconnected at will by means of a handle and driving pins on the shaft and counter. Platforms are laid round the carriage for the convenience of the attendants, one of whom must always stand by the adjusting screws and alter them when necessary to keep the joints opposite the pointers, while another looks after the lubrication and cooling of the straps and pulleys with water services. The usual lubricants used are tallow and blacklead, introduced in lumps between the wood blocks, with a little oil occasionally from lubricators suspended above the pulleys. Water cans, with cocks, are also placed above the pulleys for the water-cooling services, the supply to the cans being usually kept up by a small hose when there are conveniences for so doing.

A forked steel gauge is provided for measuring the exact radius of the joint, at which the weights are suspended. To facilitate this measurement, the joint pin is turned down to sharp points at its ends, and the mean distance of the points on either side of the pulley from the shaft centre are taken by pressing the fork of the gauge against the shaft and reading off the figures on a scale at the other end of it. The gauge has also engraved upon it a scale of the circumferences of the circles corresponding to the radii of the joint, and it is usually more convenient to read off this scale. The brakes were fitted in the first place to give a radius of 2 ft. 9 in. to this joint, corresponding to a circumference of 17.27 ft., but these dimensions of course diminish as the wood blocks wear down.

The wood block beneath the joint at which the weight is suspended is increased in width beyond the other blocks, partly to increase the bearing surface on the pulley there, and also to make the halves of the strap, with its blocks, &c., as divided by a vertical centre line, equal in weight. Then the effective load upon the brake is the load suspended by the rod at the joints just mentioned, namely, the weight of rod and washer plates as measured with the bottom disc in water, together with the weights carried by the rod.

The foot-pounds of work per revolution then equals the effective weight W, multiplied by the circumference of the circle whose radius is D H, or that at which the weight is suspended.

Putting W = total effective weight in pounds.

c = circumference in feet of circle of radius D H.

n = number of revolutions in any time.

t = time in minutes.

then total foot-pounds of work done = $W \times c \times n$, and the mean actual brake horse power $= \frac{W \times c \times n}{33{,}000 \times t}$.

It is usual in trials of portable and other engines to let each exhibitor determine the mean speed in revolutions per minute and the horse power at which he wishes his engine to be tried. Let r be the revolutions per minute, and P the power which he elects for; then the gross weight on the brake must be

$$W = \frac{33{,}000 \times P}{c \times r}$$

and from this must be subtracted the weight of the rod, &c., to determine the apparent weights which must be applied.

The Rotary Hand Dynamometer shown in the diagram was made in 1849, for testing small hand-worked machines, and has been in frequent use ever since for this purpose. Considering that very little information on the subject of rotary dynamometers was in existence at that date, it may always be looked upon as a very ingenious design. It consists of a bed-plate and two A frames carrying two parallel shafts A B and C D, connected by a pair of toothed wheels U and V, each 11 in. in diameter and 1¼ in. wide. The first of these shafts A B is supported in parallel bearings in the usual way, and carries at one end a flywheel E, 3 ft. 10 in. in diameter, with a handle of 16 in. radius, for working it by manual power. The second shaft has a bearing of rounded internal section D at the other end. When the instrument is not in use this shaft rests in the bottom of a slot C in the A frame, arranged to permit it to rise and circle round the centre of the shaft A B. At its end D this shaft carries a belt pulley of 2 ft. 7 in. in diameter and 4 in. wide, from which any machine to be tested is driven. A long lever F G H encircles the two main shafts at H and K, and is prolonged to a heavy counterweight L at one end, and at the other suspends a Salter's spring balance F, attached to a cast lever projecting from the bed-plate. An oil cylinder

La force électro-motrice d'un élément Daniell est de 1,079. Si par conséquent ce courant passe par un galvanomètre de tangente dont la résistance est de 1,079 ohms, le courant sera de 1 Weber par seconde. Le point où l'aiguille s'arrête sous l'influence de ce courant est le point de départ des divisions du galvanomètre, ce dernier indique par conséquent l'intensité du courant directement en unités Weber.

10. La boussole des tangentes de Bradley, par le Dr. G. Seelhorst. (Dinglers polytechn. Journal, vol. 215, page 121).

Elle se distingue des autres boussoles des tangentes par sa simplicité. L'aimant est un disque de deux centimètres de diamètre. Le multiplicateur se trouve entièrement au-dessous de l'aimant. Cette boussole n'est pas susceptible de mesures de grande précision, mais elle est facile à manipuler et ne se dérange pas aisément.

11. Nouvel électro-moteur, par C. Gaume. (Dinglers polyt. Journal, vol. 216, page 316).

C'est une machine pour développer la force nécessaire à faire tourner, par exemple, une machine à coudre. Les armatures, d'une forme spéciale, sont mobiles, les électro-aimants fixes. Les résultats sur les effets de la machine ne sont pas connus.

12. La machine magnéto-électrique de Gramme, par Alfred Niaudet-Bréguet. (Telegraphic Journal, vol. III, pages 186, 196, 223).

Pour rechercher les sources historiques de la machine Gramme, il faut remonter jusqu'à la découverte de la magnéto-électricité, par Faraday, en 1832. Pixii, Saxton, Clarke, Wheatstone, Wilde, Siemens et Ladd ont construit des machines magnéto-électriques. La machine de Gramme fournit un courant continu et de force constante. Les premières machines possédaient un aimant pour exciter le courant électrique. Dans les types plus perfectionnés cet aimant est remplacé par un électro-aimant qui reçoit son courant de la machine elle-même. Suivant que le fil qui forme bobine sur le noyau en forme d'anneau est fin ou gros, la machine fournit un courant d'intensité ou de quantité. Comme la machine engendre par le travail mécanique de la rotation un courant électrique, le même on peut l'employer en sens inverse et produire avec le courant d'une pile un travail mécanique. La machine devient ainsi une machine électro-magnétique. La machine s'adapte à des emplois très-divers. Elle peut servir comme étalon de la force électro-motrice, elle est très-employée dans les ateliers de galvanoplastie pour remplacer les piles. Une machine pesant 117½ kilogrammes et dimunant une force de 50 kilogrammètres ou environ ⅔ de force de cheval, produit un courant qui dépose en une heure 600 grammes d'argent. En outre, on peut employer la machine pour l'éclairage et pour la production de la lumière, par exemple dans les phares et sur les bateaux en mer. Finalement on peut se servir de la machine de Gramme pour transporter une force mécanique à une distance quelconque.

13. La machine magnéto-électrique de v. Hefner-Alteneck. (Electrical News, vol. I, pages 226 et 230).

Comme celle de M. Gramme, cette machine est construite sur le principe du professeur Pacinotti. Elle se distingue de la première en ce que les hélices d'induction ne sont pas roulées sur un anneau en fer doux, mais longitudinalement sur un cylindre creux en maillechort. Ce cylindre tourne avec les hélices allongées comme l'anneau de Gramme. Mais à l'intérieur du cylindre est placé un cylindre fixe en fer doux. L'extérieur du cylindre tournant est embrassé par les prolongations hémicyclopes de deux électro-aimants puissants. Le courant d'induction engendré dans les hélices tournantes parcourt aussi les hélices des électro-aimants. Cette machine est la plus puissante qui ait été construite jusqu'à présent, elle produit avec une vitesse du cylindre de 380 rotations par minute une lumière égale à celle de 14,000 bougies. Pour produire cet effet elle demande une force mécanique de 700 à 750 kilogrammètres par seconde (9 à 10 forces de cheval). Une lampe électrique est adaptée à cette machine qui, en conservant le mouvement du recul du système Foucault, n'est pas compliquée par un mouvement d'horlogerie.

14. Sur l'histoire des machines magnéto-électriques à courant continu, non renversé, par le Dr. Ed. Zetzsche. (Dinglers polyt. Journal, volume 216, page 491).

La première machine de ce genre figurait à l'exposition de Londres en 1851. Elle avait été inventée et construite par MM. Siemens et Halske de Berlin et avait pour effet de transformer le faible courant d'une petite pile en courant de haute tension. En 1860, le Dr. Antoine Pacinotti, de Pise, construisit une autre machine avec électro-aimant transversal. Viennent ensuite les inventions de Wilde à Manchester en 1866, et de Ladd en 1867. En 1871 les principes de Siemens et Pacinotti ont été appliqués par Gramme dans la machine qui porte son nom. La dernière invention est celle de v. Hefner-Alteneck qui figurait à l'exposition de Vienne en 1873. L'article réclame les droits de priorité pour les inventions de Siemens et Pacinotti vis-à-vis de Gramme.

15. Nouvelle horloge électrique, par Arzberger (Dinglers polyt. Journal, vol. 217, page 460).

4. Le duplex et le quadruplex système.

1. Double transmission avec courants continus. (Journal of the telegraph, vol. VIII. page 360).

Moses G. Farmer a le premier, en 1858, pris un brevet pour un système de double transmission avec courants continus. En 1873, George K. Winter a aussi pris des brevets pour deux systèmes de même nature. Ces systèmes sont tout-à-fait analogues à ceux que M. d'Infreville a fait breveter dans les Etats-Unis après Winter.

2. Explication de la méthode Schwendler pour la double transmission, par W. P. Johnston. (Electrical News, vol. I, pages 75 et 89).

Ce qui caractérise la méthode de Schwendler pour la double transmission en sens opposé, c'est essentiellement la présence à chaque station de deux ponts de Wheatstone, un pour le courant de départ, l'autre pour le courant d'arrivée. Pour le courant de départ, le récepteur ou un relais de Siemens ou d'Arlincourt se trouve dans la diagonale du pont, pour le courant d'arrivée cet instrument est placé dans une branche. L'avantage de ce double pont de Wheatstone consiste en ce qu'il n'y a que la résistance d'une seule des branches opposées à la ligne qui demande une correction si la résistance de la ligne varie et que chaque station peut établir l'équilibre des résistances indépendamment de l'autre station. L'article se termine par des indications concernant l'échange des dépêches sur les lignes à double transmission.

3. Le duplex système de M. Smith. (Telegrapher, vol XI, page 229).

L'inventeur s'est servi du diagramme employé par Poggendorff pour comparer les forces électro-motrices de deux piles. Le système se compose, comme celui de Stearns, d'un «sounder», d'un condensateur égal en capacité à la ligne et d'une résistance additionnelle. Le relais (ou le récepteur) a deux hélices. Chaque station est pourvue de deux piles, mais il importe peu que les deux stations aient les mêmes pôles ou les pôles de noms contraire en contact avec la ligne. Ce système aurait fourni de bons résultats quand il a été expérimenté entre New-York et Buffalo.

4. Le duplex télégraphe de d'Infreville, par Hugh Nelson. (Telegrapher, vol. XI, page 272).

Actuellement cinq différents systèmes de double transmission sont en usage dans l'Amérique du Nord, le système différentiel de Stearns, le système du pont de Wheatstone de Stearns et les systèmes de Haskins, Gerrit Smith et d'Infreville. Ce dernier n'a pas besoin de condensateurs, le courant de retour étant détruit par l'extra-courant d'un relais. Les manipulateurs sont simples et n'ont que deux points de contact. Les piles des deux stations doivent être opposées l'une à l'autre et d'égale force électro-motrice. Le système a été mis en fonction avec succès entre Toronto et Montreal sur une distance de 640 kilomètres. (Comme il ressort de l'article 1er, l'originalité de l'invention de M. d'Infreville est contestée).

5. Quadruplex télégraphie, par F. L. Pope. (Telegrapher, vol. XI, page 271).

Des différentes descriptions du quadruplex de MM. Edison et Prescott, c'est une des plus complètes, rendue encore plus intelligible par un dessin détaillé. L'auteur passe en revue tout l'historique de la double télégraphie en sens contraire et dans le même sens depuis Gintl en 1853, se continuant par Frischen, Siemens, Stark, Kramer, Bernstein, Boscha, Schreiber, Wartmann, Maron, Schaak, Stearns, Zetzsche et Henviside jusqu'à Edison et Prescott. La première idée de la télégraphie quadruple appartient à Stark en 1855. Il a montré qu'il n'était besoin que de trouver un système pratique de double télégraphie dans le même sens pour obtenir immédiatement la télégraphie quadruple par son application au système de télégraphie en sens contraire. La difficulté du problème de la quadruplex télégraphie repose donc uniquement dans la difficulté de trouver un bon système de télégraphie double dans le même sens. Si l'on emploie trois différentes forces de courant, il est presque impossible de donner au réglage des relais une sensibilité suffisante et, si l'on se sert de courants alternant en direction, l'un des relais subit une secousse qui trouble les signaux.

MM. Edison et Prescott ont complètement abandonné la voie suivie par les autres inventeurs. Un courant d'une force 1 traverse continuellement la ligne, quand il n'y a d'abaissé aucun des quatre manipulateurs des deux stations. Par le premier des deux manipulateurs d'une station on peut renverser ce courant, par l'autre on augmente la force du courant de 1 à 4 sans changer la polarité qui est toujours déterminée par la position du premier manipulateur. A l'autre station le courant parcourt deux relais, l'un polarisé, l'autre ordinaire, chacun ouvrant et fermant un circuit local. Le circuit local du relais polarisé est fermé quand le courant est renversé par le premier manipulateur, mais ce courant, de la force 1, est trop faible pour agir sur le relais ordinaire. L'armature de ce dernier est attirée à son tour, si la force du courant est augmentée par le second manipulateur de 1 à 4, quelle que soit la direction du courant. Ce double système est transformé en quadruple système par l'intercalation des deux relais dans la diagonale d'un pont de Wheatstone. Les mauvais effets du changement de polarité dans le relais ordinaire et du courant de retour sont paralysés par deux électro-aimants auxiliaires et par deux condensateurs à chaque station.

...E'S magneto-electric machine, devised by M. Nicolai Berquet, two horse shoe-shaped steel magnets are so fixed parallel at a certain interval that their planes are vertical, their branches horizontal, and their four poles in one plane. Beneath axis at right angles to the planes of the magnets, and midway between the poles, are twelve iron cores, parallel to this axis, arranged equally with reference to...

...ROTH.—The Gramme Machine.—The moment I did not give to there a description of this as of inferior quality, but I do not deny to do so now as impossible. [Our quality reader might wish not be able to judge. Ed.] Small machines, such as I was then using, are not to be compared to large ones, and I do not doubt a "Gramme" machine, and I doubt if even now a more simple one than that to my book is to be found when read as a part of the whole machine which excites the principles of all the machines of that class. I may, perhaps, be allowed to say that I have described the principle as efficient a very much simpler machine than ...ma, the Weston Dynamo-electric Machine.—BAMBA.

...ual, and polygonal shapes, either parallel or superior also be cut by this machine."

DYNAMO-ELECTRIC MACHINES.

[1283.]—I should much like to see a full description of the most improved form of these machines, with working diagrams, and descriptions of a sufficiently plain and simple manner to enable amateurs to construct one for themselves. Mr. Wilson-Barker or Mr. Lecomber would undertake, I am sure, to supply any parts difficult of construction, it would take pay them and gratify a large number of your readers. Such a machine could be worked by a model engine, and would be the most economical method of utilising the improved electric lamps that have lately been submitted to the public. W.

Improvement in Dynamo-Electric Machines.

It is stated by the *Bing. Ind. Jour.* that the firm of Schuckert, in Nurnberg, have lately been devoting attention to the improvement of dynamo-electric machines, for galvano-plastic purposes and the electric light. Their machines are like the Gramme, but the following points may be noted. The rotating iron ring, wound with copper wire, is a flat disc; thus the wires of the two long sides of the cross section come under the action of the flat-shaped magnetic poles, and the induced currents of the two sides combine having the same direction. The whole wire length is thus utilised. Centrifugal forces at high velocity does no injury. Again, the iron ring is not in one massive piece, but in several ring discs, separated from each other by ensulite, pasteboard, or the like, the whole ring being held together by brass rivets. The object here is to hasten the disappearance of remanent magnetism, in rapid changes of the poles, and to obtain the maximum of magnetization. This construction allows of the firing of the ring or metal without disturbing insulating section, since only a very small part of the wire is in contact with it, and the coil effects of a possible heating are obviated.

DYNAMO-ELECTRIC MACHINES.*

(CONTINUED.)

The Brush and Wallace-Farmer machines were accompanied by lamps or carbon holders, which were thought by their makers to present advantages, if not for all machines, at least to be especially adapted to the requirements of their own; the "Serrin" lamp, which is made by H. Deyrolle for the Gramme machine, did not accompany the latter. The results of the experiment, however, quickly established the suitability of the Brush lamp, with enclosed carbons, as the source of light from all the machines, and the same lamp, with enclosed carbons properly adjusted as to size, was used for the several trials.

This lamp consists of a helix of insulated copper wire, resting upon an insulated plate, upheld by the metallic post. Loosely lifted within the helix is the core, partially supported by the adjustable springs. The rod passes directly through the centre of pencil. A washer of brass surrounds the rod just below the core, and has one edge resting on the lifting finger attached to the latter, while the other edge is overhung by the head of an adjustable screw stop.

The metal post is supported and guided by a tubular post, secured to a suitable base plate. Attached to the lower end of the post, and passing out through a slot, is an arm supporting an insulated holder for the lower carbon.

If now one conducting wire, from the machine, be connected to the base plate, and the other to the lower carbon holder, the current of electricity will pass up through the posts, and through the helix, rod, and the carbons, thus completing the circuit. The axial magnetism produced in the helix will draw up the core, and the core, by means of the lifting finger, will raise one edge of the washer, which, by its angular disposition against the rod, clamps and lifts it to a distance controlled by the adjustable stop, but separating the carbons points far enough to produce the light.

As the carbons burn away, the increased length of the electric arc increases its resistance and weakens the magnetism of the helix, and, therefore, the coil, rod, and carbon move downward by the force of gravity, until, by the shortening of the arc, the magnetism of the helix is increased and the downward movement arrested. When, however, the downward movement is sufficient to bring the clutch-washer, *c*, *b*, to the support, *t*, it will rock, *t*, will slip through until arrested by the upward movement of the core, due to the increased magnetism of the helix.

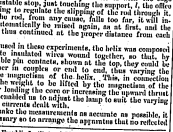
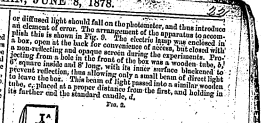


FIG. 8.

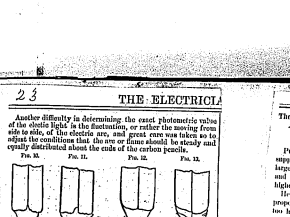
The normal position of the clamp-washer is with the edge under the adjustable pin just touching the support, in the effort of the core being to regulate the slipping of the rod through it. If, however, the rod, from any cause, fails too far, it will instantly and automatically be raised again, as at first, and the carbon points will remain at the proper distance from each other.

In the lamp used in these experiments, the helix was composed of two separate insulated wires wound together, so that, by means of suitable pin contacts, as shown at the top, they could be connected either in couples or end to end, thus varying the intensity of the magnetism of the helix. This, in connection with varying the weight to be lifted by the magnetism of the helix, either by loading the core or increasing the upward thrust of the springs, enabled us to adjust the lamp to suit the varying qualities of the current used with.

In order to make the measurements as accurate as possible, it was found necessary so to arrange the apparatus that no reflected or diffused light should fall on the photometer, and thus introduce plish this is shown in Fig. 9. The electric lamp was enclosed in a box, open at the back for convenience of access, but closed still fecting from a hole in the front of the box was a wooden tube, 5½ 6" square inside and 9' long, with its inner surface blackened to prevent reflection, thus allowing only a small beam of direct light to leave the box. This beam of light passed into a similar wooden tube, *c*, placed at a proper distance from the first, and holding in its further end the standard candle, *d*.



Another difficulty in determining the exact photometric value of the electric light is the fluctuation, or rather the moving from side to side, of the electric arc, and great care was taken so to adjust the conditions that the arc or flame should be steady and equally distributed about the ends of the carbon pencils.



Figs. 10 to 18 are full size, exact reproductions of the photographs taken, and fairly represent the average condition of the carbon when observations were made.

It was found that although there was a slow consumption of the negative carbon there was, at the same time, a constant "dodgeable" current of particles carried from the positive consumed different forms, as shown in the cuts, but no particles or shadows, except that the deposits on the negative carbon would become greater with increased current. These deposits would build up gradually until they had resumed the forms shown in Figs. 16 and 20; then growing narrower near the base, until, by a weakening of the current by this and the consumption of the upper carbon, the latter would readjust itself, and the piece would drop off. The effect of these growths on the intensity of the light was scarcely appreciable, except for a few seconds before and after the readjustment of the lamp.

[TO BE CONTINUED.]

NEW YORK, SEPT. 16, 1878.

The Pawtucket Curtiss Pumping Engine—A Practical Test and an Unexampled Performance.

Pumping engines to furnish a continuous supply of water are in use by most of our large cities and towns; their construction and adaptation calling for exercise of the highest engineering skill.

Heretofore the cost of first class engines in proportion to the actual work done has been too high for the resources of many towns exercising the need of them, and the pressure of our times has given rise to a demand for engines that may be relied upon to deliver more water with less original outlay and less cost of maintenance. The offers to meet this demand have been many; the general result disappointment.

Chanced to hear a short time since of a new style of pumping engine in course of trial at Pawtucket, R. I., and, being in that vicinity, made a visit in time to witness the conditions of that trial. The engine referred to was designed and built by George H. Corliss, of Providence, the inventor and builder of the Corliss Steam Engine, and who furnished the grand engine that ran the machinery at the Centennial Exhibition, who has given much study coupled with exhaustive experiments to produce pumping engines of higher prescribed duty than any others now in use. The trial showed a result considerably beyond the best heretofore on record, during a continuous run of 24 hours and a daily average, the precise coal working conditions being considered, never before equaled so far as we can learn, by any pumping engine in the world. To make the conditions of this test better understood by our readers we have procured a copy of the contract and specifications under which this engine was built for the Pawtucket Water Works, it will be observed from the following extracts that the requirements are unprecedented.

(1.) The engine is to be capable of raising with one three million (3,000,000) gallons of water in twenty-four (24) hours into a reservoir on Gimpy's Hill, two hundred and fifty (250) feet, more or less, above the level of the pump well. It shall force the water level through the pipes now laid in said street, and to pump directly into the distribution pipes during such time as the reservoir shall be under construction until its completion,

and thereafter, when required. It shall be able to do this under the varying conditions then ordinarily obtaining, and with the pressure corresponding to from 240 to 260 feet to the reservoir. It shall be able to do this with reasonable care, steadiness and safety.

(5.) The engine when completed and ready for service shall be subjected to trial each day and capacity; such trials to be conducted by the Chief Engineer of the Pawtucket Water Works and the Inspector, on the part of the party of the first part, with the co-operation of, and in concert with, such parties as the party of the second part shall see fit to appoint; One of said tests each day, and shall be twenty-four hours incessant duty, similar to the Lowell tests in June, 1876, with a similar provision in case of disagreement, as specified in Section 7 and 11 of the "Specifications for a Pumping Engine," hereinafter issued by said Water Commissioners. The other shall occupy two consecutive days, and shall consist of twenty-four (24) hours each day, as nearly as may be with the engines at such a speed as shall guarantee the delivery of 3,000,000 gallons in 24 hours. In this "every-day" running test, all the fuel shall be taken into the furnaces used until for kindling being reckoned as equivalent to 45 per cent. of its weight in coal. No allowance to be made for ashes or clinkers. The coal used in the tests shall be the best coal of the time, and the quantity of water delivered is to be ascertained by water measurement.

(6.) The sum to be paid by the party of the first part to said party of the second part in full compensation for all work and supplies indicated in this contract, is $23,000; provided that it shall appear that the duty of said engine on the 24 hours' trial, hereinbefore provided for, is at least 100,000,000 pounds per one hundred pounds of coal when delivering 3,000,000 gallons of water in 24 hours against a head of 250 feet, and that the duty on the two works "every-day running" test shall be at least 80,000,000 pounds per one hundred pounds of coal.

In consideration, however, that the duty of said engines is less on the every-day running test than hereinbefore stipulated, then said party of the second part shall pay said to a forfeiture on the contract price of one and a half (1½) per cent. of said price for each one per cent. of said deficiency; and if said duty shall not exceed 90,000,000 and 100,000,000 feet pounds, then said party of the second part agrees to allow said party of the first part to remain for the use of said Town of Pawtucket, without charge, for a period not exceeding six months from the expiration of said tests, in order that time may thus be given for the completion of another engine, after which it will remove it at its own cost, without claim for compensation in any way for the work it has done, or the expense it has been put to.

We know of no instance where a contract trial, *as exhaustive and as restricted to the conditions of every day work*, has ever before been demanded.

Its value, however, as showing what a pumping engine will do under the conditions of regular every-day practice, is not to be overestimated. As usually conducted trials last but a few hours, and the results are under exceptionally favorable conditions, *with no proper allowance for fuel used to start the fire*, far outstretch what they will accomplish in average running.

The Pawtucket Curtiss Pumping Engine embodies the important improvements which Mr. Curtiss brought out in the Centennial Engine, and they are here applied to the service of supplying towns with an economical system of water works. It is arranged to work on the compound principle, the high pressure cylinder 32" diameter, the low pressure cylinder 39" diameter. Each has a stroke of 30".

These vertical tubular boilers were used, of the precise plan and dimensions of those furnished by the same to the Centennial Engine, the only differences being in the greater thickness of shell to adapt the boilers to the very high pressure contemplated. Two boilers were used during the ten-hour daily running of the two weeks' trial at a pressure of 123 pounds, and the other for the night service during this trial, at a pressure of 100 lbs. No extra setting of elbows being work was employed. This arrangement be-

Bowman Mac

ing run continuously as the reservoir was not completed as was contemplated when the contract was made, and the town was dependent on continuous pumping night and day.

The two weeks' trial began Tuesday, August 6th, at 8.30 A. M., and was completed Monday, August 19th, at 8 P. M., thus including two Sundays instead of one only, as specified in contract. The coal used was Schuylkill (Shamokin) of the quality used for the current supply of the works, and was taken from the pile *without being picked or selected in any way*. The first day at 7.30 A. M., the fires under the two boilers, which had been left without banking or replenishing since 5 P. M. the previous day, were drawn, the grates cleaned, and at 8.07 new fires were built, using 161 lbs. of wood and shavings, and 220 lbs. of coal to kindle the fire. At 8.30 A. M. the engine was started and the trial began, the engine making an average of 21 revolutions a minute, steam at an average of 125 lbs., and delivering the water under head of 220 feet, including the estimated friction of the main, throughout the trial. A record was taken every ten minutes of the reading of gauges (water, steam, vacuum and receiver), the counter and the coal-scale from the center of the water gauge to surface of water in pump well. Every stroking of coal was weighted and time noted. The engine stopped at half-past six in the evening. The fires under the boilers were allowed to smolder until 7.30 next morning when they were banked, new fires built, and the trial proceeded with, continuously in this way, from day to day. It was found on Monday morning that an extra amount of coal was required to get up steam after an interval of 38 hours' rest against 14 hours of other days.

The coal taken from under the boilers was again used (after being sifted), no allowance being made for waste. An average of 85 lbs. of wood and shavings and 220 lbs. of coal was used every morning to start the fire under each boiler. The method employed of keeping an exact record of every pound of fuel used, both during the time of trial and in fi ing to make ready for trial, serves as *an effectual check to overstoking the fire*, as the fireman knows that when he commences a trial, where the record begins with starting of the engine, without allowance for coal piled upon the grate he is making ready. It often occurs, in computing the results, in trials of this kind, that no account is made of the wood used to kindle the fire, as less will be usually from 3 to 6 per cent. of the whole fuel used. In trials where the coal had been picked by hand, the apparent duty has been considerably increased. As shown by an expert, in his trial of the celebrated Lynn engine, in 1874, this excess of duty (as determined by the refuse) was 10.8 per cent.

At this trial each of the parties were represented by three practical men who took the records and carefully watched every detail.

The duty for the 15 days' trial, reckoning all the fuel used (wood at 45 per cent. of its weight in coal) *was not less than* 101,000,000 *foot pounds per* 100 *pounds of coal*. The duty for 21 hours *was not less than* 120,000,000 *foot pounds per* 100 *pounds of coal*. The Corliss during these tests delivered at the rate of 3,060,000 *gallons in* 24 *hours*. The representatives of both parties agree upon these results, which we hope to give entire in our next issue. We hesitate in saying that *no such results have ever before been achieved in a practical test of a pumping engine*. In comparing the work done by this engine with the best performances hitherto exhibited by others, it must be borne in mind that the rigor of the conditions under which this trial was made was such as to *preclude any species of manipulation to enlarge upon the ordinary duty performed*. Experts who were present while the trial was in progress, and who examined the methods employed, units in declaring it conducted with a degree of accuracy in every detail never before coming under their notice in testing a pumping engine. The most critical could find no feature to take exception to in any of the arrangements nor lack of scrupulousness in carrying them out. We had the pleasure of conversing with two of the experts here referred to, Mr. W. H. Odell, of Yonkers, and Mr. Thos. D. Stetson, of New York, (the former at one of the trials who expressed the belief that the performances of this engine was *beyond precedent*, and that a trial of such duration and care in checking possible error had never before taken place. Our own observations agree with this. The Pawtucket Curtiss Pumping Engine has been regularly working since the last day of January, and during the whole time there has been no failure of any part. Its operation is smooth and safe at very high speed, and no engineer has pointed out any liability to accident.

A number of special trials have been made in order to show what the engine will do under different conditions of water pressure from 69 to 117 lbs. These results will doubtless, in due time, be given to the public in detail. Efficient service has been performed by this engine in several cases of fire in the town. It has also been severely tried when architects have occured in the pipe mains where the pressure has been suddenly relieved, once by the blowing off of a 12-inch water gauge.

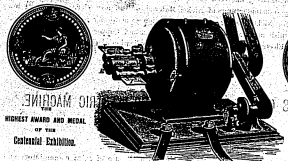
The tests that have taken place prove, beyond doubt, that Mr. Corliss has produced a pumping engine capable of much greater average practical duty, and at cost to the purchaser below what has heretofore been paid for engines of high duty, and which is calculated to work as great a revolution in water works engineering as the introduction of the Corliss Engine, thirty years ago, wrought in the application of power for manufacturing purposes.

We call attention to infringements of the WESTON DYNAMO-ELECTRIC MACHINES, in which Automatic Switches are used to prevent change of current.

The Weston Company are owners, by grant or purchase, of all forms of Automatic Switches for Electrotyping and Plating Machines. The adoption of these Machines will certainly lead to great loss to parties purchasing or using them.

WESTON

Dynamo-Electric Machine Company



HIGHEST AWARD AND MEDAL OF THE Centennial Exhibition.

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Machines for Electro-Plating, Electrotyping, Electric Light, Telegraphing, etc.

Owing to the introduction of several new sizes of the WESTON DYNAMO-ELECTRO MACHINES, and the surprising results obtained from them by our customers, we have decided to issue the following price-list in advance of our complete catalogue.

The WESTON DYNAMO-ELECTRIC MACHINES have now been in successful operation for over two years, during which time we have sold over 800 Machines. The fact that all the early Machines are still working perfectly, and in most cases the Machines during the whole time of working not having cost $5.00 for repairs, will show their great economy over batteries. The new 14-inch Machines, which have been recently perfected, show the wonderful power peculiar to the Weston construction when increasing the size. A Machine only slightly larger than the 12-inch, developing three times the

Vol. XXXIX.—No. 9.
[NEW SERIES.]

NEW YORK, AUGUST 31, 1878.

$3.20 per Annum.
[POSTAGE PREPAID.]

THE BALANCE DYNAMOMETER.

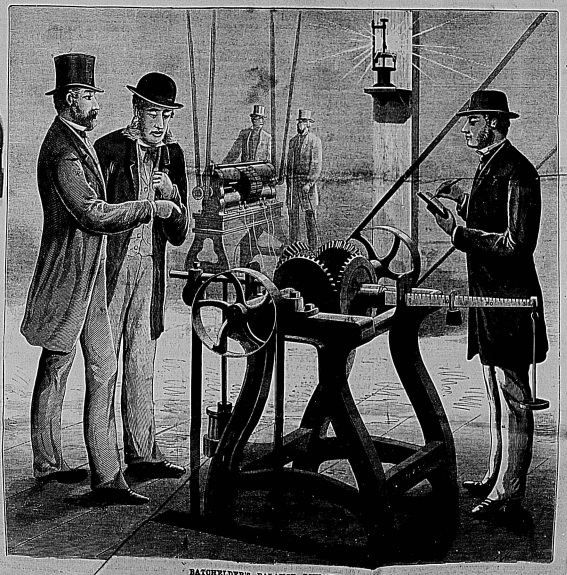
Although many forms of dynamometers have been devised, none of them are more simple or more reliable than the one invented more than thirty years ago by Mr. Samuel Batchelder, of Boston.

This instrument, which is of great value in practical mechanics, is exceedingly simple and is fully adapted to its object. It is made of suitable dimensions and strength for the degree of power to be measured, and when it is used it is placed in the line of communication between the motor and the machinery to be moved, the power exerted on the machinery may be exactly measured by means of the steelyard and weight, which form a part of the machine. There is also connected with it an index to note the number of revolutions of the drum for a given time, which being observed, together with the weight, the data are obtained for computing the number of pounds which would be raised 1 foot high per minute by the power exerted at the time upon the dynamometer and transmitted through it to the working machinery.

Our large engraving represents the dynamometer in actual use in connection with dynamo-electric machines, while the cuts, Figs. 1 and 2, page 136, exhibit the details of construction. In these figures A A and B B are two pairs of belt pulleys, each pair consisting of a fast and loose pulley. The machine receives its power from the prime mover by a belt on the pulley, A, and the power is transmitted to the machine which is the subject of experiment by a belt from the pulley, B. The fast pulley, A, has the bevel wheel, D, are fast upon the shaft, C, which revolves in bearings, I. The bevel wheel, F, is connected with the pulley, B, by a sleeve, K, which is capable of turning on the shaft, C. The bevel wheels, D, F, are geared together by the bevel wheels, E, E, which run upon a cross shaft having a hose, G, through which the main shaft passes freely. It is evident that if this cross shaft is not retained in its place by some adequate force, the motion of the bevel wheel, D, will only cause the cross shaft to move round upon the shaft, C, and the wheels, E, will roll upon the wheel, F, without communicating motion to it, or to the pulley, B; but if the wheels, E, and the cross shaft are held stationary, the motion of the pulley, A, will be communicated to the pulley, B, through the bevel wheels, and the force then applied to retain the shaft, G, and wheels, E, in place will indicate the power transmitted through the dynamometer. The amount of power is ascertained by means of a graduated scale beam, H J, connected with the shaft of the wheels, E, by straps, a.

The weight, M, fastened to the shorter arm of the graduated beam by a set screw, affords a means of balancing the beam when the machine is at rest, and the weight, W, like that of a common balance, moved on the graduated arm of the lever, will indicate the strain upon the belt. The num-

[Continued on page 132.]



BATCHELDER'S BALANCE DYNAMOMETER.

THE GRAMME DYNAMO-ELECTRIC MACHINE FOR PRODUCING ALTERNATING CURRENTS.*

Two recent improvement in the Jablochkoff system of electric illumination, and that which has given to it its present success, is the employment of an alternating current of electricity for establishing the electric arc between the carbon pencils. If the Jablochkoff candle is used with a continuous current, the positive carbon is consumed at twice the speed of the negative, but with a properly alternating current instead of a continuous one, the carbons are consumed at an equal rate, each being alternately positive and negative in the other, and an alternating current possesses this further advantage, namely, that each stick of carbon is kept beautifully pointed instead of rough and irregular, and this symmetrical consumption of the carbonaceous matter is a great source of steadiness in the light.

The Jablochkoff candle may be used with advantage with any dynamo-electric machine which produces an alternating current, or by a continuous current machine fitted with a commutator, by which the direction of the current is reversed every few seconds, but this arrangement for obtaining from a continuous current machine two currents in other dynamo-electric machines, can only be accomplished by great loss of electricity, and, therefore, of motive power; and it has been found much more economical and advantageous to use machines where currents are originally generated in alternating directions. Mr. Gramme, the inventor of Siemens' machine, and of many others, would appear, from the Scientific American, to have designed a machine for the purpose, to this new machine of M. Gramme which is shown in the engraving, and which is described in the Engineering. The electro-magnets, of which there are eight, are fixed radially to a central boss, *f*, revolving upon a horizontal steel shaft, *e*, running in suitable bearings attached to the framing, and an external pulley enables the machine to be driven by a band from a steam engine or other motor. The radial electro-magnets are alternately right and left handed in the direction in which their coils are wound, as that if they be numbered 1, 2, 3, 4, etc., up to 8, respectively, those represented by the even numbers are similarly wound in a current is sent through them all together, while those whose numbers are odd are wound in the opposite polarity. The poles of each of these magnets are, of course, of the magnets, are turned out so as to increase the size of the non-magnetic gap in which electric currents are induced in the coils of the ring.

In the old machine of M. Gramme, the electro-magnets were excited by the current from a special Gramme machine mounted on the same shaft as the two rings which generated the available current, and the current from the fine ring was exclusively devoted to exciting the electro-magnets. In further improvements upon his continuous current machine, M. Gramme dispensed with an extra and special ring for charging the magnets, and devoted a portion of the current from a single ring to that purpose, two coils being wound on the same ring. In the present machine, however, there is no self-contained apparatus for producing the current by which the electro-magnets are charged, although there is nothing to prevent an ordinary Gramme machine being attached to the same shaft. It is found more convenient, however, to use the new machine simply as an apparatus for dividing the current, and for giving to it a reciprocating nature, and, therefore, an altogether separate electro-motor is employed. An ordinary volute battery of sufficient power would answer the purpose, but in practice a small and separate Gramme machine of the continuous-current type is employed, driven by a separate strap, and the current from this machine being caused to traverse the coils of the rotating radial electro-magnets, they are magnetized to saturation with but a small expenditure of motive power.

Each of the eight sections of the induction-ring are made up of four sections, *a*, *a*, *a*, *a*, *a*, etc., all of which, in any one section, are wound in the same direction. By coupling the coils of these sub-sections in various ways, a division of the current may be made into 32, 16, 8, or only 4 circuits, and this is one of the most valuable qualities of the system.

From a consideration of the above description, it will be seen that all the sub-sections or coils marked *a* are influenced by the rotating magnets in precisely the same manner, for the influence of a north pole upon a coil wound in a positive direction is exactly the same as the effect of a south pole upon a coil wound in a negative direction, and similarly the currents induced in the coils marked *a* are similar in direction to one another, no matter what may be the position of the rotating magnets. In the same manner all the currents from the sub-coils marked *b* are homologous to one another, all that is necessary is to connect up the series of the coils marked *a* for the first circuit, all the coils marked *b* for a second circuit, all the coils marked *c* for a third circuit, and all the coils marked *d* for a fourth circuit. As the induction rings turn first, there is no difficulty in leading the current from the machine, and the apparatus is fitted with terminal screws on the exterior of the rings by which they can be collected, and by which variations in the method of coupling up may be made.

The current for the small machine is led to the rotating magnets through flat brushes composed of silk-worm gauze wire fixed to the frame work of the machine, and rubbing against two insulated drums or cylinders of copper, the two being connected to one end of the magnet-circuit and the second to the other.

When the shaft carrying the magnet is rotated, the expanded magnetic poles pass close to the coils of the induction-ring, and in so doing induce within them currents of electricity, the strength of which depends upon the intensity of the magnetic field through each coil, and, furthermore with the speed of rotation.

The new Gramme machine, as at present constructed, is made in three sizes. The largest is capable of supplying the current to 24 Jablochkoff candles, at a speed of 800 revolutions per minute, and absorbing a motive power of about 18 horse power, costs, with the smaller machines for charging the storage batteries, 10,000 francs (=£400), its length, including the steam engine, is 25 ins., its width 20 ins., and its height about 24 ins. The same; the total weight is a little over 1216 cwts. The second size machine requires 12 horse power to drive it, at a speed of 700 revolutions per minute, and supplies the light of 12 Jablochkoff candles, and costs, with its small machines, 5,000 francs (£200). It measures 22 ins. in length, 18 ins. in width, and 20 ins. in height, and weighs rather over 5 cwts. The smallest size actinetic, at a speed of 800 revolutions per minute, a Jablochkoff lights, and absorbs 4 horse power of motive power. Its dimensions are as follows: Length, 21 ins.; width, 16 ins.; height, 18 ins.; and its total weight is about 3½ cwts. In addition to these three Gramme, M. Gramme has a new machine in hand, which differs in construction, in several material points, from those to which we have referred, and from which he hopes to effect a saving in both the prime cost and the cost of working the machine. It is designed for use with 8 Jablochkoff candles.

It will appear from the above figures that the power absorbed is almost exactly one horse power for each candle, and the result of a year's working of the system at the Hotel and Magazins du Louvre very closely supports that estimate.

That M. Jablochkoff has solved the problem of producing a steady electric light, requiring but little attention, and suitable for street illumination of a very beautiful order, must be self-evident to all visitors to Paris at the present time.

Whether the system, however, is a success in an economical and commercial point of view, is another question altogether, and remains to be proved. We are rather inclined to the opinion that in its present stage it is rather costly, although light for light it will compare favorably with gas.

The whole system, much as it adds to the beauty and attractions of the city of Paris, must still be looked upon as in its childhood; it is rather more than a step, it is a long stride in the right direction, and we cannot but believe that further improvements, both in the construction of the machines for generating the electrical currents and in the apparatus for converting those currents into centers of illumination, will have brought all obstructions placed in its path.—*Journal Franklin Institute.*

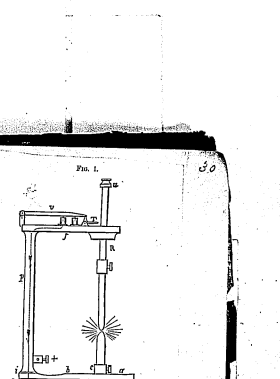
A NEW SYSTEM OF ELECTRIC LIGHTING AND A NEW FORM OF ELECTRIC LAMP.

By Profs. Elihu Thomson and Edwin J. Houston, of the Philadelphia Central High School.

HAVING been engaged in an extended series of experimental researches on dynamo-electric machines, and more especially on those for electric lighting, our attention has been directed to the production of a system that will permit the use of a smaller current for sustaining an electric light than that ordinarily required, or, in other words, the use, when required, of a current of sufficient intensity to produce a continuous arc. At the same time, our system permits the use of a powerful current, in such a manner as to operate a considerable number of electric lamps placed in the same circuit.

As is well known, when an electrical current, which flows through a continuous arc, or considerable length, is suddenly broken, a bright flash, called the extra spark, appears at the point of separation. The extra spark will appear, although the current is not sufficient to sustain an arc of any appreciable length if a point of separation is made.

In our system, one or both of the electrodes, which may be the ordinary carbon pencils, are caused to vibrate to and from each other. The electrodes are placed at such a distance apart that in their motion from each other they are gradually afterwards receive a distance apart which can be regulated. These motions or vibrations are made to follow one another at such a rate that the effect of the light produced is continuous, or, in other words, a light which does not flicker is produced by a rate greater than twenty-five in thirty per second, the electrodes being in a continuous circuit. The vibrations of one or both of the electrodes may be communicated to the electrodes by any suitable mechanism, such, for example, as mechanism operated by a rotating or reciprocating, or vibrating, armature, etc., but it is evident that the current itself fur-



nishes the most direct method of obtaining motion, as by the use of an automatic vibrator or an electric engine.

In practicing with this system in both electrical and we found it necessary to give motion to but one, and to have the negative electrode may be made of such size as to waste very slowly, motion is imparted to it in preference to the positive, which, of course, in practice may be formed by those of various substances of sufficient conducting power.

In this system, when desired, an independent battery circuit is employed to control the excitation and lighting of such lamps.

A NEW ELECTRIC LAMP.

The following is a description of one of the forms of electric lamp which we have devised, and used in connection with our system of electric lighting:

A frame, *a*, *a*, of metal is firmly attached at one of its ends to a pillar, *p*, and bears at its other end an iron armature, *a*, placed opposite the adjustable pole-piece of the electro-magnet, *m*. A metal collar, *c*, supports the negative electrode, *n*. The positive electrode being supported by an adjustable collar on the pillar, *p*. The pillar, *p*, is divided by insulation at *i*, into two sections, the upper one of which consists of the rod, *b*, again restores the contact. During the movement of the negative electrode, since it is caused to move many times per second, the positive electrode, though practically free to fall, cannot follow the rapid motions of the negative electrode; and, therefore, does not rest in permanent contact with it. The slow fall of the positive electrode may be insured either by properly proportioning its weight or by partly counterpoising it. The positive electrode thus becomes self-feeding.

The rapidity of movement of the negative carbon may be controlled by means of the right bar, *l*, which acts, practically, to shorten or lengthen the part vibrating.

In order to obtain an excellent but free contact of the arm, *a*, with the positive electrode, the rod, *b*, made of iron or other suitable metal, passes through a cavity, *s*, Fig. 2, filled with mercury, placed in electrical contact with the arm, *a*.

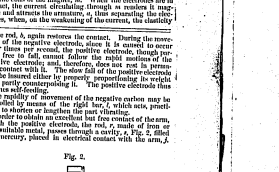


Fig. 2.

Since the mercury does not wet the metal rod, *r*, or the sides of the cavity, *s*, there is no danger of its overflowing, and the rod is allowed without any escape of the mercury. We believe that this feature could be advantageously introduced into other forms of electric lamps.

The electrical connections, occurring in the circuit, when the electrodes are connected, is traced, a, to the upper extremity of the rod, *b*, at such a distance that when the carbons are connected as much as is deemed desirable, it comes into contact with a tripping lever, *l*, which then allows the conducting plugs, attached to the bar, *r*, to fall into their respective mercury cups, attached, respectively, to the positive and negative binding-posts by a direct wire. This action practically cuts the lamp out of the circuit.—*Franklin Journal.*

THE BRITISH ASSOCIATION.

COMMENCED NOTICE.

On Tuesday, August 30th, the seventh day of the meeting, the business in Section G commenced by the presentation of the following reports of committees: "On Instruments for Measuring the Speed of Ships;" "On the Datum Level of the Ordnance Survey and on Tidal Observations in the English Channel." The first paper read was by Mr. J. N. Shoolbred "On Electric Lighting." This paper, which attracted a great many visitors to the section, and which we intend to publish *in extenso*, began by referring to the suggestion first made by M. Nollet, of Brussels, in the year 1810, of turning to account Faraday's great discovery of the induction of electricity from magnetism by the construction of magneto-electric machines. This suggestion, first taken up by Pixii, Clarke, and others, ultimately led to the construction of the Holmes and Alliance machines, which were used at the lighthouses of the South Foreland, Cape Grisnez, and La Hève. The paper then went on to refer to the researches of Siemens and Wheatstone and Varley, which led to the discovery of the reaction principle, the basis of all so-called dynamo-electric machines, which in Europe are represented by the machines of Siemens and Gramme, and in America by the Brush and Wallace-Farmer machines, descriptions of the Siemens, Gramme, and new Gramme machines being given. The paper next describes the systems for the subdivision of the electric light, the two most important of which at present are the Lontin system, now employed in London outside the Gaiety Theatre, and the Jablochkoff candle, which has been fully described in these columns.*

After describing some of the many forms of electric regulators for lamps, referring to the importance of obtaining carbon pencils of great uniformity of structure, the paper touches upon the question of horse power required to drive the apparatus, and concludes with a few remarks upon the cost of working under the different systems.

At the conclusion of the paper the president, Mr. Edward Easton, C.E., called upon Mr. J. N. Douglass, the engineer to the Trinity House, who opened the discussion by making a few remarks upon the application of the electric light to lighthouses, and referred to the experiments made for the Trinity House at the South Foreland by Professor Tyndall and himself, which were fully described in these columns nearly a year ago.† Mr. Douglass also referred to the establishment of the electric light to the two lighthouses which mark the southern extremity of the Lizard promontory.

Mr. J. H. Wigham said that from his experience of the Gramme machine, which had been considerable,

* See ENGINEERING, page 93 ante 125 ante.
† See ENGINEERING, page 93 ante.

ENGINEERING.

he had great confidence in it for the production of the electric light. He had had one which for months had been subjected to the roughest treatment, and which had kept in working order. He did not consider that the electric light would prove, for some time to come, any serious opponent to illumination by coal gas, so as to affect to any permanent degree the income of gas shares. He considered some doubt whether the electric light was any cheaper than gas, but there was a question to be decided whether the small intense light of the electric arc was superior for lighthouse illumination to the larger flame derived from gas or oil, that is to say, whether it possessed good fog-penetrating power.

Mr. Robert Briggs, of Philadelphia, U.S., said that he desired particularly to call attention to a recent report of a Committee of the Franklin Institute of Philadelphia, on dynamo-electric machines which, exhibited the relations of light, heat, and electric force with much completeness, as brought out by careful experiment and investigation for considerable time. Upon this Committee the speaker had the honour to serve, and he wished to give testimony to the diligence and labour expended by the several members during the three months of examination.

Every effort had been made to prepare a thorough and impartial report. (Mr. Shoolbred here said that this report was considered by him and had been abstracted to in his paper.) Mr. Briggs said that beside this report of the Franklin Institute, there had been a further inquiry into the subject of electric lighting, which had not been published up to the time that he left the United States. This inquiry was made at the instance of the exhibitor of the United States Capitol at Washington, Mr. Edward Clarke, who had, at the request of a Committee of the House of Representatives, referred to him the proposition to light the Hall of Representatives by the electric light by means of the dynamo-electric machine patented in the United States by Mr. Brush. The machine was one of those experimented upon by the Committee of the Franklin Institute.

The objects to be attained at Washington were first an abundance of light, secondly, removal of the heat emanating from gaslights, and, thirdly, the practical accomplishment of the first and second requirements with an expenditure which would compare favourably with the present cost for coal gaslighting. The experiments of the Franklin Institute, and a further practical illustration in the lighting of a railway station of the Pennsylvania Railroad at West Philadelphia, by a system of four separate sources of light from one dynamo-electric machine, satisfactorily demonstrated the feasibility of lighting the hall with regularity and with a quantity of light equal if not superior to what now proceeds from the gas burners over the ceiling. The experiments of the Franklin Institute gave with great exactness the quantity of heat given off, and permitted a direct comparison to be made with the heat accompanying the combustion of the gas. The cost was also determined with much certainty, for the power required and its commercial value in pence was readily estimated at well-known rates, and the attendance and repairs of apparatus, interest on plant, and a supposed substitution and renewal in two years, gave a good basis for the cost of maintenance and service.

It may be well, therefore, to quote the estimate of the cost of electric lighting in the case as compared with the present gas-lighting. The experiments of the Franklin Institute showed that about 14 ½ horse power would be consumed in driving dynamo-electric machines operating four lamps, each of 2000 candle power, and it was proposed to use three such machines, calling for 43 horse power in all. When:

	dols.
Taking 43 horse power for three hours' daily average use per day at 15½ cents per horse power	5.03*
One principal of electric lighting apparatus per day	5.00
Two assistants at 2.50 dols. per day	5.00
Carbons	1.35
Twenty per cent. of cost of apparatus 12,000 dols.=2400 dols.÷365 days ...	7.65†
Total approximate cost of lighting the Hall of Representatives by electric light, per day	24.00

* The above price is estimated at the rate of 125 dollars per year per horse power for ten hours per day, for 312 working days per year, which is a full profit rate for power supplied in small quantities.

† This percentage to cover interest, repairs, oil, &c., and 10 per cent. for supposed renewal of the whole each two years.

To effect the same purpose there are now at the present consumption of gas in the roof space about the glass ceiling of the hall, 1920 burners, each burning about 4½ cubic feet per hour, giving 8650 cubic feet per hour, or 16,600 cubic feet for three hours, assumed daily consumption. Taking thus 16,600 cubic feet at 3.200 dols. per M.=19.60 dols., or very closely twice as much as would define the cost of electric lighting. These values would vary in some degree by being estimated at English prices, but considering that the electric apparatus proposed is the most complete possible, and that the whole had been estimated at American prices, Mr. Briggs believed to think that a solution based on English prices throughout would be quite as favourable.

The report to Mr. Clark makes one comparison of the highest importance in this place with respect to the ventilation of the hall as to the heat evolved by the two systems respectively, and establishes the fact that only about one thirty-fourth part as much heat is given off by the electric light—that is to say by the arcs themselves—as is evolved by the gas burners, as they are now placed.

The total heat from gas-lighting of the whole of the upper level temperature of the escaping gases (omitting the latent heat of the water, which it is supposed is not condensed but diffuses as vapour) is nearly one hundred times that which proceeds from the arc giving equal quantity of light; but on the other hand the heat of the arc is only, according to the Franklin Institute experiments, about 31 per cent. of the total heat theoretically required for driving the dynamo-electric machines, the remainder being dissipated or conducted away either as heat or as electric current not utilised, so that the light-giving capacity of the electric light can be taken to be about thirty-one times that of a gaslight. With these facts in view Mr. Briggs protested against the assumption that as the light of the future the gaslight, as it is, occupies a strong place in the field of competition. We have long known that in the production of light by the combustion of oleaginous substances, hydro-carbons, of which coal gas is a good if not the most favourable type, a large amount of heat has been generated, a small portion only of which will have been expended in heating to incandescence, but a portion of the carbon, which will have been found in particular hydro-carbon gases (of the mixture known as coal gas) in the form of C_{14}, H_{12}. The heat proceeding from the burning of all the gas, except the C_{14}, which at most amounts to over 12 to 16 per cent. by weight, if so much) is expended in establishing the heat of incandescence, and maintaining it through a small flame, in the consumption of which the C_{14} also come to the air, and is consumed itself with the evolution of further heat.

Heat is force, and it was—said Mr. Briggs—not until the electric light, as produced by the dynamo-electric machine, gave us a measure of the force accompanying light, that we came to appreciate how unscientific, as regards the utilisation of heat, the gaslight is. We now know positively that by means of the electric light (not what may be the best result by any means) about 100 times as much heat will proceed from the theoretic combustion of coal gas as attends or is incident to the electric arc, that as a practical result 30 times as much heat is evolved from gaslighting as will impel a perfect heat engine to produce the electric light; and (taking the average best steam engine at 0.14 in useful effect as a heat engine) the heat from coal gas burning, as fuel, ought to give 4.2 times as much light through the intervention of the electric source of light with the apparatus of a dynamo-electric machine. Every showing is distinctive to the future of coal gaslighting in the competition, the advancement of science looks to the overcoming of the mechanical difficulties, and to the accomplishment of the fullest theoretic results. The absolute economy of electric lighting, as compared to gas-lighting, is so enormous that the time cannot be far distant when the former must take the latter's place for extensive illumination.

Mr. Denny Lane said that in his opinion the electric light would not be likely to take the place of gas. It was not the case that two systems of illumination occupied different ellerie, which in very few instances could be said to overlap one another, so as to dispute the same ground. In this view he was supported by Dr. G. William Siemens, with whom he had recently had a conversation on the subject. Light for light he believed the cost of electric illumination to be about one-half of that of gas, but it was impossible to produce by means of electricity, with any sort of economy, a single light of less illuminating power than that of a thousand candles, and there were many cases in which it would be better to have a hundred lights of ten candles power each, to one light possessing the concentrated illuminating intensity of the hundred distributed lights.

vivante qui électrisera, et qui est le révision du temps.

MACHINE MAGNÉTO-ÉLECTRIQUE

de M. de Méritens

Le débouché commercial et industriel qu'a ouvert dans ces derniers temps la lumière électrique aux machines d'induction électro-magnétiques, a provoqué de toutes parts des recherches et des perfectionnements qui ont fait avancer considérablement le problème de l'éclairage par l'électricité. Tout le monde connaît aujourd'hui les belles machines que MM. Siemens, Gramme et Lontin construisent, et on saisirait en les voyant qu'il serait difficile de les perfectionner davantage. Toutefois nous croyons que la solution définitive du problème n'est pas encore atteinte, et il est probable que d'ici à peu de temps nous verrons mieux encore. Déjà la machine que vient de construire M. de Méritens est un pas considérable fait en avant dans cette voie, et je suis autorisé à croire que cette machine, qui a déjà étonné ceux qui l'ont vue fonctionner, n'a pas encore dit son dernier mot.

Pour nous, qui avons suivi dès le début les progrès de ces machines, qui avons nous-même contribué aux premiers perfectionnements qui leur ont été apportés, nous voyons avec un véritable plaisir cette marche progressive de cette industrie qui est en quelque sorte née en France. Mais tout en les admirant, nous ne devons pas oublier que c'est à la compagnie l'*Alliance* et à son habile ingénieur M. J. Van Malderem que nous devons cette magnifique application de l'électricité.

A ce propos, nous croyons qu'il ne sera pas sans intérêt pour nos lecteurs de raconter brièvement l'histoire de ces machines.

En 1856 M. Nollet, constructeur belge, avait construit pour la galvanoplastie de grandes machines magnéto-électriques du système de Clarke qui donnèrent déjà d'assez importants résultats pour provoquer la formation d'une compagnie qui voulut les exploiter dans le but d'extraire le gaz de l'eau. Cette idée était insensée; mais précisément à cause de cela, elle trouva des adhérents, et ce fut cette compagnie qui, sous le nom de l'*Affluent*, installa dès 1855 dans des bâtiments attenant à l'hôtel des Invalides, les premières grandes machines magnéto-électriques connues en Europe. Naturellement les résultats obtenus furent déplorables, et en 1856 la compagnie fut obligée de liquider.

Elle se réorganisa ensuite en 1856, et après avoir nommé pour son directeur, M. Berlioz, elle chercha à tirer parti du matériel considérable qui avait été créé; ce fut alors que je fus consulté et que j'indiquai à M. Berlioz les applications qu'il pouvait en faire à la lumière électrique et à la galvanoplastie; mais pour y parvenir, bien des perfectionnements devaient être introduits dans ces machines, et tous les électriciens de l'époque apportèrent chacun leur pierre à l'édifice.

Parmi ces perfectionnements, il en est un suggéré par M. Masson, alors professeur de physique à l'École centrale et que j'aurais amené voir ces machines, qui permit instantanément de doubler les effets obtenus. Ce fut de supprimer le commutateur jusque-là employé dans toutes ces machines. Tous ces perfectionnements admirablement interprétés par M. J. Van Malderem, parvinrent, conjointement avec ceux qu'il y apporta lui-même, de faire arriver ces machines à une perfection qu'on n'aurait guère osé espérer dans l'origine, et qu'on croyait bien ne pas pouvoir être dépassée. Ce fut alors qu'on songea à en tirer parti pour l'éclairage des phares et pour l'illumination de la marche des navires; des expériences furent alors tentées conjointement avec MM. Teyssand et Degrand, et bientôt, en 1863, les phares de la Hève purent être éclairés de cette manière.

En même temps, on faisait pour l'application à la navigation des expériences qui n'eurent pas d'abord tout le succès qu'on pouvait en espérer, surtout à cause du mauvais vouloir qu'on rencontra dans la marine, mais qui devaient fournir plus tard des résultats dont on put apprécier l'importance. Ce fut la France qui précéda les autres nations dans cette double voie, comme c'est elle qui les précède encore pour l'éclairage public. Mais nous devons dire que c'est grâce à la compagnie l'*Alliance* et à la courageuse initiative de son intelligent directeur, M. Berlioz, que le monde civilisé doit ces belles applications de l'électricité.

Ce tribut d'hommages rendu à une compagnie dont la fortune ne seconda pas les efforts, nous allons examiner les progrès accomplis dans ces dernières temps en dehors d'elle.

La machine l'Alliance était une machine magnéto-électrique, c'est-à-dire une machine composée d'aimants permanents et de bobines d'induction. Dans son dernier modèle, elle mettait en contribution 18 aimants et quatre rouleaux munis chacun de 16 bobines d'induction; elle fournissait des courants alternativement renversés, et pouvait alimenter trois bougies Jablochkoff; elle employait comme force motrice environ trois chevaux, et marchait à une vitesse de 400 tours par minute. Aucun dégagement n'était produit dans la machine, et la lumière qu'elle fournissait était très-régulière.

Dans des conditions tout à fait exceptionnelles, ce rendement a été très-augmenté, et on a même parlé d'une machine pouvant alimenter six bougies; mais les machines ordinaires sont loin de fournir de pareils résultats. Or, la machine dont nous allons maintenant parler peut, avec huit aimants seulement (aimants de même grandeur que ceux de l'Alliance), illuminer de trois à quatre bougies Jablochkoff et fournir également les courants renversés qu'on regarde, avec raison, comme un élément favorable pour l'éclairage public!

Il est vrai que la vitesse de la machine est plus grande, car elle accomplit sept cents tours par minute; mais elle ne dépense, m'a-t-on assuré, que soixante dix-huit kilogrammètres de force motrice, c'est-à-dire un peu plus de un cheval vapeur, et ne s'échauffe presque pas. Ses dimensions sont très-petites, et les éléments de sa construction sont simples et faciles d'ajustement et de construction.

Les effets avantageux de ce genre de machines résultent de ce qu'aux courants d'induction déterminés dans l'anneau des machines Gramme, sont ajoutés ceux qui se produisent dans les machines magnéto-électriques ordinaires.

Pour qu'on puisse les comprendre, imaginons-

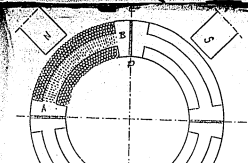


Fig. 6

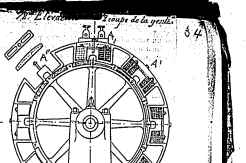


Fig. 1

Détails des bobines et de l'aimant.

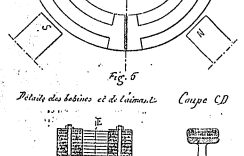
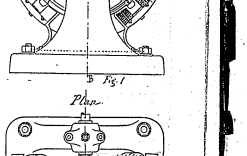


Fig. 4

Coupe CD



Coupe EF suivant la ligne ab

Plan

Fig. 3

Coupe AB

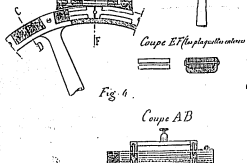


Fig. 2

MACHINE
MAGNÉTO-ELECTRIQUE
DE
M. De MÉRITENS

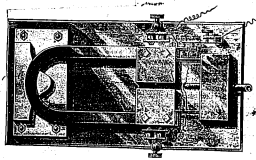
Fig. 1. — Élévation verticale de la machine.
Fig. 2. — Coupe verticale de la machine.
Fig. 3. — Vue en plan de la machine.
Fig. 4. — Détails de construction de la machine avec coupes suivant CD et EF, et détails de construction des bobines et de l'aimant qui composent l'inducteur.
Fig. 5. — Figure démonstrative du principe de l'appareil.

Échelle de 1/10 d'exécution.

MOTEUR MAGNÉTO-ÉLECTRIQUE HARMONIQUE

DE M. EDISON.

Ce moteur magnéto-électrique se compose d'un aimant en fer à cheval de grandes proportions et



Moteur harmonique de M. Edison.

Les tiges mobiles possèdent des tiges qui pénètrent dans une boîte fermée où se trouve le dispositif destiné à recueillir le courant.

Le tube qui termine à droite l'appareil est destiné à laisser arriver l'eau d'une pompe que le moteur de M. Edison met en mouvement.

Il y aurait intérêt à savoir comment l'inventeur du phonographe s'y est pris pour recueillir des mouvements si rapides et à une si faible amplitude, mais il ne nous a point donné ce renseignement.

Jusqu'à plus ample information, nous ne voyons pas en quoi cette combinaison se distingue d'une multitude d'autres qui ont été tentées avec des succès toujours assez médiocres.

Pour que cette machine puisse marcher d'une façon satisfaisante, il faut que les deux branches oscillent bien d'accord. C'est de là que vient le nom de machine harmonique qui lui a été imposé.

Le Propriétaire-Gérant: G. TISSANDIER.

16426.—Typographie Lahure, rue de Fleurus, 9, à Paris

DYNAMO-ELECTRIC MACHINES.

[15083.]—I should much like to see a full description of the most improved form of these machines, with working diagrams, and described in a sufficiently plain and simple manner to enable amateurs to construct a small machine themselves. If Mr. Wilmershurst or Mr. Lancaster would undertake this, and also supply one parts difficult of construction, I should be glad to subscribe for a number of your copies. Such a machine could be worked by a model engine, and would be the most economical method of utilising the improved electric lamps that have lately been submitted to the public. W.

MAGNETO-ELECTRIC MACHINES FOR LIGHTHOUSES.—The magneto-electric machine, adopted by MM. Sautter, Lemonnier, and Co., for the illumination of lighthouses, as shown by them at the Paris Exhibition, is a continuous current Gramme machine. When connected up "for tension," it gives a light equivalent to 2,500 Carcel burners, with an expenditure of 7 h.p., and 220 revolutions per minute; and, when arranged "for quantity," the light is equal to 4,000 of these burners, whilst 11 h.p. are expended, and the velocity is 550 revolutions per min. A similar machine constructed by the above-mentioned firm, and intended for the Planier lighthouse, was exhibited by the French Minister of Public Works. The reason for the adoption of the continuous current machine, instead of one with alternating currents is as follows:—In machines of the former class the light is concentrated on one of the carbons, whilst in those of the latter description it is equally divided between the two carbons, the distance between which, with the powerful currents now used, is from four to five millimetres at least. Now, if the middle of the arc be focussed in the lens, the horizon receives no light; whilst, if it be one of the two points, the light from the other is lost, being refracted either towards the sky or on to the sea in the vicinity of the lighthouse. The light furnished by a continuous current machine

is therefore better utilised than that produced by one with alternating currents. By varying the speed of revolution, and by the use of a commutator, the above machines allow of the intensity of the light being varied, according to the condition of the atmosphere, in the ratio of 1:4, the expenditure of motive power being proportionate to this intensity.

VOL. II., NO 1. NEW YORK, JANUARY 1, 1879. $1.00 PER ANNUM.

Electric Light Engine.

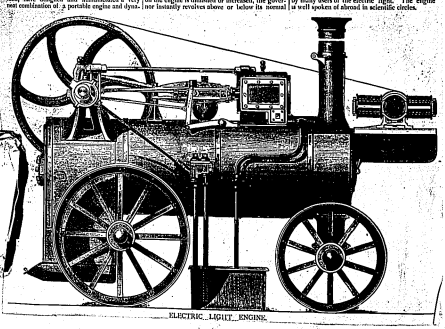
In the various trials which have lately taken place with electric lighting, says the *Engineer*, London, gas, steam, and even water have been used as motive power for driving the dynamo-electric machines; but when the machines have been attached to large fixed engines usually employed in factories, it has been found that the movement was not sufficiently regular, or that it was often necessary to keep a large engine at work at night simply to drive the electric light, an arrangement evidently somewhat wasteful in principle, and costly and unsatisfactory in practice. It has been generally admitted that when the electric light is employed, whether for permanent or temporary purposes, it is advisable to have an engine adapted specially for the purpose of driving the machines, not only on account of the economy in fuel and labor, but also from the greater regularity which can be ensured in the movement of the dynamo-electric apparatus.

Messrs. Ross, and Head, of Ipswich, England, have designed and manufactured a very neat combination of a portable engine and dynamo-electric machine on Siemen's, Gramme's, or other well known system, the whole being mounted on four wheels, and easily transported from place to place. The engine is fitted with a patent automatic expansion gear, which is very sensitive and capable of regulating the number of revolutions of the fly-wheel per minute with great accuracy—a matter of much importance to insure the proper action of all electrical machines.

This gear consists of two small eccentrics fixed on the crank shaft, and furnished with straps and rods, as usual in the usual manner. The ends of the rods are connected together by a small disk, which has two quick circular slots at the end of the bell-crank lever. The weight shall not be supporting and form the connection between the link and governor, which is on the former principle. The action of the whole is as follows:—The eccentric, which is attached to the lower end of the link, is fixed at such an angle in relation to the crank as to effect an early cut-off, whilst the eccentric attached to the top of the link is set so as to allow a late suppression of the steam. When the load on the engine is diminished or increased, the governor instantly revolves above or below its normal speed, and by the rising or falling of its arms and balls it shifts the link and brings the expansion valve more or less under the influence of the early or late cut-off eccentric, thus regulating the supply of steam to the altered load until the engine again makes its proper number of revolutions per minute.

The following diagrams will show the action of the automatic cut-off in the cylinder. They are from a ten-horse power engine with ten-inch cylinders, thirteen-inch stroke, making 140 revolutions per minute.

The electric machines are fixed on a platform in front of the smoke box, and a second fly-wheel can be attached when it is necessary to drive two machines for a double light. These engines are made of from four to twelve-horse power, and, if necessary, the wheels can be taken off and the boiler fixed to the ground. Several of these engines have been made for driving electric lights in various parts of the world, and we think we may commend the design as a practical one, and likely to supply a want which has long been felt by many users of the electric light. The engine is well spoken of abroad in scientific circles.



ELECTRIC LIGHT ENGINE.

CIRCUMSTANCES INFLUENCING THE EFFICIENCY OF DYNAMO-ELECTRIC MACHINES.*

By Profs. Edwin J. Houston and Elihu Thomson.

During the recent competitive trials made at the Franklin Institute, as to the relative efficiency of some different forms of dynamo-electric machines, the authors have been entrusted with the work of determining the relations between the mechanical power consumed, and the electric and thermic effects produced, took the opportunity thus afforded, to make a careful study of many interesting circumstances which influence the efficiency of these machines.

It is proposed in the present paper, to select from the many circumstances thus noticed, a few of the more interesting, reserving the others for a future consideration.

It will readily be understood, from the comparatively new field in which we had been working, no reliable data of the electrical work of these machines having before been obtained, that difficulties constantly arose owing to necessary conditions of operation, and new developments as to the behaviour of the machines under varied conditions, were constantly met.

A convenient arrangement of the particular circumstances we are about to discuss may be, 1st, Those affecting the internal work of the machine; 2nd, Those affecting the external work, and 3rd, The relations between the internal and external work.

The mechanical energy employed to give motion to a dynamo-electric machine is expended in two ways, viz., 1st, In overcoming friction and the resistance of the air; and, 2nd, In moving the armature of the machine through the magnetic field, the latter of course constituting solely the energy available for producing the electrical current. The greatest amount of power expended in the first way was noticed to be about 17 per cent. of the total power employed. This expenditure was clearly traceable to the high speed required by the machine. The speed, therefore, required to properly operate a machine is an important factor in ascertaining its efficiency.

The above percentage of loss may not appear so great, but when it is compared with the total work done in the arc, as heat, constituting as it did in this particular instance over 50 per cent. of the latter, and about 23 per cent. of the total work of the circuit, its influence is not to be disregarded.

In another instance, the work consumed as friction was equal to about 80 per cent. of that appearing in the arc as heat, while in the Gramme machine experimented with, this percentage fell to 20 per cent. of that which appeared in the arc as heat, and was only about 7 per cent. of the total power consumed in driving the machine.

In regard to the second way in which mechanical energy is consumed, viz.: in overcoming the resistance necessary to move the armature through the magnetic field, or in other words, to produce electrical current, it must not be supposed that all this electrical work appears in the circuit of the machine, since a considerable portion is expended in producing what we term the local action of the machine, that is local circuits in the conducting masses of metal, other than the wire, composing the machine.

The following instances of the relation between the actual work of the circuit, and that expended in local action, will show that this latter is in no wise to be neglected. In one instance an amount of power somewhat more than double the total work of the circuit was thus expended. In this instance also it constituted more than five times the total amount of power utilized in the arc for the production of light. In another instance it constituted less than one-third the total work of the circuit, and somewhat more than one-half the work in the arc.

Of course work expended in local action is simply thrown away, since it adds only to the heating of the machine. And since the latter increases the electrical resistance, it is doubly injurious.

The local action of dynamo-electric machines is analogous to the local action of a battery, and is equally injurious in its effects upon the available current.

Again, in regard to the internal work of a machine, since all this is eventually reduced to heat in the machine, the temperature during running must continually rise until the loss by radiation and convection into the surrounding air, are eventually equal to the production, and the machine will at last acquire a constant temperature. This temperature, however, will differ in different machines according to their construction, and to the power expended in producing the internal work, being, of course, higher when the power expended in producing the internal work is proportionally high.

If therefore a machine during running acquires a high temperature when a proper external resistance is employed, its efficiency will be low. But it should not be supposed that because a machine when run on no supposed resistance, that is on short circuit, without external resistance, heats to a great degree, that therefore its inefficiency is shown thereby. On the contrary, should a machine remain comparatively cool when a proper external resistance is employed, and heat greatly, when put on short circuit, these conditions should be regarded as an index of its efficiency.

As a rule the internal resistance of dynamo-electric machines is so low that to replace them by a battery, the latter, to possess an equal internal resistance, would have to be made of very large dimensions, so that the efficiency of Dynamo-Electric Machines, cannot be stated in terms of battery cells as ordinarily constructed.

In regard to the second division, viz., the external work of the machine, this may be applied in the production of light, heat, electrolysis, magnetism, &c.

Where it is desired to produce light, the external resistance is generally that of an arc formed between two carbon electrodes; the resistance of the arc is therefore an important factor in determining the efficiency. To realize the greatest economy, the resistance of the arc should be low, but nevertheless should constitute the greater part of the entire circuit resistance.

In some of our measurements the resistance of

* Paper read before the American Philosophical Society, Nov. 1st, 1878.

the arc was surprisingly low, being in one instance 54 ohms, and in another 79 ohm. It was, however, in some instances as high as 218 ohms.

It may be noted as an interesting fact that where the greatest current was flowing, the resistance of the arc thereby produced was low. This is undoubtedly due to higher temperature and increased vaporisation from the carbons. In this latter case also the greatest amount of light was produced.

The amount of work appearing in the arc as measured by the number of foot pounds equivalent thereto, is not necessarily an index of the lighting power. In two instances of measurement, the amount of energy thus appearing in the arc was equal, while the lighting powers were proportionately as three to four. This apparent anomaly is explained by considering the resistance of the arc, it being much less in the case in which the greater light was produced. The heat in this case being evolved in less space, the temperature of the carbons, and therefore their light-giving powers, was considerably increased.

A few remarks on the economical production of light from an electrical current may not be out of place. The light emitted by an incandescent solid will increase as its temperature is increased. In the voltaic arc the limit to increase of temperature is in the too rapid vaporisation of the carbon. Before this point is reached, however, the temperature is such that the light emitted is exceedingly intense. No reliable method of measuring the temperature of the arc has as yet been found.

A well known method of obtaining light from electrical currents is by constructing a resistance of some material such as platinum, having a high fusing point and heated to incandescence by the passage of a current. When platinum is employed as the limit to its increase of temperature is the fusing point of the platinum, which is comparatively but a fraction of the temperature required to vaporise carbon. Were the fusing off in the amount of light emitted merely proportional to the decrease in temperature, the method last described might be economical. Unfortunately, however, for this method, many facts show that the decrease in the light emitted is far greater than the decrease of the temperature. Most solids may be heated to 1000° F. without practically emitting light. At 2000° F. the light emitted is such that the body is said to be at a bright red. At 2000° F. the amount of light will have increased far more than twice, probably as much as four times that emitted at 2000° F.? It is reasonable to suppose that with a further increase of temperature the same ratio of increase will be observed, the proportionate increase in luminous intensity far exceeding the increase in temperature.

It would therefore appear that the employment of a resistance of platinum, or other similar substance, whose temperature of alteration of state as compared with that of carbon is low, must be for economical than the employment of the arc itself, which as now produced has been estimated as about two or three times less expensive than gas.

Indeed it would seem that future improvements in obtaining light from electrical currents will rather be by the use of a sufficient resistance in the most limited space practicable, thereby obtaining in such spaces the highest possible temperature.

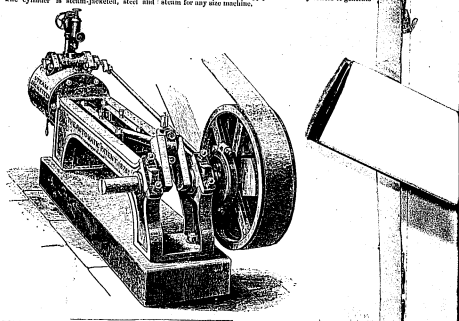
Perhaps the highest estimate that can be given of the efficiency of dynamo-electric machines as ordinarily used, is not over 50 per cent. Our measurements have not given more than 38 per cent. Future improvements may increase this proportion. Since the efficiency of an ordinary steam engine and boiler in utilising the heat of the fuel is probably over estimated at 20 per cent., the apparent maximum percentage of heat that could be recovered from the current developed in a dynamo-electric machine, would be over estimated at 10 per cent. The economical heating of buildings by means of electricity may therefore be regarded as totally impracticable.

Attention has, long ago, been directed to the use of dynamo-electric machines for the conveyance of power. Their employment for this purpose would indeed seem to be quite promising. Since in this case one machine is employed to produce electrical currents, to be reconverted into mechanical force by another machine, the question of economy rests in the perfection of the machines and in their relative resistances.

In respect to the relations that should exist between the external and internal work of dynamo-electric machines, it will be found that the greatest efficiency will, of course, exist where the external work is much greater than the internal work, and this will be proportionately greater as the external resistance is greater. Our measurements gave in one instance the relation of 72 ohm. of the arc to 49 ohm. of the machine, a condition which indicates economy in working. The other extreme was found in an instance where the resistance of the arc was 1·98 ohms, while that of the machine was 4·60 ohms. a condition indicating wastefulness of power.

THE MOTIVE POWER TO DRIVE DYNAMO-ELECTRIC MACHINES.

In our last number we described an engine designed by Messrs. Rasmusens, Sims, and Head. It is not, however, always necessary to have so complete an apparatus. In many cases, and especially in this the case in large factories, there is a sufficient boiler power to generate the steam, so that more boiler power is not wanted for the special engine required for lighting purposes. Instead, therefore, of going to the expense of obtaining a boiler and engine, in such cases the engine only is required. If there is the slightest doubt as to the supply of steam, we should advise in all cases a good margin on the safe side. The supply of steam being provided for, the engine has to be obtained and fixed. An The manufacturers of the engine call it "The Automatic," and claims several advantages for it. One of the most important for electrical engineers to consider is the governor. The makers state that the "automatic variable expansion," which governs of steam by admitting the exact amount required by a varying load, and thus keeping the machine running with extreme steadiness. As will be seen from our illustration, the engine is extremely simple, and no endeavour has been made to compensate in our engine the most important improvements of recent years. The cylinder is steam-jacketed, steel and phosphor bronze are used instead of wrought iron and brass, so that the wear of bearings may be reduced to a minimum, and that the maximum strength may be obtained from the use of the least weight of material. According to the statements of Messrs. G. Russell and Co., the 10-horse power nominal, with 60 lbs. boiler pressure, works to 30-horse power indicated. The diameter of the cylinder of this engine is 10in., length of stroke 10in., diameter of fly-wheel 42in., making 120 revolutions per minute. Supposing a small Gramme to be driven direct from the fly-wheel without any intermediate shafting, we should obtain some 880 revolutions of the dynamo machine per minute. This would be about the number of revolutions the machine would be required to make under ordinary circumstances. At the experimental shed on the Embankment the small Gramme does not make so many revolutions as this, but in other cases it is required to make 900 or 1,000 revolutions per minute. It would be well, perhaps, to caution engineers against too high a rate of speed. The dynamo machine will, like other pieces of mechanism, heat if driven too fast, and just a certain point the wires will fuse, rendering the machine useless. In fixing the engine to drive the machine, as well as in fixing the machine itself, it is necessary that great care should be taken to have a good firm foundation. Messrs. Russell make the engine we have then briefly mentioned of nine varying from 1 to 10-horse power. If required, Messrs. Russell supply the necessary boilers to generate steam for any size machine.



SIEMENS' BROTHERS' DYNAMO-ELECTRIC LIGHT APPARATUS.

[CONCLUDED FROM PAGE 40.]

CONDUCTING OR LEADING WIRES.

The leading wires are usually of copper of high electrical conductivity. They must be insulated from one another throughout their length, and not placed too close together. As their resistance affects the intensity of the light very much, the greatest care is usually exercised in the distance of the wires from the machine.

The total practical result is obtained when their resistance, together with that of the lamp, is equal to the total internal resistance of the dynamo machine. Wires of various sizes are therefore required. The following is one type adapted to a distance of 220 yards between the machine and lamp :—

It consists of a strand of 19 copper wires, No. 16 B.W.G., covered with layers of cotton tape and india-rubber.

The increase in strength of the current caused by a leading wire of low high resistance can be overcome by a higher velocity, which is obtained only by increased motive power, but if the power is much too small it will become heated. The proper remedy is to increase the sectional area of the leading wire.

Sufficient sparks should never be allowed to appear at the commutator and brushes, as sparks result from a rapid burning of the metallic parts. They can easily be avoided by properly adjusting the two arms which carry the brushes.

The position of the brushes yielding the least spark at the commutator is that giving the highest intensity of light in the electric arc.

The commutator should, while in motion, be freely oiled to prevent the brushes wearing away too rapidly. The sticky oil would from time to time, be removed by washing with paraffin oil or petroleum.

WEAR AND TEAR.

The chances of stoppage so common to the old forms of electric light apparatus have in this form been reduced to a minimum. It now do not exceed those that arise with machines generally. The Trinity House Report states that the Siemens machine worked well for a month without any necessity for stopping. The brushes are the only parts which wear away, and they are very easily replaced.

Some experiments were made at Fort Monckton on behalf of the British Government in July, 1878, with the Siemens, the Gramme, and the Wilde machines. The results are given in the minutes of the Institution of Civil Engineers for 1878, and they show the great superiority of the Siemens machine over other machines of its class. Since that, during a series of experiments made at the South Foreland Lighthouse for the purpose of selecting the electric apparatus for the Lizard lighthouse, the Siemens machine was proved to be the cheapest, lightest, smallest, and of most powerful. (See Trinity House Report, in which a full account is given.) Six of these machines are now erected in the Lizard, and they give a very excellent light. They are arranged that they can be worked either single, during the daytime or in pairs during thick weather.

The reason for coupling them in pairs and connecting them in what is called parallel circuit (or "quantity," as for "tension") is because it has been found that when they are so arranged the density of the electric light produced exceeds by some twenty per cent. the intensity of the sum of the two when worked separately. Then the Siemens machine, giving respectively a power of 4,846 and 6,063 when worked separately (total 10,909) gives when coupled up in parallel circuit a light equivalent to 13,710 candles; just as in telegraphy it has been found that the rate of signalling can be increased from 20 to 25 per cent. when the apparatus is coupled up in parallel arc. For this reason it is usual to employ two machines of medium size, instead of one machine of large size. The intense light so produced is also much more uniform than from one large machine.

AUTOMATIC ELECTRIC LAMP.

Automatic electric lamps have been produced, actuated by clockwork to enable the carbons to approach each other at a certain point, when, by means of an electro-magnet, the clockwork is checked, and the carbon points are allowed to burn away through a distance that, by the decrease of current, the clockwork released and the process caused to approach again. With both lamps the clockwork has been a source of trouble, and it is liable to get out of order.

The lamp to be here described is actuated without clockwork; also automatically separates the carbons as they burn away, checked long electric arc, or touch each other; and, by this combination of several well-known principles, a perfectly self-regulating lamp is produced.

The working parts are represented in the diagram Fig. 6, and Fig. 8 represents the largest size lamp, such as is employed for lighthouse illumination. Two smaller sizes of lamp, adapted for general purposes, are also manufactured.

E (Fig. 6) is the horse-shoe magnet with the armature, A, placed a short distance in front of its poles. A regulating screw *b* with the rubber spring *f* is attached to the lever A', forcing it against the stop *d*, and withdrawing the armature from the poles of the electro-magnet. When a current traverses the coils of the latter of sufficient strength to attract the armature and overcome the tension of the spring *f*, contact is made at *c*, which diverts the current from those coils. The consequent release of the armature breaks contact at *c*, the armature is again

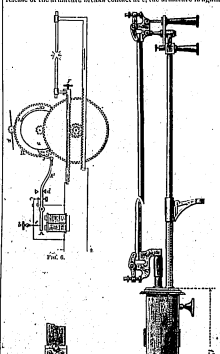


FIG. 6.

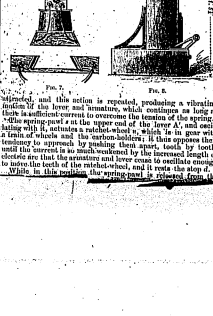


FIG. 7.

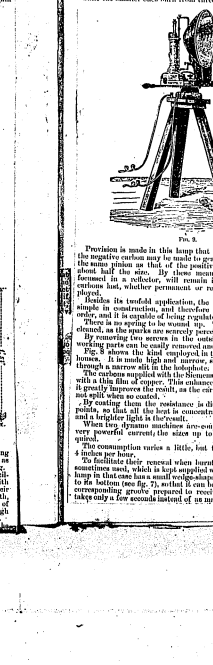


FIG. 8.

attracted, and this action is repeated, producing a vibrating motion of the lever and armature, which continues as long as there is sufficient current to overcome the tension of the spring.

The spring-rod *r* at the upper end of the lever A', and oscillating with it, actuates a ratchet-wheel *w*, which is in gear with 4 train of wheels and the carbon-holders; it is thus opposes their tendency to approach by pushing them in apart, tools by tooth until the current is so much weakened by the increased length of electric arc that the armature and lever cease to oscillate enough to move the teeth of the ratchet-wheel, and it rests the stop *d*.

While in this position the spring-rod *r* effected from three

crease of current follows decrease of resistance, the armature again oscillates, and this cycle of action is continuously repeated.

When in action the movements of the carbons are scarcely perceptible, but when, by any external cause, the carbons are separated so as to extinguish the light, they immediately run together until they touch, when they ignite and separate to a proper working distance by means of the electro-magnet above described.

The only operation requiring attention in the use of this lamp is the adjustment of the tension of the spring *f*. When this tension is once regulated to the current at disposal, the lamp will continue to give a steady light as long as the current remains uniform.

The relative rate of consumption of the two carbon points differs. The positive carbon burns away rather more than twice as quickly as the negative carbon.

The duration of the light depends mainly on the lengths and sizes of the carbons. The large lamp will burn for ten hours, while the smaller ones burn from three to four hours.

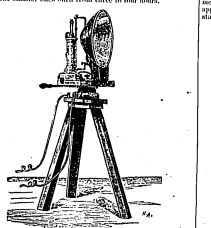


FIG. 9.

Provision is made in this lamp that the rack which supports the negative carbon may be made to gear either with the teeth of the same pinion as that of the positive carbon, or into one of about half the size. By these means the light, when once focussed in a reflector, will remain in focus as long as the carbons last, whether permanent or renewed currents are employed.

Besides its twofold application, the lamp is very compact, is simple in construction, and therefore not likely to get out of order, and it is capable of being regulated with great precision.

There is no spring to be wound up. The contact need not be cleaned, as the sparks are scarcely perceptible.

By removing two screws in the outside casing, all the chief working parts can be easily removed and inspected.

Fig. 8 shows the kind employed in the lighthouse of lighthouses. It is made light and narrow, so that it can be inserted through a narrow slit in the lighthouse.

The carbons supplied with the Siemens Patent Lamps are coated with a thin film of copper. This enhances the cost somewhat, but it greatly improves the result, as the carbons burn longer and do not split when so coated.

By rendering them the resistance is diminished, except at the points, so that all the heat is concentrated in the electric arc, and a brighter light is the result.

When in use, dynamos are coupled together to give a very powerful current, the size up to 20 unit diam: are required.

The consumption varies a little, but the average is from 3 to 4 units per hour.

To facilitate their renewal when burnt short, a spare lamp is sometimes used, which is kept supplied with fresh carbons. The lamp in that case has a small wedge-shaped contact-slide attached to its bottom (see fig. 7), so that it can be inserted quickly into a corresponding groove prepared to receive it. The process thus takes only a few seconds instead of as many minutes.

In the cabin shops at Siemens Brothers' telegraph works at Woolwich, where the electric light has for the past two years taken the place of gas, and has been thoroughly tested, this economical machine, to be at 2 to 1 in favour of electricity, taking it under most unfavourable circumstances, as regards cost of coal, and with interest on first cost at 25 per cent.

The advantage would, however, be much greater in favour of electricity if the light intensities were compared, for in the above case the electric light is three times as powerful as the gas formerly used. The ratio thus becomes 6 to 1 against gas light.—*Ed.*

Two kinds of concentrating apparatus are supplied in combination with the automatic lamp, both of which are capable of giving a powerful parallel beam which will reach to an enormous distance, and are well adapted for naval, military, and other purposes. The one kind consists of a parabolic reflector of silvered metal, its concave surface being silvered and burnished. The apparatus is mounted with a ball-and-socket joint upon a wooden stand, as shown in fig. 9.

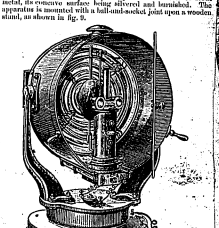


FIG. 10.

The other kind is the Pecenel Catadioptric lens or Holophote (see fig. 10) which may be substituted for the reflector, and gives a more powerful beam than one given by reflection. The lens is surrounded by a metal case or lantern, in which is placed the electric lamp upon a slide for focussing. Behind the carbon-points a hemispherical reflector is placed to catch all the back rays and reflect them back through the lamp focus. The entire lantern is capable of revolving on horizontal friction rollers upon pivots. Two handles are placed at the back to manipulate it.

As the electric arc is much too bright to be looked into with the naked eye, both concentrating apparatus are supplied with a hood, called a dome or lume observer, by means of which an image of the burning carbons is thrown upon small screens at the back, so that the lamp can be easily adjusted without fatigue to the eyes. The fresh observer is shown on the lamp in the Holophote, fig. 10.

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HOW TO MAKE A DYNAMO-ELECTRIC MACHINE WITH WORKING DRAWINGS ONE-HALF ACTUAL SIZE.

By Geo. M. Hopkins.

Probably the most important invention following the discovery of magneto-electrical Induction is the dynamo-electrical machine, which is now made in many forms, all of which are based on the same general principle, viz.: that rotation, within the influencing powers of the poles of a magnet, of a soft iron armature surrounded by one or more helices, an electrical current being produced in the helices by the rapid magnetization and demagnetization of the soft iron armature.

While several of the principal machines seem to stand on about the same footing in regard to efficiency, none of them can be more easily made than the Siemens; and I do not think a small machine of any other type would give better satisfaction than the ones described in this article.

It is not necessary to use permanent magnets in this machine. Electro-magnets may be employed, the slight residual magnetism left in the soft iron cores serving to excite the armature, which in turn excites the magnet, thus multiplying the magnetic induction until a strong current is realized.

In the accompanying engravings, which are exactly one half size, Fig. 1 is a perspective view of a dynamo-electric machine having electro-magnets and a Siemens armature. Fig. 2 is a vertical transverse section taken on line $x\ x$ in Fig. 3. Fig. 3 is a horizontal section, taken through the electro-magnet looking toward the forward. Fig. 4 is a vertical longitudinal section of the armature and its commutator, taken on line $z\ z$ in Fig. 3. Fig. 5 is a transverse section of the commutator and commutator strips, taken on line $z\ z$ in Figs. 3 and 4. Fig. 6 is a perspective view of a dynamo-electrical machine employing permanent magnets. Fig. 7 is an end elevation of the same, and Fig. 8 is a perspective view of this machine, showing the manner of adjusting it. As the dimensions of either machine may be obtained from the engravings, I shall omit them in the description.

The electro-magnet is, for the sake of convenience, composed of two pieces, A B, which are exactly alike consisting of the connecting piece, C, in cast with the pieces, A. These pieces, A, are planed at their joinings at the top, and secured together by two bolts which pass through the part C. The lower ends of these parts are also planed to receive the base plate, E, which is secured in place by dowels and screws, two of each entering each part. The cylindrical cavity which receives the armature, G, is bored out truly

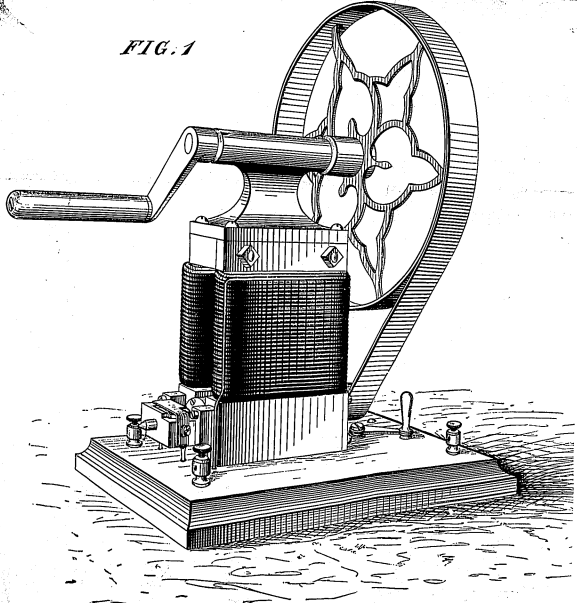


FIG. 1

HAND POWER ELECTRIC MACHINE.—Half Size.

and smoothly of a uniform caliber from end to end. The edges of that portion of the electro magnets around which the wire, D, is wound are rounded, as shown in Fig. 5. Before winding a piece of cotton factory cloth should be wrapped around each core; upon this is wound several layers of No. 16 gutta-percha-covered copper wire. The finished magnets should be wound in opposite directions, or in such a way that when the two portions, A B, are placed end to end, one coil would be simply a continuation of the other. The inner ends of the coils are connected together, while their outer ends are of sufficient length to run downward through the base, and leave room for the curved iron bar, E, secured with the binding posts, *a* and *a*.

The armature, G, consists of a cylindrical piece of soft cast iron grooved longitudinally, and across the ends, and wound with No. 16 cotton or silk covered copper wire. It is, in fact, a very short and wide bar electro magnet, having enlarged and elongated ends of the form of a segment of a cylinder. In diameter the armature is only a very little less than that of the cylindrical space between the parts, A B, of the electro magnet, and its length is a little less than the width of the electro magnet. In Figs. 2 and 4, G' is the core of the armature around which is wound the wire, H. To opposite ends of the armature are fitted the brass heads, J J, into which are screwed the shafts, *b c*. It will, of course, be understood that the armature needs filing around the core, G', and that the heads and shafts must be fitted to the ends of the armature before it can be turned and fitted to the cylindrical space in the electro magnet. The shaft, *b*, is journaled in a brass support, L, which is attached by screws to the edges of the parts, A B, of the electro magnet. The shaft, *c*, is journaled in a similar support, M, which is secured to the opposite side of the electro magnet. Outside of the bearing, L, upon the shaft, *b*, is secured the pulley, *d*, and between L and the support, M, and the head, J, the commutator is placed upon the shaft, *c*. The commutator consists of a vulcanite cylinder, *e*, having upon its periphery a copper or brass ferrule, which is slit longitudinally at diametrically opposite points, forming the insulated segments, *f g*. These are secured to the vulcanite cylinder by small brass screws, and the slits are placed exactly opposite the center of the longitudinal grooves in the armature. The commutator is prevented from turning on the shaft by a set screw, and with the segments are connected the terminals of the armature coil, H. The terminal wires pass through holes in the head, J, which are lined with an insulating material.

To opposite sides of the support, M, are secured the copper commutator springs, *k l*. The spring, *k*, bears forward over the commutator and bears upon it with a constant pressure. The spring, *l*, is bent so that it touches the side of the commutator at a point diametrically opposite the contact point of the spring, *k*. The spring, *k*, is connected, by a wire (No. 16) insulated, and extends downward through the wooden base of the machine to a similar wire runs from the spring, *l*. As the design of the machine is such that its magnet may be connected with a battery, that all of the current from the armature may be utilized, instead of allowing a portion of it to pass through the helices of the magnet, two extra binding posts, *r s*, and a switch, N, are added.

The connections under the base are as follows: The terminals, *a a*, of the electro magnet are connected with the binding posts, *a a*. The commutator spring, *k*, is connected by the wire, *i*, with the binding post, *r*; the commutator spring, *l*, is connected with the switch, N, by the wire, *t*. The switch button, *r*, is connected with the binding post, *p*, by a suitable wire, and the switch button, *s*, is connected with the binding post, *n*, by the wire, *t*. All of these connections should be made with No. 14 wire. A support, O, for the shaft, P, is secured to the top of the electro magnet. The shaft, P, has at one end the driving wheel, Q, and at the other end a crank for operating the machine. A one inch belt, R, runs around the pulley, *d*, and the wheel, Q.

When the machine is driven by power the pulley, *d*, may with advantage be larger. The size of the wire on the magnets and armature may be varied for some special purpose, but for general use the sizes here given are recommended. The slit in the commutator should be made slightly angular, so that one section of the copper ferrule will touch the spring before the other section leaves it. The armature should fit in as nearly as closely as possible without rubbing. The parts mentioned as brass or copper should be made of those metals, as a magnetic insulation is required wherever they are used.

To run the switch, N, is in the position shown in the drawing, the binding posts, *s r*, being connected by a wire, the current passes from the post, *n*, through the commutator and the armature, thence by the wires, *f g*, through the commutator and through the button, *r*, and by the wire, *i*, to the post, *p*, thence through the electro magnet to the post, *n*, through the switch, N, and by the wire, *t*, to the post, *s*. Here the machine is arranged in this manner, the wires leading from the machine are taken from the posts, *a a*. The full force of the machine is developed on Sistari after the connection of the posts, *r s*.

By moving the switch, N, so as to make contact with the button, *s*, and connecting *r* and *n* by a wire, and using eight Bunsen elements with the posts, *a p*, the magnets are excited without disturbing from the power of the armature, and the current from the latter is taken through the wires, as before, to the post, *s*, but the wire, *t*, is now in electrical connection with the binding post, *n*, through the switch, N, button, *s*, and wire, *t*; therefore the current is taken away from the machine by inserting wires in the posts, *s n*.

Wires not connected with a battery this machine will vent from four cools inches of No. 26 platinum wire. It will rapidly and impressive water by slipping the coils of the wire in water slightly acidulated. It will run as induction coil and produced a small electric light between two fine carbon points when arranged same as in the apparatus described in SUPPLEMENT No. 149. The machine affords a current sufficiently intense to give strong shocks by connecting it with a bells or electro magnet, small permanent magnets may be charged, and it answers an admirable purpose for ringing large gongs. The effect may sometimes be increased by interposing a resistance of two or three coils between the binding posts, *s n*. This is especially the case when the apparatus with which it is connected is of low resistance kind. It may be connected with a small electric motor, thus affording a striking example of the convertible of force into electricity and of the development of power from the electricity thus produced. For many purposes this machine will be found equal to six or eight Bunsen cells.

When a battery is employed to excite the electro magnet the effect is very much increased. For example, it will run with twelve inches of platinum wire instead of four or six inches, and it will afford a current sufficient for a strong electric light.

The speed has much to do with the efficiency of the machine. The writer advises a speed of from 1,000 to 1,500 turns of the armature per minute. The drive wheel in the example given may with advantage be made much larger, say two feet in diameter, where space is not considered. The construction of the machine shown in Figs. 6, 7, and 8 will be readily understood after what has already been said.

The armature is precisely the same as in the other case, and so is the commutator, the only difference being that the armature is wound with No. 32 wire and the slits in

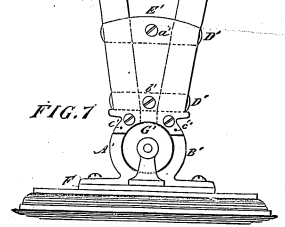


FIG. 7

END VIEW.—HALF SIZE

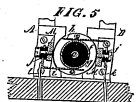


FIG. 5

TRANSVERSE SECTION OF COMMUTATOR.

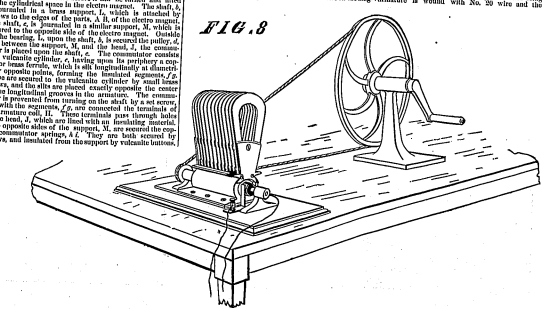


FIG. 8

PERSPECTIVE SHOWING HAND CRANK ARRANGEMENT FOR DRIVING ELECTRIC MACHINE.

to project them upon a screen, and to obtain copies of them by photography.

Taking up the subject where others had left it, Dr. Silvanus P. Thompson, Professor of Experimental Physics in University College, Bristol, has, during the last two years, elaborated this method of magnetic and electro-dynamical investigation to an extent and to a degree that he may be said to have brought it to a new and practical result. The subject was first brought by Dr. Thompson before the Physical Society of London in February last, and a second communication was made by him to the same society in the month of June, when some of the figures with which the article is illustrated were projected upon the screen. At the meeting of the British Association which was held at Dublin in August last, Professor Thompson brought the research before Section A, in a paper "On Some New Magnetic Figures," which was illustrated by a very large number of magnetic and electro-dynamic figures fixed upon glass for use in a projection lantern, as well as a number of photographs from them and from others of a similar nature. These figures, some of which we now reproduce, illustrate in a very beautiful manner not only lines of magnetic force and the mutual attraction and repulsion of voltaic currents passing within what may be called "electro-dynamical range" of one another, but also the phenomena of electro-magnetic rotation and the forces at work in the action of such physical instruments as galvanometers dischoding, of course, all needle telegraph instruments) and magnetometers. Since that time Dr. Thompson has still further elaborated the system so that he is enabled by it to demonstrate and illustrate nearly all the laws of magnetism and electro-dynamics. The method which he adopts is to coat plates of glass about 2½ ins. square with a solution of gum arabic, to which a small proportion of gelatine is dissolved to prevent the film cracking off in flakes; when this is dry it is perfectly smooth transparent laid coating is given to the glass plate. The wires or magnets having been placed below, finely sifted filings of wrought iron are dusted over the plate from a muslin bag, the plate being gently tapped with a light glass rod until the figures are formed. A gentle stream of steam from a small boiler is then directed on to the plate by a flexible tube, the effect of which is to soften the gum, into which the filings sink without being displaced, and are found to be firmly adhered to the glass when the plate is dry. A glass cover plate, upon which the positions of wires, poles, magnets, etc., are marked by means of opaque paint or black paper, isthen fastened over the edges to the plate carrying the figure, and can then be photographed either as a transparent plate for projection on the screen, or as a negative for printing upon paper.

If the end of a small bar magnet be placed below a card or a plate of glass, a fitting figure formed around it would consist of radiating lines crowding a star, of which the end of the magnet would be the center, and this would be the case whether the magnet were presented to the under side of the plate, but if the end of a second magnet be placed against the plate within the influence of the first, that is to say, so that the magnetic lines of both magnets would overlap, the filing figure between greatly changes. If the end of the second magnet be of the same character as the first, mutual repulsion will ensue; this will be shown by the lines which radiate from the one magnet turning away from as if avoiding those from the other, and the effect will be to form a sort of bend on each side of the line joining the poles, more of the lines from the one pole coalescing with or running across any of those from the other. But if an opposite polarity be substituted for that of similar polarity, attraction will take place, which will be illustrated by the running together of the lines of force radiating from both magnets, so as to form between them a bundle of elliptic loops connecting the one pole with the other. If instead of placing the end of a magnet against the glass, whereby lines of magnetic force are formed, a hole be drilled through the plate, and a wire be passed in a direction normal to its surface, through which a strong voltaic current is passing, the lines of force instead of radiating from a center will be found to consist of more or less concentric circles of which the wire is the center; this effect is illustrated in Fig. 1. Were it not for the necessary imperfection of the process by which they are formed these circles would be perfectly circular and perfectly concentric, and the distances between any circle and its nearest neighbor would be proportional to the squares of their distances from the central wire. The circles would, in fact, illustrate a section through a sectsoid supposed at surfaces described about an electrified point in space.

Fig. 1 represents the effect of a current passing in a wire upon a plate below which there is a wire conveying an electric current in a direction parallel to the plane of the plate. In this figure the filings arrange themselves in a series of straight lines perpendicular to the direction of the wire and at equal distances from one another, and may be looked upon as a number of repetitions of Fig. 1, strung upon the wire at equal distances apart and looked at edgeways.

Fig. 2 represents the effect of a crossed loop or large "kink" formed in the wire. This figure illustrates very well the mutual attraction of two currents flowing in opposite directions; as well as the corresponding repulsion of currents whose direction is the same, and it also exhibits the electro-magnetic effect within one turn of a helix, through which a voltaic current is passing; in that case the lines of magnetic force would be perpendicular to the plane of the loop, and the filings under their influence could only form themselves (as far as the plate will allow them) into lines perpendicular to the plane of the paper, and therefore seem, for from above they appear simply as isolated dots or points.

Fig. 4 shows the effect of two currents crossing one another at right angles; here again mutual attraction and repulsion are well illustrated, loops being formed in one pair of corners, and lunules in the other pair, showing at the same time a tendency of the two currents to set parallel. These attractions and repulsions are beautifully shown in Figs. 5 and 6, in which the two white dots represent wires passing through the glass plate in a direction perpendicular to its plane, and through which voltaic currents are passing. In Fig. 5 the currents in the two wires are in opposite directions, the one being up, and the other down, while in Fig. 6 the currents are in the same direction. These two latter figures are interesting as illustrating Faraday's conceptions of the physical action of lines of force, which were (1) that lines of force have a tendency to "shorten" themselves; (2) that when lines of force meet one another "end on" they either attract and coalesce, or else they repel and part, according as they are "unlike" or "like;" and (3) that when like lines of force run parallel to one another, they are mutually repelled. The first of these phenomena is well shown in Fig. 6; the annular lines of force around one of the wires have a tendency to run into those surrounding the others, so as to become elliptic curves round the two wires, while in Fig. 5 mutual repulsion takes place, brushes being formed between them.

Fig. 7 represents not only the lines of force radiating from a magnet shown as a small black square and the concentric circles formed around a wire, but it illustrates the influence which the one has upon the other when brought into proximity. Here the lines of force show the tendency of an electric current to rotate round the pole of a magnet, and that of a magnet to rotate round a current, the radial lines from the magnet and the circular bands round the wire attracting and coalescing on the one side, and mutually repelling on the other. Fig. 8 is an exceedingly interesting electro-dynamical figure in which the influence of an electric currents upon a magnetic needle, free to rotate about its center, is beautifully illustrated. In this figure the forces pulling the needle round and round can be seen at work, and the pictorial action of the lines of force brought into play in the action of the galvanometer and of all other instruments is well illustrated. Dr. Thompson has still further elaborated this experiment by passing the wire sometimes to the current over the needle and down through a hole on the opposite end, with greatly increased effect; the duplicating of the lines of force are repeated at the opposite end and on the opposite side of the needle, forming a couple tending to turn the needle about its center.

The experiment of which Fig. 9 is a diagram was designed to illustrate the lines of electro-dynamic and magnetic force brought into play in the induction of magnetism in an iron bar when an electric current is sent through a wire coiled round it. It represents a small electro-magnet showing four turns of its coil. In the actual experiment the bar was a strip of fernstype iron, and the wire carrying the current was threaded through the eight holes, four being on one side of the bar and four on the other.

One of the most beautiful results of Professor Thompson's experiments is shown in Fig. 10, and illustrates at a glance the phenomena of the rotation of a magnetic pole round itself under the influence of a voltaic current. We have seen that the lines of force around the pole of a magnet are simply radial straight lines forming the figure of a star of which the pole is the center, and that lines around a current are, as shown in Fig. 1, of the nature of concentric circles. If now these two influences be combined, if a current of electricity be sent vertically upward through a magnet, what would be the effect upon the lines of force generated around the pole by the rotation of the current and its magnet? The filing figure shown in Fig. 10 answers the question exactly in the manner that might be expected. Just as the influence is a combination of the magnet and the current, so are the effects a combination of the radiating lines of the magnet figure with the concentric circles of the current, and a spiral figure is produced, represented in the figure, which is somewhat similar in form to the great spiral nebula in Orion discovered by Lord Rosse. When either the direction of the current or the pole be reversed, a similar spiral is formed, but the striating curves turn in the opposite direction; in other words, with one polarity, the spiral is left-handed, and with the opposite polarity the spiral is right-handed. Here, then, is a clear graphical illustration of the phenomenon of electro-magnetic rotation, and to Dr. Thompson belongs the credit of being the first to discover a proof of the fact that even when the magnet is fixed the lines of force are rotated when a current is sent through it.

In these experiments, Dr. Thompson employs wires of silver 0·8 mm. in diameter, using a current from a Grove's battery of either ten or twenty cells. He has produced a very large number of figures, some of which are of the greatest possible interest, illustrating as they do the action of the various magnetic and dynamo-electric machines, as well as other magnetic motions and the action of different physical instruments which depend for their action upon electro-dynamic currents or upon magnetism.—*Engineering.*

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

I.

Messrs. Robey and Co.'s Patent Fixed Engine.

THE question of the engine power required for driving dynamo-machines employed in producing the electric light has received considerable attention lately, and many engineering firms have manufactured engines which are remarkably well adapted for the purpose.

Before proceeding to describe any of these engines, we would draw attention to the cause of the large discrepancies which exist when comparisons are made from the popular accounts of electric light trials, the discrepancies we mean as regards the horse-power required to produce the light. This almost entirely arises from *nominal* horse-power being confounded with *actual* or *indicated* horse-power. Now there is almost always a very wide difference between these quantities. The *actual* horse-power is often a *third* times the *nominal* horse-power. As the former quantity is the only true index of the work done in producing the light, it should always be the one employed in making calculations for comparisons. The *actual* horse-power is calculated with great facility. Thus, if we have given

Length of stroke in feet $= l$;
Diameter of cylinder in inches $= d$;
Pressure of steam in lbs. per square inch $= p$;
Number of revolutions of fly-wheel per minute $= n$;

Point of stroke at which steam is cut off $= x$; then

$$\text{Actual H. P.} = \frac{d^2 \times .7854 \times l \times 2n}{33000} \times$$

$$p\,x\,(r_2 \log \frac{1}{x} + 1)$$

Thus if the length of stroke were 1 ft., diameter of cylinder 6 in., number of revolutions of fly-wheel per minute 100, pressure of steam 60 lbs., and the steam was cut off when the piston had moved through $\frac{1}{4}$ of its entire stroke, that is $x = \frac{1}{4}$, then

$$\text{Actual H. P.} = \frac{36 \times .7854 \times 1 \times 200}{33000} \times$$

$$60 \times \tfrac{1}{4}\,(r_2 \log 4 + 1) = 10, \text{ very nearly.}$$

The *nominal* horse-power of an engine is calculated from the formula

$$\text{Nominal H. P.} = \frac{d^2\sqrt{l}}{156}$$

Taking the values we have given to d and l, we get

$$\textit{Nominal} \text{ H. P.} = \frac{36 \times 1}{156} = r_3, \text{ which is very}$$

considerably less than the *actual* horse-power.

We cannot too strongly insist upon the necessity in all trials of the electric light of the *actual* or *indicated* horse-power of the engines being given and not the *nominal* horse-power; and we are inclined to think that if this was done, the results of some of the trials would be by no means so favourable to the light as one is led to suppose, although as regards the engines the results would prove highly creditable to the engine makers.

The engine of which we give an illustration, is manufactured and designed by Messrs. Robey & Co., of Lincoln. It is admirably adapted for driving the dynamo-machines, and is especially remarkable for the small space it occupies, its regularity of speed, large margin of power, and regularity in running; this latter point is especially valuable, as upon it depends very much the steadiness of the light.

The locomotive type of boiler employed enables about 20 per cent. more water per lb. of coal to be evaporated than would be the case in one of the Cornish or egg-ended form. There is no loss due to the leakage or radiation from steam pipe and other large surfaces. The boiler working with an artificially strong draught, as inferior, and therefore cheaper class of fuel can be used.

The engine parts are fitted up with all modern improvements, the cylinders are steam-jacketed, and the valve gear is arranged to work with variable degrees of expansion.

The result of the whole being an economy of fuel, as proved by actual comparison with the old type of engine doing the same work, of from 20 per cent. to 30 per cent.

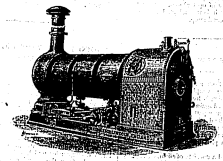
As will be seen, the entire engine is erected on a massive cast-iron bed-plate, so that the boiler is relieved of all strain due to the engine, and is confined to its legitimate purpose—that of raising steam.

The base-plate is formed at one end into an ash-pit, with damper doors, and is made suitable for receiving the fire-box end of the boiler—the other end of which is carried by a crutched-shaped casting fixed over the cylinders.

The end of the base-plate under the cylinder is formed into a feed water tank, into which the cylinder cocks discharge all condensed water, and into which a portion of the exhaust is so directed as to heat the feed water to nearly boiling point before going into the boiler.

The whole of the parts of both engine and boiler being included on one foundation or base-plate, heavy and expensive foundations are dispensed with—the weight of the boiler and its contained water acting as an extra weight to assist in keeping the whole machinery in rigid position.

The 16 "Jablochkoff" lights recently employed for lighting the Billingsgate Market were produced by a dynamo-machine, driven by one of Messrs.



Robey's *so nominal* horse-power engines; the boiler pressure being 60 to 80 lbs., the point of cut-off one-half, and the *indicated* horse-power 23.

It will be noticed that in this case, the indicated horse-power was but very little in excess of the nominal horse-power. The form of engine is capable, if necessary, of working up to 60 indicated horse-power.

General Science.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

Engines of Messrs. Ransomes, Sims, and Head.

Messrs. Ransomes, Sims, and Head, of Ipswich, have devoted a great deal of attention to the subject of motive power for electric-machines of various kinds.

Their engines have already for some years been used for electric light for lighthouses in Russia, New Zealand, and also for other purposes. At the Exhibition of Scientific Apparatus, held at South Kensington, in 1876, Messrs. Ransomes supplied one of their engines for driving the electric-machines shown in operation, and it gave the most universal satisfaction, on account of the perfect regularity of its motion.

It is well known that, in all cases, the greatest regularity in speed is required in the motive power for all electric-machines, and for this purpose Messrs. Ransomes recommend their Patent Automatic Governor Expansion Gear, which will regulate the movement of the engine to such a nicety, that the revolutions will remain without any perceptible fluctuation, even when the entire load is suddenly put on or thrown off. As it has also been found better in all cases to employ a small separate steam engine for the electric light, rather than to drive the machinery from the main engine or running shafting of the factory, Messrs. Ransomes have been induced to pay great attention to the adaptation of their portable engines for electric purposes.

The engraving (fig. 1) represents one of Messrs. Ransomes, Sims, and Head's portable engines, which has been recently designed, and is specially

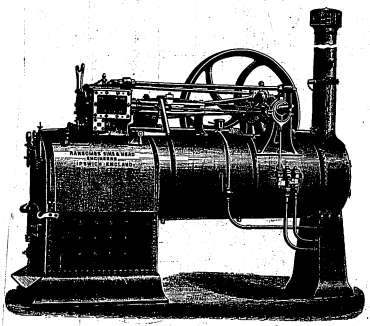


Fig. 1.

arranged for driving a dynamo-machine. The electric-machine is carried on a bracket extended beyond the smoke-box, so that the whole apparatus, motive power, and electric-machine is self-contained, and being mounted on the four wheels of the engine, it is readily transported from place to place. The

platform can be arranged, when required, to carry an exciter and distributor, so that, by fitting on a second fly-wheel, both machines may be driven at one time.

It will be noticed that in this arrangement the cylinder has to be placed next the funnel, and the crank-shaft over the fire-box; but Messrs. Ransomes have also supplied engines of their standard pattern, in which a bracket for the dynamo-machine is fixed on the side of the fire-box, or they can attach a bracket to each side of the fire-box, so as to drive two machines at the same time.

The 6 horse-power machine, which we illustrate, has a cylinder 8½ in. in diameter, with 12 in. stroke, and a speed of 150 revolutions a minute. With a steam pressure of 60 lbs. per square inch, cut off at about half-stroke, this engine will develope about 30 indicated horse-power, and the coal consumed under ordinary circumstances would not be more than about 3 lbs. per indicated horse-power per hour, according to quality of coal.

For the experiments now being carried on by the Metropolitan Board of Works in lighting the Thames Embankment by electricity, Messrs. Ransomes have supplied a 30 horse-power portable steam engine, which is fitted with the patent automatic governor, and has been much approved, and the excellent working and regularity of motion in this engine has contributed greatly to the success which has thus far attended the experiments in question.

This engine has two cylinders each of 10 in. diameter, with 12 in. stroke, and makes 140 revolutions a minute. It is mounted on cast-iron pedestals or saddles, instead of wheels, which gives great steadiness.

The engraving (fig. 2) shows one of Messrs. Ransomes' simple cylinder engines on pedestals, and fitted also with the patent, automatic, governor expansion. These engines are made from 4 to 20 horse-power, and they may all be had either on wheels or on pedestals.

The engraving, fig. 3, shows Messrs. Ransomes' Traction Engine (as used for agricultural purposes) arranged for driving an electric light for railway purposes. The ordinary wheels have been replaced by flanged wheels to suit the rails and the engine, which is of very light but strong construction, and can be run from place to place at speeds of 12 or 3 miles an hour. This arrangement of railway engine and light will be found most useful for lighting up works at night on the permanent way, or for repairs, or inspection of tunnels. The dynamo-machine is fitted to the front part of the boiler between the cylinder and furnace, and is driven by strap from the fly-wheel. The light which may be of any system preferred, is intended to be placed in front of the smoke box at a height most convenient.

When the engine is travelling on the line the dynamo-machine is driven by the strap from the fly-wheel as before mentioned, and the light is diffused along the road. When, however, it is necessary to stop in order to direct the light to some particular spot, the driving wheels are readily thrown out of gear, so that the engine ceases to be locomotive, the power being employed only for driving the dynamo-machine.

During the day the engine can be used for driving saws or pumping, or any other description of work.

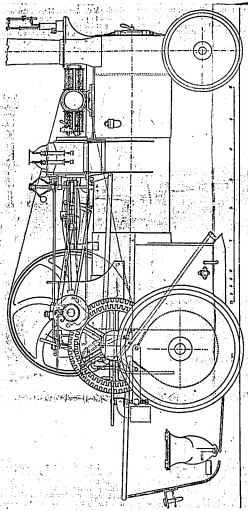


FIG. 2.

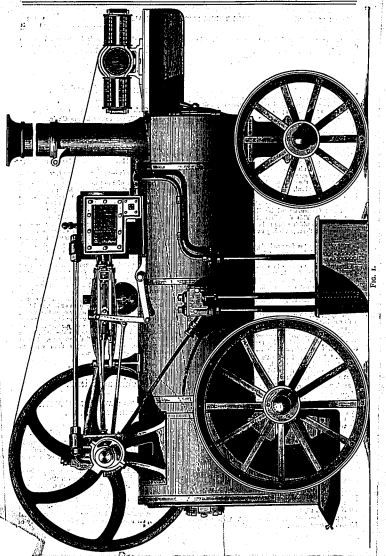


FIG. 3.

SCHUCKERT'S DYNAMO-ELECTRIC MACHINE.

THE improvement, introduced by Mr. S. Schuckert, consists in the construction of dynamo-electric machines with the most advantageous arrangement for utilizing the induction wire or conductor on the revolving iron armature so as to reduce the warming of it to a minimum.

For this purpose the armature is ring-shaped, and composed of several short-iron discs. Both side faces as well as the outside are brought under the influence of the magnetic poles, and these poles are arranged with the highest intensity of magnetism directly opposite the side faces of the ring.

The flat ring is made up of a number of short-iron discs, which are magnetically insulated from each other, which serve to reduce eddy-currents in these discs when the ring is in working; because in these single short-iron rings of small volume, the pole changing goes on with little resistance, and the electrical interpolation is easily destroyed. The warming

TEMPERING THE ELECTRIC LIGHT.—It has occurred to J. Pumphrey that, as clouds temper the brightness of the sun, so an imitation of clouds, by wadding and strips of glass fibre, would temper the electric light; and by using screens of glass wadding instead of opaline or clouded shades he reduces the loss of light from 50 to 25 per cent.

We have received Mr. Killingworth Hedges' pamphlet entitled "Useful Information on Practical Electric Lighting" (E. and F. Spon, publishers). It is designed as a guide to the unscientific public, who wish to make use of the new illuminator, and in the best of its kind we have seen.

MR. EDISON has exhibited the working of his incandescent light in the basement of his laboratory and factory with excellent results, furnishing 14 of the new lamps, each with 16 to 20 candle power, on one circuit, giving a steady white light, much superior to the carbon, and equivalent to the number of gas jets. The generator was a Gramme machine of 24-horse power. Mr. Edison states that he can now supply light for practical domestic use at less than half the cost of gas, but is experimenting for further improvements in the lamp and economy in the generator. —*Daily News*, March 28.

THE Metropolitan Board of Works have decided to continue the Jablochkoff lights for three months longer on the Thames Embankment, at a reduced cost.

JABLOCHKOFF'S candle was tried on March 19, in the theatre of the Royal United Service Institution, as a means of illumination for facilitating surgical operations and examinations in dull weather or after dark. Mr. Balmanno Squire, Senior Surgeon to the British Hospital for Diseases of the Skin, exhibited a remarkably small, light, and portable hand-lantern, which, he says, may be projecting from the back of a bibliokeeper, and be served also as a handle for the lantern) a fitted to the tube the burning end of the electric candle could be advanced forward into the lantern as the candle gradually burnt back. This, with two connecting screws for attachment. The electric wires, formed the whole blue glass placed at the side of the lantern formed the means of ascertaining from time to time the exact position of the burning end of the electric candle. He

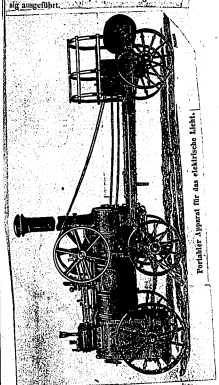
Portbarer Apparat für das elektrische Licht.

Unbestreitbar wird Interesse mehr für die praktische Einführung und Verwendung des elektrischen Lichtes gethan als — im praktischen Amerika... Wien, Paris und London sind hierin New York weit, weit voraus. Namentlich in England trachtet man nach einer praktischen Anwendung desselben nach jeder Richtung hin. Davon gibt uns wieder die hier abgebildete portable Dampfmaschine einen Beweis, welche von Messrs. Marshall, Sons & Co. zu Gainsborough im Auftrage der Ingenieure für Elektricität, Messrs. Crompton & Fawkes, hergestellt worden ist, um — sie Contractoren oder Anderen auszuleihen, welche des temporären Gebrauches kräftigen elektrischen Lichtes bedürftig sind.

Das Arrangement besteht aus einer portablen Dampfmaschine von 6 Pfkr. mit zwei Triebrädern mit eigens schweren Kränzen und ist mit dem wohlbekannten Hartnell'schen automatischen Expansionsventil-Geschirre versehen, welches vom Regulator controllirt wird. Dieses Geschirr gibt nämlich eine merkwürdige Gleichförmigkeit der Schnelligkeit unter verschiedenen wechselnden Lasten und ist insbesondere deshalb sehr geeignet für den irgend welcher Neigung, zu pulsiren oder zu trudeln, eine Neigung, welche gewöhnlich allen Regulatoren eigen ist, welche auf das Dreschwerk wirken, die aber in jeder Beziehung zweckmässig ausgeführt.

Der vorbeschriebene Apparat ist an einen Contractor eingeliefert worden, der die neuen Bauten der „Stanton Iron Works" zu Nottingham herzustellen hat. Acht Arbeiter vermochten, ohne einander im Wege zu stehen, bei'm Lichte dieser bedeutenden Lampen begonnen zu arbeiten und so schnell zu mauern, als am Tage; Am Tage wird die Dampfmaschine behütet, um eine Mörtelmühle zu treiben, und Contractor und Bauherren waren wohl damit zufrieden und wussten besonders die wirksame Eigenschaft des damit erhaltenen Lichtes zu schätzen, das obendrein durch die Nebenvergünstigkeit der Dampfmaschine sich als billig herausstellte.

Wie aus der Abbildung zu ersehen ist, nimmt sich das ganze Arrangement der einzelnen Theile an diesem Apparate für elektrisches Licht gefällig aus und ist es auch in jeder Beziehung zweckmässig ausgeführt.



Portabler Apparat für das elektrische Licht.

Das Ausleihen, Herrichten, Verbinden mit den Lampen, um die erforderliche volle Beleuchtung zu geben, erfordert nur eine Stunde.

Die hier verwendeten Lampen sind Modificationen des Serrin'schen Regulators und sollen die Vorzüge dieses Systems sämmtlich eine Form in sich schliessen, welche in den Stand setzt, die Theile derselben vermittelst gewöhnlicher Maschinenwerkzeuge zu verdoppeln, auf welche Weise die ersten Herstellungskosten um die Hälfte verringert werden.

Der Telegraph

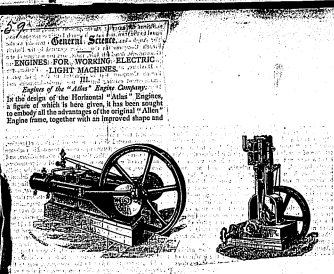
4076. ELECTRIC APPARATUS FOR GENERATING AND MEASURING ELECTRIC CURRENTS, &c. F. Jacques.—Dated November 24, 82.

In one type of machine the poles each of the inducer system are composed of a horseshoe core of iron of the magnetic field magnet system, or horseshoe core of iron of the magnetic field magnet system, being [illegible] and the [illegible] of the same [illegible] of the same [illegible] of the same

GENERAL SCHEME OF ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

Engines of the "Atlas" Engine Company.

In the design of the Horizontal "Atlas" Engines, a figure of which is here given, it has been sought to embody all the advantages of the original "Atlas" Engine frame, together with an improved shape and



finish in the details. Thus, while the guide bars, front cylinder, cover and main carriage are cast in one with the bed, the bed is carried out with a square shape so as to facilitate foundations and ensure a more even distribution of the bearing surface and of the holding-down bolts. The square bars have been retained, as the crosshead is of improved design, with slippers adjustable by means of a wedge and screw so that it can be slipped on in any position. With the exception of the guides and the outline of the slide-valve spindle, which the feed-pump plunger provides the former with the short form of radius on the right hand, and has also the advantage of throwing only a "sensional" strain on the eccentric rod.

In the "Atlas" Vertical Engines the vertical tubular frame merges into a square hollow base in which are cast two carriage or slide-valve crank shaft. The guides are cylindrical, form part of the frame, and are cast with set bosses opening outside the frame. Both horizontal and vertical engines are made to gauges, so that any part can be easily replaced at any time.

The "Atlas" Engine Company have been trying several kinds of governors, with a view to fixing out the best, and hope to introduce shortly a very superior one.

When combined with vertical boilers the "Atlas" engines are fixed on a hollow foundation plate, forming a tank, in which the feed water is admitted and is warmed by the heat of the under part of the furnace.

We may mention that "Atlas" Engines were selected to drive the Dynamo-Electric Machine at Aston, near Birmingham.

The current from a dynamo-electric machine of Mr. Field was recently applied to telegraphy in the working of fifteen large circuits.

DYNAMO-ELECTRIC MACHINES.

By Profs. Edwin J. Houston and Elihu Thomson.*

During the recent competitive trials made at the Franklin Institute as to the relative efficiency of some different forms of dynamo-electric machines, the authors, having been intrusted with the work of determining the relations between the mechanical power consumed and the electric and thermic effects produced, took the opportunity thus afforded to make a careful study of many interesting circumstances which influence the efficiency of those machines.

It is purposed in the present paper to select from the many circumstances thus noticed a few of the more interesting, reserving the others for future consideration.

It will readily be understood that, from the comparatively new field to which we have been working, no reliable data of the electrical work of those machines having before been obtained, difficulties constantly arose, not only from the conditions of operation, and new developments, as to the behavior of the machines under varied conditions, were constantly met.

As a certain arrangement of the particular circumstances we are about to discuss may be, 1st, those affecting the internal work of the machine; 2d, those affecting the external work; and 3d, the relations between the internal and external work.

The mechanical energy employed to give motion to a dynamo-electric machine is expended in two ways, viz., 1st, in overcoming friction and the resistance of the air; and 2d, in imparting motion to the armature of the machine. The magnetic field, the latter, of course, constituting solely the energy available for producing electrical current. The greatest amount of power expended in the first way was noticed to be about 17 per cent. of the total power employed. That expenditure was clearly traceable to the high speed required by the machine. The speed, therefore, required to properly operate a machine is an important factor in ascertaining its efficiency.

The above percentage of loss may vix appear great, but when it is compared with the useful work done in the machine, as here, consuming as it did in this particular instance over 80 per cent. of the latter, and about 38 per cent. of the total work of the circuit, its influence is not to be disregarded. In another instance the work consumed as friction was equal to about 80 per cent. of that appearing in the arc as useful work in the former machine experimented with this percentage fell to 20 per cent. of that which appeared in the arcs as heat, and was only about 7 per cent. of the total power consumed in driving the machine.

In regard to the second way in which mechanical energy is consumed, viz., in overcoming the resistance necessary to drive an armature through the magnetic field, or, in other words, to produce electrical current, it must not be supposed that all of the energy thus spent is lost in the circuit of the machine, since a considerable portion is expended in producing what we term the local work of the machine, that is, heat developed in the conductors of the machine, that is, local wire, exposing the machine.

The following instances of the relation between the actual work of the circuit, and that expended in local action, will show how that latter is to be considered. In one instance an amount of power somewhat more than double the total external work of the circuit was thus expended. In this instance also it constituted more than five times the amount of power utilized in the arc for the production of light. In another instance it constituted less than one-half the total work of the circuit, and somewhat more than one-half the work in the arc.

Of course, the work expended in local action is simply thrown away, since it adds only to the heating of the machine. And since that adds to the internal electrical resistance, it is doubly injurious.

The local action of dynamo-electric machines is analogous to the local action of a battery, and is equally injurious in its effects upon the available current.

Again, in regard to the internal work of a machine, since all life is eventually reduced to heat in the machine, the temperature during running must continually rise, until the loss by radiation and convection into the surrounding air equal the production, and thus the machine will acquire a constant temperature. This temperature, however, will differ for different machines according to their construction and to the power expended in producing the internal work, being, of course, higher when the power expended in producing the internal work is proportionally high.

If, therefore, a machine during running acquires a high temperature when a proper external resistance is employed, its efficiency will be low. But it should not be supposed that because a machine heats when run without external resistance, that is, on short circuit, it must equally inefficiency be shown thereby. On the contrary, should a machine thus easily consumption, and when a proper external resistance is employed, and keep greatly within it, on short circuit, these conditions should be regarded as a proof of its efficiency.

As a rule the internal resistance of dynamo-electric machines is so low, that to replace them by a battery, the latter, to possess an equal internal resistance, would have to be made of very large dimensions, so that the efficiency of dynamo-electric machines cannot be stated in terms of battery cells as ordinarily constructed.

In regard to the second division, viz., the external work of the machine, this may be applied in the production of light, heat, electrolysis, magnetism, etc.

Where it is desired to produce light, the external resistance is generally that of an arc formed between two carbon electrodes; the resistance of the arc is, therefore, an important factor in determining the efficiency. To realize the greatest economy, the resistance of the arc should be low, but, nevertheless, should constitute the greater part of the entire circuit resistance.

In some of our measurements the resistance of the arc was surprisingly low, being in one instance .34 ohm, and in another .29 ohm. It was, however, in some instances, as high as 2·18 ohms.

It may be noted as an interesting fact that, where the greatest current was flowing, the resistance of the arc thereby produced was low. This is undoubtedly due to higher temperature and increased vaporization from it. In some of the latter case also the greatest amount of light was obtained.

The amount of work appearing in the arc, as reason, by the number of foot pounds equivalent thereto, is necessarily an index of the lighting power. In two instances of measurement the amount of energy thus appearing in the arc was equal, while the lighting powers were proportionately as three to four. This apparent anomaly is explained by considering the resistance of the arc, it being much less in the case in which the greater light was produced. The heat in this case being evolved in less space, the temperature of the carbons, and, therefore, their light-giving powers, was considerably increased.

A few remarks on the economical production of light from electrical current may not be out of place. The light emitted by an incandescent solid will increase as its temperature is increased. In the voltaic arc the limit to increase of temperature is in the rapid vaporization of the carbons. Before this point is reached, however, the temperature is such that the light emitted is exceedingly intense. No reliable method of measuring the temperature of the arc has as yet been found.

A well known method of obtaining light from electrical currents is by constructing a resistance of some material, such as platinum, having a high fusing point, and heated to incandescence by the passage of a current. The platinum is employed, the limit to its increase of temperature is the fusing point of the platinum, which is unquestionably but a fraction of the temperature required to vaporize carbon. Were the fusing off in the amount of light emitted merely proportional to the decrease in temperature, the method last described might be economical. Unfortunately, however, the method, many facts show that the decrease in the light emitted is much greater than the decrease in the temperature. Heat sufficient to produce 1,000 °C. without practically emitting light. At 2,000° C. the light emitted is such that the body is said to be a bright red. At 4,000° C. the amount of light will have increased more than twice, probably as much as four times, that emitted at 2,000° C. It is reasonable to suppose that, with a further increase of temperature, the same ratio of increase will be observed, the proportionate increase in luminous intensity for exceeding the increase in temperature.

It would, therefore, appear that the employment of a resistance of platinum or other similar substance, whose temperature of alteration of state as compared with carbon is low, must be far less economical than the employment of the arc itself, which, as now produced, has been estimated as about two or three times less expensive than gas.

Indeed, it would seem that future improvements in obtaining light from electrical currents will rather be by the use of a sufficient resistance in the most limited space incandescent, thereby obtaining in such space the highest possible temperature.

Perhaps the highest estimate that can be given of the efficiency of dynamo-electric machines, as ordinarily used, is not over 50 per cent.; our measurements have not given more than 38 per cent. Future improvements may increase this proportion. Since the efficiency of an ordinary steam engine and boiler in utilizing the heat of the fuel is probably overestimated at 10 per cent., the apparent maximum percentage of heat that could be recovered from the current developed in a dynamo-electric machine would be overestimated at 10 per cent. The economical heating of buildings by means of electricity may, therefore, be regarded as decidedly improbable.

Attention has long ago been directed to the use of dynamo-electric machines for the conveyance of power. Their employment for this purpose would, indeed, seem to be quite promising. Since in this case one machine is employed to produce electrical currents, to be reconverted into mechanical force by another machine, the question of economy rests in the perfection of the machines and in their relative results.

In respect to the relations that should exist between the external and internal work of dynamo-electric machines, it will be found that the greatest efficiency will, of course, exist where the external work is somewhat greater than the internal work, and this will be proportionately greater as the external resistance is greater. Our measurements gave in one instance the relation of 82 ohm of arc to 32 ohm of the machine, a condition which indicates economy in working. The other extreme was found in one instance where the resistance of the arc was 1·93 ohm, while that of the machine was 4·00 ohms, a condition indicating wastefulness of power.

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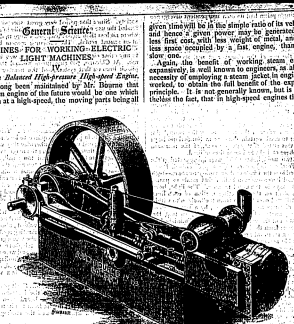
* Read before the American Philosophical Society, Nov. 1, 1878.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

IV.

Bourne's Balanced High-pressure High-speed Engine.

It has long been maintained by Mr. Bourne that the steam engine of the future would be one which is driven at a high-speed, the moving parts being all



designed so that no unbalanced momentum may cause a tremor.

The benefits which this high-speed system possess are numerous; not only is the noise and complication of gearing avoided, but, as an engine with any given pressure of steam will generate a given amount of power at each stroke, whether the strokes per minute be many or few, it is clear that the amount of power generated by a given engine in a given time will be in the simple ratio of its velocity; and hence a given power may be generated with less first cost, with less weight of metal, and with less space occupied by a fast engine, than by a slow one.

Again, the benefit of working steam engines expansively is well known to engineers, as also the necessity of employing a steam jacket in engines so worked, to obtain the full benefits of the expansive principle. It is not generally known, but is nevertheless the fact, that in high-speed engines there is a further benefit arising from the inability of the cylinder to become sensibly heated and cooled at each stroke, from the shortness of the time given for that process, and in such engines the cylinder approaches to the condition of a non-conductor, which is known to be favourable to the economical generation of power. Then, in the case of all high-pressure engines, it is easy to see that a considerable pressure must be more beneficial than a lower

pressure. To raise a given quantity of water into steam takes just the same quantity of heat, whether the evaporation is effected at the pressure of the atmosphere or at six or eight times that pressure. But at the low pressure the steam will not generate any power, whereas at the high pressure it will generate much power. A very high pressure of steam, however, is inconvenient, as it involves a correspondingly strong and heavy boiler, an extra strong and heavy engine, and separate expansion gear, which is not compensated by the small amount of increased economy obtained from excessive pressure. A pressure of about eight atmospheres is found to be, on the whole, the most eligible that can be adopted.

The figure shows one of Mr. Bourne's high-speed engines, employed in generating the electricity for the electric light at the Polytechnic Institution, in Regent Street.

The proportions of these engines for all powers is as follows:—

Extreme length of engine, about 3 times the length of stroke.

Extreme breadth of engine, about 3 times diameter of cylinder.

Breadth of fly-wheel for strap, about 14 times diameter of cylinder.

Diameter of vertical boiler, about 8 times diameter of cylinder for small, and 6 times for larger powers.

Height of boiler, about 22 times its diameter.

Working pressure in boiler, 120 lbs., tested to 240 lbs.

Water required for feed, about 4 cubic ft. per *indicated* horse-power per hour.

Coal consumed, about 3½ lbs. per *indicated* horse-power per hour.

In addition to the engines, which have been already described, those manufactured by several other firms are worthy of notice, as being especially adapted for driving electric-light machines, amongst others, the engines of Messrs. Marshall, Sons, & Co., of Gainsborough, and also Messrs. Tangye, of Birmingham. Messrs. Marshall's engines are fitted with patent automatic expansion gear, which insures the greatest regularity in the working.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

IV.

The Otto Silent Gas Engine.

The first practical gas engine was, it is believed, introduced by M. Lenoir, of Paris, now nearly twenty years ago. In this engine the ignition of the explosive mixture of gas and air in the cylinder was effected by the passage of an electric spark, obtained from an induction coil worked by a battery. This arrangement, although effective, had many manifest inconveniences, and M. Hugon and others improved upon the idea by effecting the ignition by means of a small gas flame placed opposite a slight aperture in the cylinder, which was opened and closed by a valve. This device has been adopted in all the engines subsequently invented, and answers the purpose most effectually.

The progress of the electric light has given an impetus to the manufacture of gas engines, and at the present time a large number are employed for the purpose of driving dynamo-electric machines.

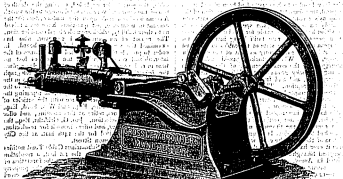
The general appearance of the Otto and Lenoir gas engine, as manufactured by Messrs. Crossley Brothers of Manchester, is shown by the cut on the following page.

The principle of combustion in these gas engines is entirely new. In them an explosion does not take place in the ordinary meaning of the term. A small part only of the charge is combustible, which on ignition serves to expand the remainder, thus avoiding shock and effecting great economy. The engines have also the peculiarity of igniting their charges at the *beginning* of the stroke, having *the whole* of the stroke for effective expansion of the gases, instead of merely a fraction as in obsolete constructions.

Every part of these engines is now made to gauge,

and is therefore easily replaced. The wearing portions are also of the simplest and most inexpensive patterns; for instance, the working barrel of the cylinder itself can be supplied for about 11 per cent. on the first cost of the engine, and being strictly gauged, can be put in with great facility in a few hours.

By this system the engine may be kept permanently almost equal to new for a certain annual expenditure.



The pistons are of great length—of which the peculiar construction of the engine readily admits, and being also as light as possible, ride on the oil with the least degree of wear.

The slides valves keep in excellent condition with proper care; but, as far as possible, to prevent risk of stoppage even from neglect, they are supplied in duplicate with each engine without extra charge.

These engines will run with extreme smoothness and regularity of speed, and have very few working parts. They possess the great and sometimes indispensable advantage, as compared with steam engines, of starting at full power at once on the gas being lit, and, starting on boiler, they avoid all the dangerous and pecuniary risks, annoyances, expensive repairs and attendance which a boiler frequently entails. The cost of a chimney, the nuisance of smoke, coal, ashes, and water must also be considered when a boiler is used. Where work is intermittent, trouble with a steam boiler and engine is at its maximum, but with a gas engine the reverse is the case.

The smallest engine capable of driving a Gramme "A" machine, is one 3½ H.-P. *nominal*, or 5½ H.-P. *indicated*. The 8 H.-P. *nominal* will *indicate* 14 H.-P. These will drive 3 Gramme "A" machines and 4 Siemens "A" machines. The gas consumed by these engines per *indicated* H.-P. is four 21 to 25 cubic feet, the engine running at 160 revolutions per minute.

LES NOUVELLES MACHINES
A LUMIÈRE DE M. SIEMENS

M. Siemens est, comme on le sait, le premier inventeur des machines dynamo-électriques sans organe excitateur spécial, et dès l'année 1867 il avait employé ces sortes de machines dans beaucoup d'applications électriques, notamment pour le tir des mines. Depuis les résultats avantageux obtenus par les appareils d'induction pour la lumière électrique, il a cherché lui aussi à combiner des machines dynamo-électriques capables de fournir [illegible]

[illegible] peuvent de la manière la plus heureuse. On connaît les expériences si curieuses faites en Angleterre, à South Foreland, sur la valeur réciproque des différents générateurs imaginés dans ce but, et on doit se rappeler que les machines de M. Siemens du petit modèle avaient été classées en première ligne. Nous devons toutefois faire observer qu'à cette époque les machines Gramme qui avaient été essayées étaient loin d'être aussi perfectionnées qu'elles le sont aujourd'hui. Toujours est-il que les machines Siemens passent encore comme excellentes et nous croyons devoir d'autant plus les étudier sérieusement qu'elles sont généralement peu connues en France.

Aujourd'hui, MM. Siemens ont établi à Paris, rue Picot, n° 8, un grand établissement de construction de ces machines, dirigé par M. Boistel, et que nous avons visité récemment avec un véritable intérêt. On y construit en ce moment un assez grand nombre de types différents, depuis les machines à génération de courants de grand et de petit modèle, jusqu'aux machines à division de lumière qui sont établies pour quatre, pour huit et pour seize foyers lumineux. Ces dernières machines n'emploient, m'a-t-on assuré, que trente chevaux de force, y compris la mise en marche de la machine génératrice. Ce serait une force motrice moindre que celle nécessaire par les machines Gramme à division. Mais des expériences comparatives devront évidemment être faites pour que l'on puisse être fixé à cet égard. En ce moment, nous ne voulons rien préjuger, mais seulement faire connaître ces dispositions nouvelles, qui sont vraiment très-intéressantes.

La machine génératrice de M. Siemens a été décrite dans notre ouvrage sur *l'Eclairage électrique* et, avec plus de détails, dans notre *Exposé des applications de l'électricité*, t. V; il y a cependant été apporté dernièrement, pour le petit modèle, certaines modifications que nous croyons devoir rappeler.

Dans cette machine, l'inducteur est constitué par deux électro-aimants à noyaux plats et larges, opposés l'un à l'autre par leurs pôles semblables, et réunis ensemble de manière à former un épanouissement assez étendu recouvrant en une sorte de demi-circonférence. Les parties creuses de ces demi-circonférences sont opposées l'une à l'autre, et c'est dans le cylindre ainsi constitué que se trouve placée la bobine induite. Cette bobine est constituée par un cylindre de cuivre recouvert de taffetas gommé, sur lequel sont enroulées, dans le sens de sa longueur, une série d'hélices disposées comme des multiplicateurs galvanométriques, lesquelles se trouvent réunies en tension et dont les fils de jonction aboutissent à un collecteur comme dans la machine Gramme. A l'intérieur de ce cylindre se trouve, mis une carcasse de fer immobile, soit une série de fils de fer disposés comme dans les machines d'induction électro-magnétiques et qui, tout en servant d'excitateur au système électro-magnétique de l'inducteur, contribuent eux-mêmes à l'induction comme dans les machines de Rukmkorff et autres. Deux poignes de cuivre, appuyant sur le collecteur servent la région neutre du système électro-magnétique, recueillent le courant et le distribuent au circuit.

Dans le grand modèle, l'inducteur est horizontal et la bobine induite est pourvue de la carcasse de fer dont nous avons parlé. Dans le petit modèle, au contraire, l'inducteur est placé verticalement et la bobine induite est remplie de fils de fer; c'est ce petit modèle, dont les dimensions ne dépassent pas celles de certaines machines d'induction de cabinets de physique, qui sert d'organe générateur pour mettre les machines à division et à inversion, et on est très-étonné qu'un organe excitateur aussi petit puisse déterminer des effets aussi considérables.

Les machines à division sont fondées toujours sur le principe du système Lontin, mais dans des conditions tout à fait différentes et en mettant à contribution des effets électriques entièrement nouveaux. Si nous prenons par exemple le modèle pour seize bougies, nous voyons que l'inducteur, au lieu d'être mobile comme dans les systèmes Lontin et Gramme, est constitué par deux couronnes verticales d'électro-aimants fixés parallèlement l'un devant l'autre et entre lesquelles tourne le système induit qui est composé d'autant de cadres galvanométriques qu'il y a d'électro-aimants dans chacune des deux couronnes. Les électro-aimants de l'inducteur, qui sont à deux branches, sont disposés les uns à la suite des autres, mais sans se toucher et de manière à présenter des intervalles égaux entre les noyaux magnétiques. Ils sont naturellement isolés du bâti de fonte qui les soutient au moyen de lames d'ébonite, et ils sont reconnus de manière qu'un pôle nord se trouve toujours entre deux pôles sud, et un pôle sud toujours entre deux pôles nord. Comme on le comprend facilement, les électro aimants, pris vis-à-vis sur l'autre bâti, sont de polarités contraires; par conséquent, un cadre galvanométrique qui viendra s'introduire entre deux noyaux consécutifs de ce double système inducteur se trouvera impressionné sur quatre points opposés; d'abord sur les deux faces du multiplicateur, et en second lieu sur les deux parties opposées du cadre galvanométrique.

Le système induit se compose d'une roue en bronze à l'extrémité de laquelle sont fixés les 16 multiplicateurs galvanométriques dont nous nous parlé; ces multiplicateurs sont contenus sur deux chevalets de bois fixés entre deux lames de cuivre percées de trous et ayant la forme de secteurs allongés. Chaque multiplicateur se compose de 23 rangées de spires, au nombre de 17 par rangée, et le fil a 18 dixièmes de millimètre de diamètre; il n'y a d'ailleurs aucun moyen de fer dans chacun d'eux, et ils ont exactement l'aspect d'un cadre galvanométrique; c'est par leurs joues que tous ces multiplicateurs sont fixés sur la roue de cuivre, et ils s'y adaptent avec une telle précision, que l'on croirait la roue munie de deux larges circonférences métalliques présentant sur ses bords extérieurs des découpures circulaires correspondant à chaque multiplicateur. Les trous dont sont pourvues ces joues métalliques ont été pratiqués pour permettre à l'air de refroidir les fils des multiplicateurs enfermés au dedans, précaution négligée en France, mais que l'on prend toujours dans les machines construites à l'étranger.

La partie centrale de la roue du système induit est occupée par une forte planche circulaire, sur laquelle sont fixés les fils de communication des bobines entre elles et avec le collecteur. La combinaison de ces fils est, du reste, très-simple : les multiplicateurs sont répartis comme dans la machine Gramme, en quatre séries, et les multiplicateurs de chaque série sont réunis entre eux en tension. L'un des bouts homologues de chacune de ces séries aboutit à un anneau métallique fixé sur l'axe de rotation de la roue, et les autres bouts aboutissent à quatre autres anneaux isolés les uns des autres et sur lesquels appuient des frotteurs en communication avec les lames d'attache des quatre circuits correspondant aux lampes électriques, lesquels circuits sont complétés par une communication avec un frotteur appuyant sur l'anneau commun à tous les multiplicateurs. Le courant de la machine excitatrice qui est placée à côté correspond d'ailleurs aux 32 électro-aimants des deux couronnes de l'inducteur, lesquels sont tous réunis en tension et sont composés chacun de cinq rangées de spires ayant 32 spires en fil de 2 millimètres.

Ce qui est remarquable dans cette machine, c'est le peu d'échauffement qui est développé en elle. Les électro-aimants de l'inducteur n'ont guère plus de 30° de température, les multiplicateurs sont un peu plus échauffés, mais je n'ai pu me rendre compte du leur degré de chaleur.

D'après M. Boistel, la force motrice employée pour faire fonctionner le système à seize foyers serait de 13 chevaux; la vitesse de rotation de la machine à division est de 590 tours par minute, et celle de la machine excitatrice est de 1373 tours. Dans le modèle destiné à alimenter huit foyers, la force employée est de 7 chevaux, la vitesse de rotation de la machine à division est de 550 tours, et celle de la machine excitatrice de 1373 tours. Dans le modèle pour quatre foyers, la force employée est de 4 chevaux, la vitesse de rotation de la machine à division est de 660 tours, et celle de la machine excitatrice de 1100 tours.

Avec de légères modifications, M. Boistel pense que l'on pourrait disposer la machine à quatre foyers pour 6 et la machine à huit foyers pour 12.

Le principe des machines de MM. Siemens repose uniquement sur les réactions d'induction produites par le passage des spires des multiplicateurs devant un inducteur électro-magnétique et sans l'influence d'un mouvement tangentiel : ce n'est pas exactement l'effet produit dans l'expérience classique de Faraday, et lesdits deux courants engendrés entièrement différent de ce qu'il devrait être, d'après les idées que l'on se fait généralement de l'induction. J'ai étudié longuement ces différentes sortes d'inductions dans un Mémoire présenté à l'Académie le 23 février 1879, et ce mémoire est, du reste, résumé dans une des Notes qui terminent notre volume sur l'Eclairage électrique.

TH. DU MONCEL.

APPAREIL DE LUMIÈRE ÉLECTRIQUE

DE M. JAMIN.

On appelle fort justement *lampes électriques* les appareils pourvus d'un mécanisme automatique, plus ou moins simple, destiné à maintenir à bonne distance les deux charbons entre lesquels jaillit un arc voltaïque, malgré l'usure inégale de ces charbons et les variations du courant.

On appelle *bougies électriques* les appareils dans lesquels, par des artifices convenables, on fait jaillir l'arc voltaïque entre les pointes de deux charbons placés côte à côte, sans mécanisme aucun. Le premier appareil de ce genre est dû à notre ami, M. Jablochkoff; nous avons eu occasion de le présenter aux lecteurs de *la Nature* en 1877 et d'y revenir en 1878 pour constater l'immense succès qu'il a obtenu, succès parisien d'abord, puis européen et universel.

M. Wilde, de Manchester, a proposé une seconde bougie électrique, appareil qui avait été essayé à Paris, à l'insu du physicien anglais, par M. Nysten, neveu et collaborateur de M. Gramme.

M. Wilde place les deux charbons parallèlement, mais l'un des deux est mobile autour d'un axe, de telle sorte qu'en repos ils se rapprochent et se touchent par leurs extrémités; au moment où le courant est lancé dans l'appareil, il passe par le point de contact, un électro-aimant est actionné qui écarte le charbon mobile et l'amène au parallélisme exact avec l'autre, l'arc voltaïque apparaît et se maintient.

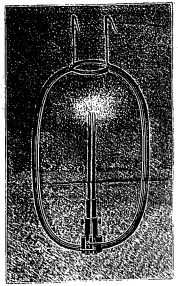
L'arc persiste entre les deux extrémités des charbons dans des conditions et avec des irrégularités que nous indiquerons tout à l'heure.

M. Jamin vient de réaliser un appareil, représenté par la figure ci-jointe, qui résout d'une façon singulièrement élégante le même problème.

Les deux charbons, plantés parallèlement dans le chandelier, sont entourés d'un fil dans lequel le courant même qui fournira la lumière, circule et circule parallèlement. L'appareil étant ainsi établi, touchons les deux charbons au milieu de leur longueur avec un troisième charbon, qui sert ici d'*allumette* ou, si on veut parler moins familièrement, d'amorce au courant en lui offrant un passage.

On écarte l'allumette et l'arc voltaïque apparaît, mais loin de rester où on l'a produit, il se transporte avec une extrême rapidité jusqu'au bout des charbons où il reste.

Toute l'idée de M. Jamin est dans ce transport, déterminé par l'action directrice de courants qui enveloppent l'appareil. Il faut donc nous y arrêter un instant.



Appareil de lumière électrique de M. Jamin.

Le courant, avons-nous dit, circule parallèlement dans les charbons et dans les fils enveloppants; cela veut dire que si le courant monte par le charbon de droite et descend par celui de gauche, il monte également par les fils de droite et redescend par ceux de gauche.

Il résulte de là que l'arc voltaïque, qui est comme un élément mobile du courant, se transporte dans le sens indiqué par les lois d'Ampère.

Il est à la fois attiré vers le haut par la partie du courant qui passe au-dessus et qui agit en vertu de l'attraction des courants parallèles et, de même sens, — repoussé vers le haut par la partie du courant qui passe au-dessous et qui agit en vertu de la répulsion de courants parallèles et de sens contraire — poussé vers le haut par la tendance du courant de droite à faire tourner le courant mobile dans le sens qui l'amène au parallélisme, — poussé également vers le haut par la tendance du courant de gauche à faire tourner le courant mobile dans le sens qui l'amène au parallélisme.

Les quatre actions sont concomitantes, exactement comme dans un galvanomètre, les quatre parties du fil (deux verticales et deux horizontales) concourent à faire dévier l'aiguille.

L'énergie de cette action peut être variée à volonté; il suffit, en effet, de multiplier le nombre des spires de fil qui entourent l'appareil pour aug-

DEPREZ'S ELECTRO-MAGNETIC ENGINE.

BY THE COUNT DU MONCEL.

ACCORDING to Count du Moncel (writing in *Le Lumière Électrique*) M. Marcel Deprez has succeeded in solving the problem of making an electro-magnetic motor capable of doing useful work, and which can compete with the steam-engine in point whether the new motor can compete with even a water-motor as regards economy, to say nothing of gas and steam-engines; but, according to Du Moncel, Deprez's apparatus is barely 8m. long, by ten thin rods in breadth; it weighs about 60lb., and can supply a power of nearly 8 horse-power, or 8 times that of the best electromotors. This (says Du Moncel) is really an extraordinary result, and one which could scarcely have been anticipated a few years ago. Under these conditions saving machines may with perfect ease be worked by electricity without any exorbitant expenditure. This ingenious system consists of a horse-shoe electro-magnet, about 1m. in length, between the pulsed which is introduced a little more than one-third open by the magnet over a length of 0m. 25. Up to the present time no one has ever thought of causing magnets or electro-magnets to act otherwise than by their polar extremities; and all the engines devised hitherto have been arranged on this principle. M. Deprez, however, thinking that under these conditions the whole of the magnetism that can produce a magnet was not utilized, endeavoured to cause the whole of the sufficiently-magnetised portions of the magnet engine to act upon the mobile system to be influenced; that is to say, in the present case, the branches of the magnet nearly 0m. 25 in length. The electro-magnetic armature, instead of being placed transversely to the magnet, is arranged longitudinally and parallel to it. Under these conditions the attraction and repulsion exercised on this armature is found to be considerably augmented, as is perceptible from the difference of force necessary in producing rotation; and this increase of force may give an idea of the considerable advantage which the employment of motors, which work by the effect of attraction, presents over those which work by the effect of attraction, reversals of the current. Everybody knows that a horse-shoe magnet is a kind of galvanometer frame, of which one side constitutes the two poles of a straight electro-magnet, and the other, that core, broader than it is long, upon which the wire is wound. The axis of this electro-magnetic frame is the thread of wire in the magnetising helix, and, consequently, to the axes of the magnet. At one end of this axis is a pivot communicated, and at the other end is a projecting axis with a pinion which gears into a wheel of 60 teeth, communicating 60 times greater. When the apparatus is properly regulated, the armature makes 90 revolutions per second, and, consequently, the wheel which it moves makes three revolutions. It is upon the axis of this wheel that is fixed the friction transmitting the movement, and from the axis of which is caused inwards either a saving-contact or a motive-contact, by the intervention of a sort of rocking lever. In order to render the working of this apparatus perfect, M. Marcel Deprez has adopted to it an extremely ingenious regulator, the action of which is very effective, and the work of which is fixed by one of its extremities to one of the branches of the armature. By means of a screw this tension can be given to any given velocity of the engine is given to the spring. The transmission of the current from the collector to the wire of the armature is effected with great difficulty by this spring, as in the case of all frictional contacts; but, again, a certain velocity is greater than that which is required, a centrifugal force is brought into action which the moment the engine reaches a slackening of the speed, and then there is a reversal of the circuit, which up again before when the velocity again becomes too great. These alternations occur with such immense power is somewhat higher than a second. Thus, first a continuous spark is seen which is essential to the regulating spring is to continue apparent, while, in reality, it is not continued, but by means of great inertia. In fact, may be retarded by trying to stop the pulley, the direction of the current is not changed. With five Bunsen elements at which this engine can be effected only with great difficulty; there is, however, a peculiarly electro-magnetic a little upon the subject of motors, a stoppage by pressing the finger upon the pulley. Count du Moncel does not say what is the cost of five Bunsen elements, nor whom they are to be placed when employed in working a sewing-machine in a lady's boudoir.

Electro-magnetic Railway. — One of the novelties in the Berlin Exhibition is an electric railway for Lichterfelde and Halbke. The electrical power is supplied by a dynamo-electric machine worked by a steam-engine, to another dynamo-electric machine, which sets in the wheels of an electric locomotive. The train is to run at a way at 20 miles per hour, carrying three metres (or second; the same time that will be tried at the Scientific Exhibition at the Palais Bourbon, Paris. Deprez's motor, which is very promising. A new gramme, and with twelve Bunsen elements giving seven kilogrammetres power. This result of Marcel Deprez's exhibiting now at Lille, on the Exposition of 1878 (we hoped that it will have been exhibited at Paris). It is actual help of breaking and directing without any sacrifice of ballast and escape of gas.—*Nature*.

Le mois de mars 1879 est particulièrement intéressant à ce point de vue. Les 18 dépressions signalées sur toute l'étendue du continent, 11 sont venues de l'océan Pacifique et ont abordé la côte par l'Oregon et le Territoire de Washington ; le plupart ont marché sensiblement dans la direction de l'est, leurs centres se déplaçant le long du 45e parallèle. C'est sans doute à ce manière exceptionnel de heurtmques qu'il faut attribuer l'excès de température que tous les observateurs ont signalé ; cet excès semble croître avec la hauteur du lieu au-dessus du niveau de la mer ; c'est ainsi que le plus grand écart (+ 21,5) a été constaté au sommet du Pike's Peak, dans le Colorado. Pendant les premiers jours du mois, il est tombé dans le nord de la Californie des pluies considérables à la suite desquelles le Sacramento a rapidement grossi, détruisant les digues et submergeant les rivières. Par contre, les cultivateurs se plaignent de la sécheresse dans l'Utah, le Kansas et le Texas. La débâcle des glaces sur les rivières a permis à la navigation intérieure de reprendre son cours, interrompu pendant les mois d'hiver. Sur le Mississipi, le premier steamer de la saison passait à Saint-Louis de fer 1er mars, le Keokuk le 8, à Burlington le 16, à La Crosse le 23 ; à cette date la rivière était encore prise en amont de Saint-Paul, c'est-à-dire au nord du 45e degré de latitude. A la fin du mois, la navigation sur les Lacs n'était pas rétablie, mais la fonte des glaces s'effectuait activement.

TH. MOREAUX.

MACHINE MAGNÉTO-ÉLECTRIQUE

DE MÉRITENS[1].

A en juger par le nombre de langues électriques que cette machine peut allumer, on pourrait croire qu'elle constitue le générateur magnéto-électrique le plus puissant pour une force motrice donnée. Elle pourrait, en effet, avec une force motrice ne dépassant pas un cheval-vapeur, maintenir allumées indéfiniment trois bougies Jablochkoff, sans exiger de la part du moteur une vitesse de plus de 200 tours par minute et sans produire d'échauffement appréciables. Mais la lumière fournie par ces bougies ne semble pas être aussi forte que celle des bougies alimentées par les machines Gramme, et jusqu'à ce que des mesures précises soient données, on ne peut préjuger définitivement de la puissance relative de ce générateur. Cette machine est magnéto-électrique et fournit comme celle de l'Alliance des courants, renversés, mais elle ne demande pour produire le même effet, que huit aimants d'Arvarre au lieu de quarante-huit et seulement un quart de la force motrice, c'est au moins ce que dit M. de Méritens.

Les effets avantageux de ce genre de machine résultent de ce qu'aux courants d'induction déterminés dans l'anneau des machines Gramme, sont ajoutés ceux qui se produisent dans les machines magnéto-électriques ordinaires.

Pour qu'un puisse la comprendre, imaginons un anneau Gramme (fig. 1) divisé par exemple, en quatre sections, isolées soigneusement l'une du l'autre et constituant par conséquent quatre électro-aimants acquis, placés bout à bout. Imaginons que le noeud de fer de chacune de ces sections soit terminé à ses deux extrémités par une pièce de fer A B, formant comme un quatuor-cement de ses pôles, et supposons que toutes ces pièces réunies par l'intermédiaire d'une pièce de cuivre C b, constituent un aimant solide autour duquel sont disposés des aimants permanents N, S, N, Save leurs pôles alternés de l'un à l'autre. Examinons ce qui se passera quand cet anneau accomplira un mouvement de rotation sur lui-même, et voyons d'abord les effets qui résulteront, par exemple, du rapprochement du pole épanoui B, quand marchant de gauche à droite il s'approchera de X. A ce moment il se développera dans l'hélice électro-magnétique de A B un courant induit d'aimantation, comme dans une machine de Clarke. Ce courant sera instantané et de sens inverse aux courants particuliers d'Ampère de l'aimant inducteur, il sera très énergique en raison de la proximité de B du pôle X ; mais l'anneau en s'avançant va déterminer entre le pôle X et le noyau AB une série de déplacements magnétiques, qui donneront naissance à une série de courants d'intersection polaires, qui se manifesteront de B en A ces courants seront directs par rapport aux courants particuliers de X, mais ils ne sont pas instantanés et vont encroissant d'énergie de B en A. A ces courants se joindront simultanément les courants d'induction dynamique résultant du passage des spires de l'hélice devant le pôle X. Quand A abandonnera X, un courant de désaimantation se produira, égal en énergie et de même sens que le courant d'aimantation.

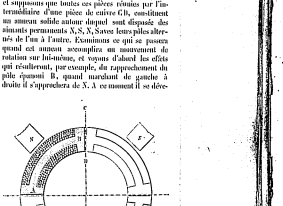


FIG. 1. — ANNEAU GRAMME.

[1] M. du Moncel vient de publier dans la *Bibliothèque des Merveilles* (librairie Hachette) un volume très complet et d'un *excellent* d'actualité particulier, sous le titre *l'Éclairage électrique*. Nous empruntons la description de cette machine, dont on a beaucoup parlé, à cet intéressant ouvrage.

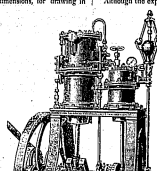
General Science.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

VI.

Simon and Sue's Gas Engine.

This engine has two cylinders, one for driving and the other, of smaller dimensions, for drawing in



the combustible mixture of gas and air, and for transmitting it into the driving cylinder. This gaseous mixture passes into the cylinder through a network of metal gauze, and is ignited on the driving cylinder side of it; the result of this arrangement is that the expansive union of the gaseous mixture, which drives the piston, takes place gradually, as the mixture is forced through the gauze, and on the principle of the safety lamp, the combustion cannot be communicated to the opposite side of the gauze, which would have the effect of causing the combustion before it is required.

The valves and governor, which regulate the admission of the gas and the exit of the products of the combustion, are very simple and effective.

Although the expansive effect of the combustion of the gas and air is a motive power employed in working the engine, it is not the only motive power, and to this point the engine differs materially from others. Each cylinder is water-jacketed, and between the cylinders and the jackets water flows continuously, the source being derived from a bucket or other small receptacle, whence it is pumped by the engine itself. These water-cavities are in communication with each other. Now the expansion and combustion of the gaseous mixture necessarily generates heat, and this is communicated to the water surrounding the cylinders, moreover, the spent gases are also very hot, and these being caused to pass through a vessel containing a network of tubes through which the water circulates adds additional heat to the water, so much so that the latter very soon begins to boil and generate steam; this steam is allowed to pass into the driving cylinder, and adds greatly to the motive power. When spent it passes out with the spent gases, adding what heat remains in it to the incoming steam, so that a uniform supply of the latter is maintained. The advantages of this type of engine are numerous. First, no water-vessel to cut the cylinder is required; indeed, the hotter the cylinder the better the engine works. However, the greater part of the heat is utilized in generating steam. Next the utilization of the steam overcomes another difficulty. The dryness of many explosions is destructive to cylinders, and soon destroys the lubrication which has consequently to be renewed. In Simon's engine no such difficulty occurs, as the steam preserves the lubricating qualities intact. Also the pressure of the expanded gas does not exceed 40 lbs., which puts but very little racking strain on the machinery.

There can be no doubt but that this engine, of which we give a general view, is a step in advance.

We learn that by a recent improvement, Messrs. Simon have obtained a gain of 20 per cent. in the power of their engine without any increase in the consumption of the gas used.

LIGHTING BY ELECTRICITY.—No. I.

During the past few weeks several events of a public nature have occurred which have had the effect of giving a fresh impulse to the interest taken in the question of lighting by electricity, a question which must before long occupy a far more important position that it does at the present time. The most noteworthy of these events, as indicating the advance which the subject has made in the way of official recognition, has been the appointment and session of the Select Committee of the House of Commons on Lighting by Electricity, which has been sitting twice a week for more than a month, and before whom independent scientific witnesses have been examined as well as others, who, although

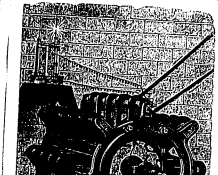


FIG. 1.

interested for or against one or another system of illumination, gave evidence none the less valuable for the purposes for which the committee was appointed.

While this committee was sitting at Westminster, not only was the electric illumination of the Victoria Embankment extended from Waterloo Bridge to Blackfriars, opening up an unbroken line of electric lights extending from Westminster to the Bank—a distance of more than a mile—but the very excellent report to which we have already referred in a previous issue* has been issued by the Metropolitan Board of Works, which shows that the finally good results the Jablochkoff system is not, by a long way, as costly as previous experience would seem to indicate.

Immediately after this followed the exhibition of electric lighting apparatus at the Royal Albert Hall; an exhibition which, from the splendid support accorded to it by the representatives of special systems, as well as by manufacturers of apparatus, proved to be one of the most complete and instructive illustrations of the present position of the science of electric lighting that had ever been brought before the public; and, owing in a like harmful way in which the exhibition was got up, and the still more harmful manner in which it was closed within three days of its being opened, a grand opportunity was thrown away and lost, and one, we fear, such as is not likely to present itself again.

Again, the lighting of the Albert Hall by the Siemens light during great musical performances, and the illuminations of the South Kensington Museum and Horticultural Gardens on occasions of conversazziones and fêtes, have each and all contributed to keeping alive public interest in the electric light, and have shown that, for such purposes, it has become a practical and recognised application of science to useful purposes. We do not think, therefore, that there could be a more fitting occasion than the present for running over in brief review the general question in a new strain, remodelling our renders as we go of the principle and construction of the various electric generators employed, of the characteristic features of the different systems for utilising the currents so produced, and of such necessary instruments and apparatus as are employed in the regulation, measurement, and general investigation of these currents.

Passing over the history of the subject from the

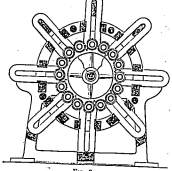


FIG. 2.

first discovery of the electric arc by Sir Humphry Davy in the year 1810, and the early magneto-electric machines which followed Faraday's brilliant discovery of magneto-electric induction, all of which have been described in these columns, and over and over again elsewhere, we will confine our attention to those generators of electricity which are actually used at the present time for the production of the electric light, and to those lamps and regulators which have stood the great battle of competition and experience, and which by their survival have proved themselves to have some claim to be reckoned among the fittest.

VOLTAIC BATTERIES.

Of voltaic batteries only two that are ever used for the production of the electric light are now in common use, and these are Grove's and Bunsen's carbon battery used to the exclusion of all others on the Continent. The zinc of the acids employed and of the size consumed in both these combinations render them both completely unfitted for the economical generation of electric currents of such strength as are required for the electric light, and batteries are only now employed for very special cases, such as lectures, public entertainments, and such occasions where it is inconvenient to employ the more cumbrous mechanical generators or where expense is no particular object, but even for such special purposes batteries are now giving way to dynamo-electric machines, which are very easily transported from place to place and installed even only for a few hours' use.

MAGNETO-ELECTRIC MACHINES.

The earliest forms of mechanical electric generators which have been used successfully for the production of the electric light were the magneto-electric machines of Professor Holmes, which for many years illuminated the lighthouse of Dungeness and the South Foreland, and the machines of the Société l'Alliance, of Paris, which have been in use at the lighthouse of Cape Grisnez, La Hève, and at several other Continental stations. These machines are identical in principle and very similar in construction, and it will be sufficient for our purpose to describe the latter arrangement which is shown in perspective in Fig. 1, and in cross section in Fig. 2. It consists of a framework of cast iron carrying four horseshoe steel magnets arranged radially and symmetrically around a central axis in right angles of five magnets each, their poles all being directed towards this axis. The four spaces between the magnets revolve upon a horizontal axis four bronze discs wheels, each carrying sixteen soft iron bobbins, each of which consists of a tube of soft iron wound with insulated copper wire, all being wound in the same direction. The magnets are so arranged around the machine that opposite poles meet each other both in each circular series as well as in each horizontal row, so that at each revolution of the machine, the core of each of the sixty-four bobbins has its magnetic polarity reversed sixteen times, and as it is impossible to reverse the polarity of a magnetised bar without reversing the direction of an electric current induced in a wire wound round it, it follows that at each revolution of the machine no less than 1024 electric impulses, alternating in direction, are transmitted into the external circuit of the machine.

Professor Holmes also designed a machine in which, like the early machine of Pixii, the inducing bobbins were fixed, and the magnets moved in front of them, but he constructed a machine of this type in which electro-magnets were substituted for the permanent magnets, part of the current produced being utilised to excite them. This was therefore a dynamo-electric machine, and in principle of working, and of distributing the coils, it bore some resemblance to the more recent machines of M. Lontin, to which we shall refer further on.

For many years the Holmes and Alliance machines divided the field between them, and for lighthouse illumination, where economy was not so great an object as power and efficiency, they served their purpose well, but they were of too costly form in prime cost and in expense of working to be in any way applicable to general purposes, and they were moreover subject to all the inconveniences and faults to which machines which have their commutators permanent magnets are liable.

The very important invention made by Dr. Werner Siemens in the year 1854 of the longitudinal induction bobbin, or Siemens armature, as it is called, and which has been described in these columns,† resulted in the production by Messrs. Siemens Brothers, of Berlin, of a magneto-electric machine possessing a very high degree of efficiency, although not specially applicable to the production of the electric light, was the first machine of any considerable size to which the invention by Mr. Wilde, of Manchester, of a very important principle of working as being the first brought before the public in which permanent magnets were employed instead of the more powerful electro-magnets, and still more interesting in connection with the history of the subject as furnishing an important and specially characteristic link between the early magneto and dynamo machines what are now called dynamo-electric machines, to which, with one exception, all the modern electric light-producing machines belong. Mr. Wilde's apparatus consisted of a large magneto-electric machine having powerful fixt electro-magnets in the place of the compound permanents usually employed, and these magnets were charged by the current generated by a subsidiary Siemens shuttle magneto machine, which for comparisons was mounted on the top of the larger machine, and was driven at a higher velocity by a separate belt. With this machine very powerful effects both calorific and illuminating were produced. This double machine has by some been classed among dynamo-electric machines, but it clearly has no claim to be so reckoned, for it occupies a distinct position of its own. It might be called an electromagneto magneto-electric machine whose electro-magnets are excited by the current from a magneto-electric machine instead of from a voltaic battery.

* See ENGINEERING, page 417 ante.

† See ENGINEERING, vol xxi, p. 434.

SMALL DYNAMO-ELECTRIC MACHINES.

[15462.]—So many queries appear in our columns asking for information about the above, that I think the following description of one I made may interest our readers. My machine was got a Gramme armature, of which the dimensions are as follow:—Iron ring width 2½, diameter inside 3½, outside 6.

The coil is in thirty divisions made of No. 18 cotton-covered copper wire, total diameter 9mm., outside diameter 12mm. The coil is embraced by the horns from the electro-magnets above and below; these last are made so as to shape these poles into the centre where the horns are fixed. The cores of field magnets are 35mm. diameter, having a length of 140mm. on each side of horns, and are wound with No. 16 wire. So far this appears to be all right, but although I am able to drive the armature at a speed of 1,200 revolutions per minute, still I am unable to get more than the smallest trace of current from it.

If, however, I connect three or four Bunsen cells to the terminals of my machine (turning it into an electro-motor), it will then get reverse rotation of the armature, which with five cells runs about 1,100 revolutions per minute. Further, if I connect the coils of field magnets to a battery, having them separate from the armature circuit, I can get a powerful current from the armature, when the horns showing that if my magnets were permanent, the machine would work all right. If any of our correspondents have been successful in making a machine of this class, I shall, for their rewards, as the above case will be interesting, theoretically a small machine ought to act upon the same principle as the large ones, and as I have had some trouble in studying them last I am sure my case, &c., are all correctly made.

As a small machine like this would be useful for experimental work, I trust some one will be able to help me.—Ohm.

[15193.]—Siemens' Armature.—Our present knowledge of magneto-electric induction is very limited indeed, as many of our readers, no doubt, have succeeded in producing a dynamo-machine that could be worked by hand. The success of these machines made requires at least 2½ h.-p. to drive. Hand magneto-machines have been made, but, however, they all do not come up to our expectations. To enjoy the action of your own instrument, one requires steel magnets of great strength.—Wimshurst.

THE New York correspondent of the *Daily News* telegraphs as follows:—"Mr. Edison has obtained a dynamometer of sufficient delicacy to measure every one-hundredth of horse-power. With this instrument he can calculate the cost of the electric light to the minutest detail. He has demonstrated that from 80 to 90 per cent. of energy is converted into light, and that six electric lights are supplied from one horse-power at one-third the cost of gas. He estimates that the problem of applying the electric light to domestic use has been practically solved, but admits that a great mass of detail remains to be worked out. He has satisfied himself that platinum can be supplied in large quantities so as to reduce the expense.

THE Society of Control Work [illegible]

RESEARCHES WITH PROFESSOR HUGHES' AUDIOMETER.

By BENJAMIN WARD RICHARDSON, M.D., LL.D., F.R.S.*

PROFESSOR HUGHES having done me the honour to show me first his newly invented instrument for the measurement of hearing, and having supplied me with an instrument for the purpose of testing the application of it for physiological and practical purposes, I have been enabled to make a considerable number of experiments, on which I venture to submit the following preliminary report:—

The instrument, as it has been used, is before the Society. It consists of two Leclanché's cells for the battery, a new and simple microphonic key connected with the cell and with two fixed primary coils, and a secondary or induction coil the terminals of which are attached to a telephone. The induction coil moves on a bar between the two fixed coils, and the bar is graduated into 200 parts, by which the readings of sound are taken. The graduated scale is divided into 20 centims., and each of these parts is subdivided into 10, so that the bearing may be tested from the maximum of 200 units to 0—zero. The fixed coil on the right hand contains 5 metres of wire; the fixed coil on the left hand contains 100 metres. By this means a long scale from the left hand coil is produced. The secondary coil contains 100 metres of wire.

In using the instrument, one Leclanché's cell has been found sufficient, as a general rule, but two have been used in instances where the hearing of the person under test has been very defective. The Leclanché cell was selected by Professor Hughes as affording a reliable current for the purpose he had in view, and for standard comparisons. In using the instrument, the induction coil is moved along the scale from or towards the larger primary, as may be required, and the degrees or units of sound are read from the figures on the scale, the

* Paper read before the Royal Society May 15.

will be in contact with the bare place on the lowest turn of wire on the bobbin, consequently the major portion of the current conveyed by the wires connected to the two terminals on the bobbin flows from the bare spot on the wire, up the lever, and thence through the electro-magnet back to the second terminal. The armature being consequently attracted, the curved lever is made to rock or roll on the bared surfaces of the wires, thus making contact with turns of the wire higher up the bobbin; but when this is so, the current entering the lower terminal has to traverse all the turns up to the turn with which the lever may be in contact, and the current is thus weakened. Hence it is easy to see that when the spring *s*, is adjusted to a certain tension, the current flowing will, by pulling the armature *c*, pull the lower lever on to such a turn of the wire on the bobbin as will introduce an amount of resistance sufficient to produce equilibrium, and if the current weakens or strengthens, the lever will move backwards or forwards until the resistance adjusted by the decreased or increased number of turns in the circuit again produces equilibrium.

To adapt the apparatus for alternating currents, the electro-magnet is replaced by a bar or wire, which expands by the heating effect of the currents.

For dynamo-machines, the apparatus is arranged to be worked by the machine itself. This is done by connecting the rocking lever to a Watts's governor. Under these conditions the apparatus regulates the velocity of the machine, and not the strength of the current.

It is hardly necessary to call attention to the utility of the invention, but the importance may be well understood when we consider that the apparatus bears the same relation to the regulation of the electric currents as the Watts's and other governors, or to the regulation of the flow of steam in steam engines.

PACCINOTTI'S DYNAMO-ELECTRIC MACHINE.

THE novelty in the magneto-electric machine invented by Dr. Antonio Paccinotti of Pisa, in 1860, which we illustrate below, is the peculiar shape of

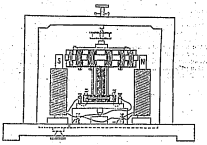


FIG. 1.

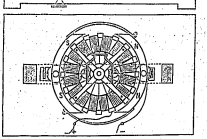
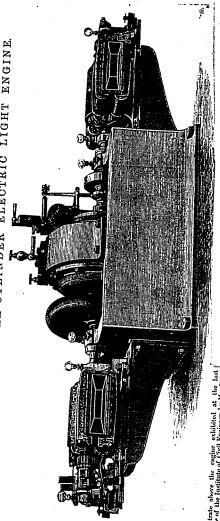


FIG. 2.

the rotating electro-magnet, which is an iron ring, whose induced poles during rotation move constantly from one point to the other without interruption. About this iron ring coils of isolated copper wire, *a*, fig. 1, were placed, which were connected with each other so as to form a continuous wire. From each connection a conducting wire was brought to metallic pieces *b* of the same number, laid parallel to, and insulated from, each other around the shaft carrying the ring.

The ring was arranged horizontally, and on each side of the diameter was placed one pole of a powerful electro-magnet ending in elongations of soft iron *s s*, fig. 2, inclosing about one-third of

BROTHERHOOD'S THREE-CYLINDER ELECTRIC LIGHT ENGINE.



We illustrate above the engine exhibited at the last conversazione of the Institute of Civil Engineers, which is described at length in another column. The shaft of the engine drives a dynamo-electric machine of the Siemens type, constructed for Messrs. Siemens Bros. cable-ship Faraday.

Vol. II.—No. 7. Manufacturer & Builder JULY, 1879. ELEVENTH YEAR.

Weston's Electric Light Generator.

Mr. Edward Weston, of Newark, N. J., who has earned a great reputation as the inventor and manufacturer of the dynamo-electric machine, now used in many electroplating and electrotyping establishments, both here and abroad, has for some time given his attention to the construction of a similar machine, especially adapted for the production of electric light, and of the lamps used in connection with the same. In the adjoined engravings Fig. 1 represents the machine, Fig. 2 the lamp exteriorly, Fig. 3 another form of lamp, showing details of carbon carriers and of electro-magnet and armature regulating their position, and holding the sliding rod with a clamp, which automatically releases and keeps the light steady. This is one of Mr. Weston's latest improvements to the electric lamp. Fig. 4 represents the iron armature of Fig. 1, without its coils.

The machine (Fig. 1) is constructed with a view of keeping it in continuous operation without heating it to such a degree as to necessitate its stoppage so as to allow it to cool off, a feature in which many machines of this kind have failed. For this purpose the large stationary soft iron electro-magnets are, where they are not covered by the coils, perforated by slits. Fig. 4 shows these slits in the center of the top and on the sides, and when in motion the hand can feel the currents of air pass out of these slits, being propelled from the rotating center to the circumference by the centrifugal tendency, on the same principle as the action of a rotary fan blower. This continuous current of air, taken in cool at the center, and blowing out at the circumference, is most effective in keeping the machine cool, which, without this provision, loses much of its effectiveness, as the magnetic power of iron decreases when the temperature rises, and the conductivity of the coils for electric currents diminishes from the same cause. Therefore, even if a machine does not become hot enough to necessitate its stoppage, it is of importance to keep its temperature at as low a degree as possible, so as to secure its maximum efficiences.

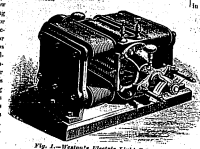


Fig. 1.—Weston's Electric Light Generator.

The power required to drive these machines is from two to twelve horses, and depends on their size, at which the price varies from $200 to $1,200, the larger ones being capable of furnishing several lights. They are commencing to be largely used for brilliant illumination purposes in New York and vicinity, for instance, on the new iron pier at Coney Island, which we have described in a previous number.

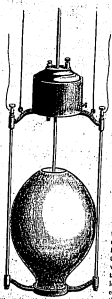


Fig. 3.—Weston's Electric Lamp.

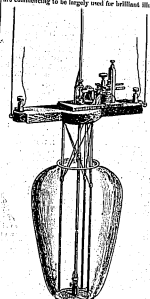


Fig. 2.—Details of Electric Lamp.

These machines excel in simplicity and compactness; they appear to be eminently durable, and are claimed to be the most powerful for their size and cost of any in the world, as it is reported that actual tests showed them to yield more than double the amount of light per horse-power absorbed, than that obtained from any other machine built in this country.

The ability of the company to execute satisfactorily any orders for electric light, can be inferred from the fact that they have now in successful operation nearly seven hundred dynamo-electric machines among the largest manufacturers in this country and in Europe.

Figs. 2 and 3 represent lamps with ground glass globes, seen below, and which contain the carbons, the lower one being fixed to the bottom and the upper one suspended from the conducting rod, which is capable of sliding downward, but this down-sliding motion is arrested and regulated by a small clamp, worked by an electro-magnet, situated in the cylinder seen in Fig. 2, and its interior arrangement in Fig. 3; Fig. 4 shows the revolving armature, placed inside Fig. 1. The little electro-magnet in Fig. 3 is charged by the current; when its magnetism becomes too strong by a too close proximity of the two carbon electrodes, its attraction draws the clamp and draws the rod upward, separating the carbons. When the current, by this separation, suffers resistance enough to become weaker and cause the electro-magnet to relieve the armature by diminished attraction, it allows, by relieving the clamp, the rod to slide down and bring the carbons closer together. This simple device works so well that we have watched the light for hours and did not notice any perceptible change in it.

Fig. 4.—Armature of Light Generator.

We advise parties desiring the use of electric light, before ordering a machine, to communicate at the manufactories full particulars in regard to the buildings and localities to be lighted, to give, for instance, the size of the rooms or areas, the amount of power disposable, where it is located, etc. They can be sure that the manufacturers, the Weston Dynamo-Electric Machine Co., of 292 Washington street, Newark, N. J., will without delay give all particulars as to cost of machines, etc.

Messrs. Cordli, Hassan & Van Winkle, the agents for the Weston Dynamo-Electric Machine Co.'s plating machinery, have opened an office at 22 and 24 Liberty street, New York, where information as to the light machine can also be obtained.

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NOTICE.

NEW YORK, June 1st, 1878.

The trade is hereby cautioned against infringing the Letters-Patent of the Weston Dynamo-Electric Machine Co., for certain improvements in Dynamo-Electric Machines, or either selling or using machines embodying those improvements. We are the owners of the Letters-Patent, and will promptly prosecute all persons or parties proceeding against all who shall be detected in infringing them in any way. Proceedings have already been commenced against the more prominent infringers.

DUNNAKER & DUNNAKER, Counsel for W. D. E. M. Co.

WESTON DYNAMO-ELECTRIC MACHINE CO

Machines for Electro-Plating, Electrotyping, Electric Light, Etc., Etc., Made under Letters-Patent of the United States, and are beg to refer to the following houses: HORTON BRITTAIN, Co.; HOWELL & EDMUX M'F'G Co.; HERR & HATTON; HATH-AWAY BROS.; ROBERT WARNER & Co.; THE ELECTRO-PLATING & OX. 1 PLATING WORKS; ROGERS' CUTLERY CO.; CHAS. HOERES BRASS; EDWARD MILLER CO.; MOUSELL, YALE & TOWNE; THE HOTCHKISS MFG. CO.; THE N. Y. LOCKSMITHING COMPANY; MARTINEZ CO., Philadelphia; MERRIAM, CHAMBERLAIN CO., SIMPSON & HARRIS; FISHER & SON; and over 500 others. Works for Silvering, Silvers, Bronze Platers, Etc. The two highest CENTENNIAL AWARDS, and the CENTENNIAL GOLD MEDAL, were awarded to us.

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Engineer July 1879

One of the most interesting novelties in the Berlin Exhibition is the construction of an electrical railway by Siemens and Halske. The electrical power is says *Nature*, supplied by a dynamo-electric machine, which works the wheels of an electric locomotive. The length of the way is 300 metres, the velocity three metres per second; the number of engines three, and passengers twenty. The same experiment will be tried at the Scientific Exhibition at the Palais de l'Industrie, with Marcel Deprez's motor, which is very promising. A new model has been constructed, weighing seven kilogrammes, and, with twelve Bunsen elements, can give a man-power.

Engineer July 1879

4505. APPARATUS FOR OBTAINING ELECTRIC CURRENTS, &c., *C. F. Brush*.—Dated 25th December, 1878. 2½.

Upon a revolving shaft are placed as many electro-magnets in the circumference of a circle as the circumstances require. The shaft is then arranged that the one pole of one of the electro-magnets terminates in the reverse pole of the next electro-magnet in the length of the shaft; but in the circumference of the circle the same pole. The coils are to an electric lamp, and extends to the manufacture and application of circular or spiral carbon pencils.

Sc. Am. Aug 9 1879

Edison's Dynamometer.—An Improvement

Sc. Am. Aug 9 1879

To the Editor of the Scientific American:

Noticing in your last issue the dynamometer invented by Mr. Edison, it occurred to me whether odd for him to adopt such coarse devices for measuring power, however effective they may be. Why did he not apply the principle of the tasimeter to this purpose? It seems feasible enough to a layman. Suppose the driving and driven shaft to be placed suitably in line, but not connected, provide each with an arm, allow the arms to overlap each other at the ends, and place between the ends of the arms a carbon button having electrical connections as in the tasimeter. The button would be pressed more or less, according to the power consumed by the driven shaft, and its electrical conductivity would be changed with every variation of pressure.

To insure accuracy in the indications of the galvanometer, another tasimeter arranged to receive a variable amount of pressure should be connected with a switch, so that it could at any moment be thrown into the electrical circuit in place of the button carried by the arms.

If the tasimeter is so sensitive and so accurate for exceedingly small pressures, why should it not be more accurate in indicating heavy pressure?

X.

The Edison Dynamometer.

To the Editor of the Scientific American:

In your issue of July 26th, you remark that Mr. Edison's new dynamometer is "in principle something like other dynamometers." Are you aware how much it is like one devised by Mr. Horatio Allen and used in the government experiments on steam expansion in 1855?

As described by Prof. Fairman Rogers, at a meeting of the Franklin Institute, March 19th, 1860, and published in my report as secretary, it appears as follows (see *Journal of the Franklin Institute*, vol. 40, page 201):

"The shaft, being cut between the engine and, the first fan, a grooved pulley is keyed upon the engine shaft and one exactly similar upon the fan shaft. An endless rope is laid over these two pulleys in such a way that the light of the rope hangs down before and behind. In these lights are long two grooved pulleys of a diameter equal to the distance of the large pulleys apart, and to these smaller pulleys equal weights, so that the rope is held tightly in the grooves of the large pulleys. The engine pulley being turned by the engine, sufficient extra weight is added to the hanging pulley on the driving side of the rope to equal the strain on the rope, which represents the resistance of the fans, when the whole system will be in equilibrium, and the amount of power to drive the fans will be measured by the tension of the rope, and consequently by half the extra weight which has been added.

"If the resistance of the fans increases by any means, the weight rises; if the resistance diminishes, the weight falls, and a spring balance is fastened to the weight and to the floor to take up these irregularities.

"A rod attached to the weight and carrying a pencil, moving over the surface of a cylinder running from the shaft, serves to register the power required to run the fans.

"By the apparatus the friction of the fan shaft can be measured and any change in the resistance from varying density of the air is immediately indicated."

HENRY MORTON,
Stevens Institute of Technology,
Hoboken, N. J., July 18, 1879.

and, as experiments have proved, allowing every with the expenditure of a very small amount of kind of mechanical treatment. Subsequent force. If, now the switch of a single lamp is experiments with other metals, such as iron, turned, the lamp is connected in the branch when steel, copper, and their alloys with nickel, tin, then the main conductors, the circuit is closed, and zinc, have led to the same result. A small and only sufficient current passes from the addition of magnesium at times in these metals external station to supply that lamp, because the considerably greater elasticity was given to them external resistance determines the amount of than when they possess without it. The carry- current. In this way the current will be pro- ing out of the process is a very simple one. The portioned to the number of lamps in the circuit. said substantially consists in introducing the Each lamp contains a resistance, when incan- requisite quantity of magnesium through a small descent, of 100 ohms. The consuming of one opening by the covered thermometer-like arrangement or more lamps, because says the patentee, a tooltes metal after it has been cleared of all sufficient amount of time to be developed at a dross, and the addition of the same together by heated station in keeping the same incandescent; agitation of the vessel. It is somewhat it follows that if the resistance of a station ar- difficult to know the proportionately ranged expressly for tension and quantity proper temperature for rendering the addi- very hundreds of lamps may be placed in circuit tion and the introduction of the magnesium between the main conductors, the substitution of metal to be treated must be heated considerably resistance upon placing each lamp in circuit above its melting point, as otherwise it may lowering the proper quantity of current from the happen that after addition of the magnesium station, hence the greatest economy possible is the whole mass will congeal or be too thick for obtained by causing all the resistance outside of pouring.—*Scientific American*. the main conductors to be light-giving resistance.

Another part of the invention relates to means for storing the electric current or energy so that it may be utilized as used as required. This is done by the use of secondary batteries, and there are devices for shifting the connections from one secondary battery to another, especially so that one may be in use while the other is being charged from the main circuit. The secondary batteries are of any desired construction. Mr. Edison prefers two sheets of lead wound together into a spare or spiralform and immersed in dilulated water in a closed case. The main line is connected with any magneto-electric machine or other source of electric energy, and by wires to the secondary batteries, and the return wires are through a switch to the earth connection.

Engineer July 1879

EDISON'S CHALK CYLINDER BATTERY, DYNAMOMETER, AND NEW ELECTRIC LAMP.

THE uses of the chalk cylinder in Edison's receiving telephone have been sufficiently explained in our pages, but it appears that in the course of some experiments with the electro-chemical telephone Mr. Edison discovered some peculiar phenomena which at first puzzled him; but on connecting the binding posts of the telephone with a galvanometer, he found to his surprise that the chalk and platinum rubber of the telephone formed a generator of electricity of no mean order, as it equalled in electromotive force a half of a Daniell cell. He therefore arranged four of the chalk cylinders upon a non-conducting shelf, and connected the platinum rubber of each cylinder with the one beside it, the box of the next, the terminals being a rubber on one end, and a spring touching the rubber on the box of the chalk cylinder at the other end. A series of four chalk cylinders thus mounted and connected (see Fig. 1) is equivalent to two Daniell cells, but

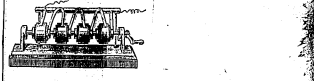
FIG 1

the power varies somewhat with the speed at which it is rotated. Mr. Edison is investigating the action of this peculiar battery. He states that its resistance is 1,200 ohms when at rest, and only 50 ohms when in motion; that for 10c. metallic surface on its rubber. When this surface is increased to 15in. the resistance will be reduced to 1 ohm. Whether the current is due to the decomposition of the solution with which the chalk is moistened, or whether it is due to capillarity or some other cause, has not been definitely determined.

As to Mr. Edison's dynamo all sorts of statements are made, and we are asked to believe that 95 per cent. of the power applied to the machine is converted into electric current, and 82 per cent. of the power is made available outside the machine. This, it is said, is about double the effective exterior current realized by other machines.

In endeavoring to measure the power required to drive the generator Mr. Edison has tried every dynamometer within reach, and condemned them all. At last, after considerable experiment, he hit upon the simple contrivance shown in Fig. 2. He claims that with the apparatus he can measure the 1-100th of a horse-power. The weighted box rests on the platform scale, and is provided with a pulley for receiving the driving belt, which passes over the driving pulley A, under the tightener C, and over the driven pulley B. The number of foot-pounds of power used will be indicated by

75 Manufacturers & Builder July 1879

NOTICE.

New York, June 1st, 1878.

The trade is hereby cautioned against the infringement of the Patents of Every Description Electric Lighting Company, for Improvements in Dynamo-Electric Machines or other utilizing or using machines embodying those improvements. We are the owners of the Patents, and will protect our rights, and shall promptly institute suit for the recovering against all who shall be detected in infringing them in any way. Proceedings have already been commenced against the most prominent infringers.

BURTNESS & DICKERSON, Counsel for W. D. & H. Co.

WESTON DYNAMO-ELECTRIC MACHINE CO

Machines for Electro-Plating, Electrotyping, Electric Light, etc., etc., are now in operation in the following places, to which we beg to refer to the following Issues: Remond Brothers, 24 Cliff Street; Hall & Ruckel, 218 to 224 Front Street; Hall, Ruckel & Co., 218 to 224 Front Street; Hall, Ruckel & Co., 2 Stanley Place; Board of Water Supply, 31 Chambers Street; Edward Miller Co., Stamford, Conn.; Nichols & Co., Stamford, Conn.; Hall, Ruckel & Co., Bridgeport, Conn.; Bridgeport Brass Co., Bridgeport, Conn.; Norwood & Haskell Forge & Bolt, and many other users. Orders for Nickel, Silver, Bronze Plating, etc. Thirteen highest Centennial Awards, and the Centennial Gold Medal. Send for Illustrated Circular.

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Engineer July 1879

4205. Apparatus for Generating Electric Currents, &c. C. F. Brush.—Dated 19th November, 1878. 10d.

Upon a revolving shaft are placed as many discs-magnets in the circumference of which are embedded soft iron cores. Coils of wire are so arranged that the one pole of one of the electro-magnets faces always the reverse pole of the next electro-magnet in the length of the shaft; but in the intervening spaces between the same poles. The coils are so so electrically connected as to the manufacture and application of circular or spiral carbon pencils.

De Comp Aug 9 1879

Edison's Dynamometer.—An Improvement

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Noticing in your last issue the dynamometer invented by Mr. Edison, it occurred to me as rather odd for him to adopt such coarse devices for measuring power, however effective they may be. Why did he not apply the principle of the taximeter to this purpose? It seems feasible enough to a layman. Suppose the driving and driven shaft to be placed suitably in line, but not connected; provide each with an arm, allow the arms to overlap each other at the ends, and place between the ends of the arms a carbon button having electrical connections as in the taximeter. The button would be pressed more or less, according to the power consumed by the driven shaft, and its electrical conductivity would be changed with every variation of pressure.

To insure accuracy in the indications of the galvanometer, another taximeter arranged to receive a variable amount of pressure should be connected with a switch, so that it could at any moment be thrown into the electrical circuit in place of the button carried by the arms.

If the taximeter is so sensitive and so accurate for exceedingly small pressures, why should it not be more accurate in indicating heavy pressure?

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"The shaft being cut between the engine and the first fan, a grooved pulley is keyed upon the engine shaft and one exactly similar upon the fan shaft. An endless rope is laid over these two pulleys in such a way that the light of the rope hangs down before and behind. In these lights are hung two grooved pulleys of a diameter equal to the distance of the large pulleys apart, and to these smaller pulleys equal weights, so that the rope is held tightly in the grooves of the large pulleys. The engine pulley being turned by the engine, sufficient extra weight is added to the hanging pulley on the driving side of the rope to equal the strain on the rope, which represents the resistance of the fans, when the whole system will be in equilibrium, and the amount of power to drive the fans will be measured by the tension of the rope, and consequently by half the extra weight which has been added.

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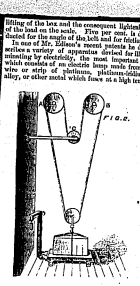
"A rod attached to the weight and carrying a pencil, now lag over the surface of a cylinder running from the shaft, serves to register the power required to run the fans.

"By the appearing the friction of the fan shaft can be measured and any change in the resistance from varying density of the air is immediately indicated."

HENRY MORTON,
Stevens Institute of Technology,
Hoboken, N. J., July 16, 1879.

fitting of the box and the consequent lightening of the load on the neck. Five per cent. is allowed for the angle of the bolt and for friction.

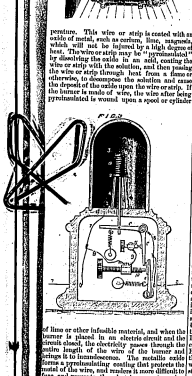
In one of Mr. Edison's recent patents he describes a variety of apparatus devised for illuminating by electricity, and one important of which consists of an electric lamp made from a wire or strip of platinum, platinum-iridium alloy, or other metal which fuses at a high temperature. This wire or strip is coated with an oxide of metal, such as magnesia, lime, zirconia, which will not be injured by a high degree of heat. The wire or strip may be "pyrolaminated" by dissolving the oxide in an acid, coating the wire or strip with the solution, and then passing the wire or strip through heat from a flame or otherwise, to decompose the solution and leave on the surface of the cable upon the wire or strip. When the burner is made of wire, the wire after being pyrolaminated is wound upon a spool or cylinder into a spiral. The strip of metal should be thin, so as to obtain considerable length in a short spiral. The spiral or helix thus made is compressed, and then compressed into a compact cylindrical form. Sometimes the pyrolaminating material is placed on a layer between the coils of the spiral or helix. When the expansion and contraction of the burner c is made to regulate the amount of current to the burner, the helix or spiral is placed between leads 2, 3, as shown in Fig. 2, and the rod b is connected to the burner c at one end and to the lever e. The burner c is supported by the legs 4, 4. The spiral helix may be continuous as a whole, and given exactly by the rod b to the best lever e, which latter opens and closes the circuit at f. When the burner is of platinum entire by wire 7 and passes to the burner c, by rod b, lever e, and wire 8, to the line. If the current becomes excessive the heat expands the burner c and rod b, and moves the lever e into contact with the short circuiting or shunting the current so that it passes by the contact-lug the most resistance, going by 7, 9, 6, e, and 8 to line. A resistance coil equal to the resistance of the burner may be placed in this short circuit. The lever e is a safety device which closes the short circuit through the screw 10, in case c and b should fail to make electrical contact.



This pyro-insulating coating allows of very fine wire being used for the burner, hence several feet of the wire may be wound upon the spool. Platinum is preferable material, and the burner will have a inclination of several hundred ohms which permits the use of a few burners or lamps being connected in multiple arc, as they are, without requiring bulky resistance.

Mr. Edison has devised a modification of pyro-insulating the wire, consisting of a spool or cylinder filled in more layers each forth under the described wire, and carrying a sponge moistened with the pyro-insulating solution, and a lamp for drying the coating applied to the wire. The sponge is moistened with a soluble salt of a pyro-insulating such as the nitrate, carabic, or acetate of lime, magnesium, or cerium, and the sponge of metals, whose oxides are infusible after being heated. The sponge is placed in a chamber, with the moistened sponge leaves a very thin film upon the wire, and the heat from the flame which is behind the sponge severely decomposes the salt and leaves the oxide of the metal as an adherent coating on the wire. This operation may be repeated many times, and thus the deposit becomes thicker, infusible oxides resolved a thickness of about one-third that of the wire, itself. The wire should be wound upon a spool having a large circumference before being wound upon the spool of the burner, to prevent the cracking of the oxide.

In some instances Mr. Edison makes the burner or candle of finely divided iridium or other metal that is not easily fused, mixed with an oxide of thorium, iron, or other metal which acts as a conductor when highly heated: this is to be moulded into the desired form, and by gradually proportioning the entrance the current to the burner is regulated by the heat of burner, the resistance falling lower in proportion to the heat.



Another feature of this invention relates to the arrangement of the main conducting wires so as to obtain a complete metallic circuit, and at the same time allow advantage of the conductivity of the earth, so that the mass of metal in one of the conductors may be reduced; the earth and metallic conductor serve at the same time as a protection for the underground conductors. The magneto-electric machines may be of any suitable character and driven by power. They may be arranged between the two main conductors, A, B, in multiple arc or series, or four, five, four, or more in each, and the connections should be for intermediate machines to each conveyor the current, but at every fifth, or such other interval as may be desired, the reverse end of the machine is only or one strand. Each machine is constructed, as single strand will connect the wires in the circuit, as shown in Fig. 3. Each lamp is to be provided with a switch, so that it may be disconnected from the conducting wires. The electric generators at the central station are provided with constant field of force magnets, the helices of which are in the electric circuit: hence if all the lamps feeding from the main conductors are disconnected by their switches the circuit will be broken and no current passes through the conductors leading from the station to the lights, hence the steam-engine driving the magneto machines will exhibit no

of line or other infusible material, and when the lamps are placed in an electric circuit and the circuit closed, the electricity passes through the entire length of the wire of the burner and brings it to incandescence. The metallic oxide forms a protoplasticizing coating that protects the metal of the wire, and renders it more difficult to fuse, and prevents the electric current passing from one coil to the next, thereby compelling the electricity to travel the entire length of the wire. If the burner is made from a strip of metal, the strip will be thicker at one edge than the other, so that it may be rolled to a uniform thickness at the same time that it is coiled

with the expenditure of a very small amount of force. If now the article of a single lamp is turned, the lamp is connected to the branch wires from the main conductors, the circuit is closed, and only sufficient current passes from the central station to supply that lamp, because the resistance of the conductors determines the amount of current. In this way the current will be proportioned to the number of lamps in the circuit. Each lamp contains a resistance, when incandescent, of 1,000 ohms. In case one consisting of one or more lamps ceases, from any cause, to receive a sufficient amount of current to keep it incandescent, the central station is to keep the same incandescent; it follows that if the machines at the station are arranged expressly for tension and quantity many hundreds of lamps may be placed in circuit between the main conductors, the reduction of resistance upon placing each lamp in circuit lowering the proper quantity of current from the station, hence the greatest economy possible is obtained by reading all the resistance outside of the main conductors to be light-giving resistance.

Another feature of the invention relates to means for storing the electric current, or energy so that the same may be used as required. This is done by the use of secondary batteries, and there are devices for shifting the current from the secondary battery to another periodically so that one may be in use while the other is being charged from the main circuit. The secondary batteries are of any desired construction. Mr. Edison prefers two sheets of lead wound together into a square or cylindrical form and immersed in acidulated water in a closed case. The main line is connected with any magneto-electric machine or other source of electric energy, and by wires to the secondary batteries, and the return wires pass through a switch to the earth connection.

MACHINE MAGNÉTO-ÉLECTRIQUE

Jeudi 15 — DE M. BENOIST

Nous recevons de M. l'envoyeur la communication suivante; elle constitue un document intéressant pour l'histoire des machines génératrices d'électricité, nous nous faisons un devoir de lui donner place.

Le Comité de rédaction.

Depuis que M. Gramme a inventé sa machine dynamo-électrique, les machines magnéto-électriques semblent délaissées par les inventeurs, bien que, théoriquement, le rendement de ces appareils dut être supérieur.

Les machines dynamo-électriques doivent créer en même temps l'action et la réaction; or personne n'ignore que rien ne vient de rien, et qu'une force produite, qui est ici l'aimantation de l'électro-aimant, doit se traduire par un excédent de charbon brûlé sous la chaudière de la machine à vapeur.

C'est pourquoi nous sommes convaincu que les machines magnéto-électriques doivent conserver leur supériorité de rendement, au moins dans certaines applications spéciales et surtout dans les machines à courants alternatifs et à division de foyers lumineux.

Du reste, rien encore dans la pratique n'est venu contredire ces prévisions.

Mais dans les machines magnéto-électriques créées jusqu'à ce jour, a-t-on placé les deux éléments de l'appareil, les aimants et les bobines, dans les conditions voulues pour obtenir le maximum de rendement? Nous ne le pensons pas.

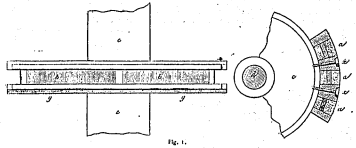


Fig. 1.

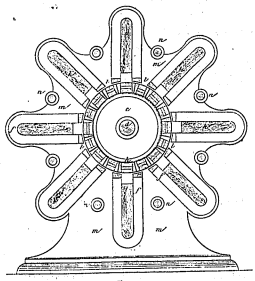


Fig. 2.

Ainsi, d'après les nombreuses expériences théoriques que nous avons faites en 1870, 1871, 1872, nous avons reconnu que, pour obtenir ce maximum de rendement :

1° Les aimants ne doivent pas être employés en fuseaux, afin d'éviter les actions réciproques des pôles de mêmes noms.

2° Les bobines doivent présenter de grandes surfaces polaires magnétiques.

1° Le fil induit doit être aussi rapproché que possible du noyau de fer doux.

2° Il est plus avantageux d'employer plusieurs fils enroulés parallèlement, au lieu d'un seul fil d'égale section.

3° La nature du noyau, acier trempé ou non trempé, fer doux au bois, ou fer au cobe, fonte grise ou blanche, n'influait pas autant qu'on le suppose généralement sur l'intensité de l'onde magnétique, mais que cependant il y a avantage à employer du fer doux.

4° Il y a également avantage à diviser le noyau magnétique pour faciliter la désaimantation.

5° L'un doit employer des bobines longues et étroites à pôles magnétiques rapprochés, afin de pouvoir en placer un plus grand nombre surune circonférence restreinte, ce qui procure le double avantage d'augmenter le nombre des ondes électriques pour chaque tour, sans exagérer la résistance angulaire du mouvement de rotation.

6° Il faut disposer un nombre suffisant de bobines, pour ne pas employer des vitesses exagérées de plus de 200 tours par minute, qui doivent fournir 6 à 7,000 ondes électriques.

7° Enfin, on doit donner la préférence aux aimants permanents, qui agissent mieux à distance que les électro-aimants.

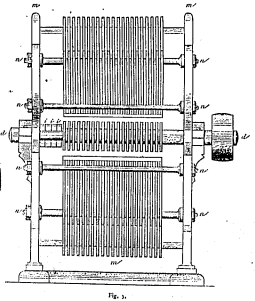


Fig. 3.

Dans le but de satisfaire autant que possible à ces conditions multiples indiquées par la théorie, nous avons réalisé en 1872 une première machine qui nous a donné des résultats remarquables; mais, depuis, en présence du succès toujours croissant des machines dynamo-électriques, nous avons dû renoncer à la suite de nos recherches, après avoir cependant assuré notre priorité par un pli cacheté déposé à l'Académie des sciences dans sa séance du 20 janvier 1873, sous le n° 2718.

Voici la description de notre machine :

Les bobines sont en fer doux (fig. 1 et 2) et ont une longueur de 0m,20, leur coupe transversale a la forme d'un fer double T, le voile latéral entre les ailettes est de 0m,03. L'âme I est formée de morceaux de tôle douce juxtaposés et encastrés dans une rainure longitudinale.

Le fil en fer fils s'enroulent dans le sens de la longueur et sont isolés comme dans toutes les machines analogues.

Les bobines sont juxtaposées au nombre de seize, au pourtour d'un cylindre en bronze, c, monté sur un arbre *dd* auquel on peut imprimer un mouvement de rotation.

Le cylindre en bronze est occupé que 1/3 de la longueur des bobines qui y sont fixées au moyen de deux fortes vis *ee*. Les deux extrémités libres des bobines se trouvent à droite et à gauche un cylindre creux, dans lequel on introduira plus tard un cylindre en tôle douce *h* d'un diamètre un peu plus petit, fixé sur le bâti de la machine, qui fermera l'armature magnétique intérieure par influence, et concourra à augmenter sensiblement le rendement.

Si l'appareil doit fournir des courants redressés, les fils des bobines aboutissent à des commutateurs ordinaires; si, au contraire, les courants sont alternatifs, l'un des pôles sera relié en communication directe avec l'arbre, tandis que l'autre sera relié à une ou plusieurs rondelles isolées *ll*, également centrées sur l'arbre, sur lesquelles les courants seront recueillis au moyen de frotteurs.

Par cette disposition du cylindre aimant induit, rien n'est plus facile que de diviser le courant, soit en couvrant plusieurs fils parallèlement sur chaque bobine, soit en divisant les bobines par groupes de 2, 3, 4, etc., et en recueillant les courants sur des bagues séparées et isolées.

Le cylindre aimant induit décrit ci-dessus tourne au centre de seize armatures en fer doux *ll*, convenablement espacées et sur lesquelles reposent les pôles alternés des aimants *fff*.

Les aimants permanents, au lieu d'être disposés en faisceaux, sont espacés le long des armatures au nombre de 21 de manière à en occuper toute la longueur, en sorte qu'il reste entre deux aimants consécutifs un espace vide occupé par une triangle en bois fixée sur la barre transversale *kk* qui est également en bois, et règle ainsi l'écartement entre les aimants.

Les barres en bois *kk* qui supportent les aimants, reposent par leurs extrémités sur le bâti en fonte non de la machine, dont les deux parties sont reliées entre elles par le socle en bois et par les boulons en bronze.

Aujourd'hui que les machines magnéto et dynamo-électriques sont entrées dans la pratique journalière de l'éclairage par l'électricité, par suite des nombreux perfectionnements apportés dans la disposition des lampes et des charbons, on peut dire que la période des tâtonnements est passée, et que d'après ces données exactes de rendement que le mérite de chacune d'elles sera établi. Dans ces conditions, nous croyons que les machines magnéto-électriques doivent reprendre leur rang.

On reproche à ces dernières d'être d'un prix plus élevé, d'un poids plus grand que les machines dynamo-électriques et d'occuper plus de place. Nous ferons remarquer que, pour une machine fixe, quelques kilogrammes en plus ou en moins et quelques décimètres sur toutes les dimensions importent assez peu, il d'autre part un rendement supérieur couvre en quelques mois la légère différence du prix.

Enfin, pour terminer, nous dirons que si les machines magnéto-électriques ne sont pas appelées à remplacer entièrement les machines dynamo-électriques, du moins dans certaines conditions spéciales, elles l'emporteront sur ces dernières sous le rapport économique, puisqu'elles exigent moins de force motrice.

A. DEMONT.

41940. DYNAMO-ELECTRIC MACHINE FOR PRODUCING ELECTRIC CURRENTS, C. J. Pilsworth.—dated 18th December, 1891. 6d.

Covered cylinders or rings are formed of soft iron capable of receiving one in the other concentrically, and insulated from each other. Each cylinder is wound with insulated wire leaving the spaces clear at one or more places to allow without producing injurious friction. In the grooves are lodged insulated conducting wires, either by single convolutions or a zig-zag manner, or the ring is surrounded with the wire wound on in the ordinary manner. Between the rings are placed permanent magnets lodged in the grooves, and are fixed with the projections. The rotary rings are brought under the influence of either permanent, temporary, or stationary magnetism, which rotating, [illegible]

THE SIEMENS DYNAMO-ELECTRIC MACHINE.

[From the Journal of the Society of Telegraph Engineers.]

Read at a meeting of the Society, held on March 11th, 1875.

At the meeting held on May 6, 1874, Dr. John Hopkinson, F.R.S., Mem. Inst. C.E., which gives some very interesting results of tests on a Siemens machine. By these tests the machine appears to have given, at 1,000 revolutions per minute, 27 per cent. of the energy delivered to it through the belt, which is very low. The following methods were used: The power absorbed was measured by a dynamometer, and the energy of the current was calculated either by measuring the electro-motive force in volts at the terminals, with a Daniell's cell and calculating the results in the usual manner, or measuring directly the heat given off from a part of the circuit, the total resistance in a calorimeter.

I would call attention to the fact that the electro-motive force of the gravity form of a Daniell's cell is assumed as nine-eighths of a volt, or 1.125 volts, though this form of cell is constantly employed as giving less than the standard cell with concentrated acid, and is accordingly the source of a serious error. The value taken by Messrs. Latimer Clark and Chrisperson, in their tests for the Practical Institute was 1.079 volts for the electro-motive force of a Daniell's. This value is the one given by Mr. Latimer Clark and is generally received as the normal one. As the energy given off is very directly as the square of the electro-motive force, in comparing the figures given by Dr. Hopkinson with those in his Practical Institute report, one must multiply his results by $\left(\frac{1.079}{1.125}\right)^2 = 0.92$. If this correction is made the Siemens machine would give back 32 per cent. instead of 30 per cent. of the power applied in the shape of electricity.

Though Weber's measurements, as cited by Winderman, in his work, vol. ii. 1110, give a high electro-motive force to the Siemens cells, yet since his results are questioned, there is no sufficient reason why the standard adopted by the British Association should be abandoned. In order that values obtained by various experimenters may be readily compared, even if the standards are slightly incorrect, it would be well to retain the original values until the question is fully settled. If nine-eighths of a volt be taken as the value of the electro-motive force of a Daniell's, a further correction must be made, that is, new machine tests by Mr. Latimer Clark gives their power in the current that it receives through the belt, unless some very careful ample tests are at fault.

It may mentioned that this machine, while transforming

five-hours power of energy, allows seven-eighths of the total amount to be recovered suitable, and that with less than one-tenth of a horse power consumed in the magnets the electro-motive force of 725 volts has been obtained from the armature, which is a remarkable result indeed.

In Dr. Hopkinson's last experiment of the kind, by means of the calorimeter, the resistance of the wire used was given as 0.2 of an ohm. As a very slight difference in this would be largely multiplied in the complete circuit, it seems always to me that the resistance was about one-fifth of an ohm, and that the conducting wire was sufficiently large to prevent undue heating. No allowance is made for the heat lost by the calorimeter during the passage of the current through it.

In experiment Number 12, a horse power is given off from a surface of 14.5 in., or, in other words, the total heat from a large-sized gas jet was concentrated on this surface. It seems impossible that the resistance of the wire could not have increased materially by this, and, consequently, the power absorbed by the machine must have seem to say slightly when a powerful current is passed through it, thus allowing economies from heating, and consequently increase of resistance.

The percentages obtained by comparing the power utilised, measured by the calorimeter, to the power applied were the following:

					Per cent.
Experiment	4	—	—	—	101
"	6	—	—	—	102
"	8	—	—	—	104
"	10	—	—	—	92
"	12	—	—	—	92

These results would lead one to distrust the accuracy of the methods used, as in two cases impossible values are obtained, and there is so great a difference between the extremes.

Before I am entitled to discuss the paper so fully in itself high praise of the care which was successfully taken to give full data regarding the experiments. Such a paper is on many accounts better than experimenting personally, for besides having another's experience, one often sees scores of error more easily in another's work than in his own.

Yours truly,

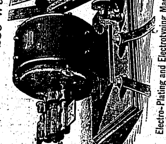
FRANCIS B. UPTON.

Laboratory of Thos. A. Edison, Menlo Park, N.J., July, 1875.

Weston Dynamo-Electric Machine Co.,

286 Washington Street, Newark, New Jersey,

Manufacturers of Machines FOR Electric Light, Electro-Plating, and Electrotyping.



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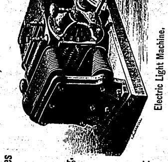

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Centennial Gold Medal, American Institute, 1876; Medal of Superiority American Institute, 1877; Centennial Medal, Philadelphia, 1876; Medal, Paris, 1878.

centre of gravity of load is upon the other, the maximum bending moment in that field occurs at that point. For each field in which the last condition is possible, there is a maximum, provided always that all the weights remain on the span. When a weight can roam all over its field without any of the others going off the span, I say it can "overtake its field."

Note that it is not necessary to know the fixed distances between the weights, but only their amounts and order of disposition in order to divide the span into fields. But to determine the maxima in the fields respectively, it is necessary to know these distances. When a weight fails to overtake a portion of its field on account of a weight going off the span, it may be necessary to redivide the span into fields corresponding to the reduced number of weights and examine the remaining portion; however, it is generally only necessary to calculate the maxima for a few fields near the centre, as one or other of these will be the maximum.

It is interesting to notice the bending moments at the junction of two fields.

LIGHTING BY ELECTRICITY.—No. II.

DYNAMO-ELECTRIC MACHINES.

IN our last article* we described generally those forms of electric generators that were successfully applied to the production of the electric light in the early days of its development, commencing with the production of electricity by voltaic batteries and passing to those mechanical generators which derived their currents by induction from permanent magnets; we shall, in the present article, refer more particularly to that very interesting and far more important class of electric generators to which the term *dynamo-electric* is now almost universally applied, and which, dispensing altogether with permanent magnets, induce their currents from electro-magnets which are excited by those same currents being caused to circulate, in whole or in part, around them.

In the beginning of the year 1867 was announced to the Royal Society, simultaneously by Dr. C. W. Siemens and the late Sir Charles Wheatstone, the great discovery independently made by Dr. Werner Siemens and by Sir Charles Wheatstone of the reaction principle of magnetisation by which a very powerful electric current may be generated through the building up of the effects of action and reaction taking place between an electro-magnet and a magneto-electric inductor revolving in its magnetic field, and included in the same circuit.† This great discovery, which is by far the most important in connexion with the history of electric illumination that has been made since Faraday's classical discovery of magneto-electric induction, is also claimed by Mr. S. A. Varley and by Mr. M. G. Farmer, of the United States Torpedo Department, but the question of priority of discovery or invention must in history be determined by the date of its being made public, there being no other satisfactory criterion. Judged by this standard the merit of priority must be accorded to Dr. Werner Siemens, who announced his discovery to the Berlin Academy of Science a month before it was described at the Royal Society, and, as far as this country is concerned, the claims of Sir Charles Wheatstone and Dr. Siemens are equal, although the paper of Dr. Siemens was received by the Society ten days before that of Sir Charles Wheatstone was sent in. The term dynamo-electric is now applied generally to all those machines which produce a current of electricity by the conversion of dynamic or mechanical energy into electric force through the movement of some of their parts in the neighbourhood of others. They are magneto-electric machines so far as is implied by the fact that the first minute charge, from which their powerful currents are ultimately developed, is induced from the feeble residual magnetism which all iron more or less possesses, and which may be caused or modified by the influence of terrestrial magnetic induction. But even if both of these could be entirely eliminated in the first instance, we are of opinion that in any good dynamo-electric machine there would still always be present a germ which would be developed into a powerful electric current if the armature were rapidly rotated. The smallest difference of electrical potential between one part of the circuit and another would give rise to a current in the wire, and that current, however small, must alter the magnetic intensity of the cores round which it would circulate, and thus an acting current would be produced which would increase in strength through every fraction of a revolution made by the rotating armature, and just as in the very beautiful electrostatic "Replenisher" of Sir William Thomson,* which in a few revolutions induces a static charge of considerable magnitude from primary charges which are practically infinitesimal, so a dynamo-electric machine in rapid rotation induces from well-nigh infinitesimal current the great rivers of electric force by which the most powerful lights are produced.

One of the first practical machines for the production of the electric light on the dynamo-electric principle was the very beautiful continuous current machine of M. Gramme, which was brought out in Paris in the year 1871, and was introduced into this country at the close of the following year. The Gramme machine differed from all other generators previously constructed most conspicuously in the form of its rotating armature or electrical inductor, which consists of a ring of iron covered with insulated copper wire, which is wound in such a way as to give to it the appearance of a flat bar electro-magnet bent round into a circle, its two ends being united together. The wire was not wound in one continuous length, but in a number of sections all connected together, so as to form a closed circuit, each section at the same time being connected to a commutator of a form which appears to have been adopted in nearly all the machines that have succeeded it. Fig. 3 represents a Gramme armature partly in section and partly dissected, so as to show its principle of construction. The inner ring or core A is made of a continuous length of iron wire wound into a solid circular hank upon a wooden form or mould attached to a lathe, and which is removed when the ring is complete; the wire while it is being coiled passes through a bath of a bituminous substance, which binds the whole together, as well as tends to insulate the convolutions of the wire, whereby the cross currents within the core are reduced to a minimum, magnetism is more rapidly accomplished, and the lines of magnetic force within the ring are maintained parallel in direction to the convolutions of the iron wire and therefore with the annular axis of the ring. Around the iron wire ring so formed are wound a series of lengths of insulated copper wire, one of which is shown at the lower part of the figure marked B. These coils of insulated wire, or induction bobbins as they are called, are wound close together, and the contiguous ends of each adjoining pair of coils are joined together and to a metallic strip or conductor R R, there being as many of these conductors as there are coils wound on the ring. The opposite ends of these conductors are metallically connected to as many insulated copper strips arranged side by side around a circle, so as to form sectors of what is called the commutator cylinder upon which the metallic collecting brushes are pressed by means of springs and screws. These brushes are composed of hard copper wire electro-plated with silver, and their object, by forming a rubbing contact between the internal and the external circuits of the ring, is to offer a passage for the currents induced in the coils of the armature, so as to enable them to be used for doing external work.

When such a ring is mounted on a spindle passing through its axis of figure, and rotated in its own plane in a magnetic field produced by two opposite magnetic poles diametrically opposed to one another, electric currents are induced in its coils which, if no external circuit were provided, would be equal in strength and opposite in direction, and would therefore neutralise one another, but by placing collecting conductors in suitable positions the two opposing branches of the current unite and flow out together, forming an external current of their combined strength. The diagram, Fig. 4, will serve to explain the electrical action of the Gramme machine. N and S are two magnets having their dissimilar poles opposed to one another, and producing a magnetic field between them, within which is rotated a ring of iron which is wound with an endless coil of insulated wire. If now it be supposed that those convolutions which are on the outside circumference of the ring are stripped of their insulating covering, and against the denuded wires so produced two fixed springs or brushes X and Y are caused to press at points A and B at opposite ends of a diameter which is perpendicular to the line passing through the

* See ENGINEERING, vol. xxvii., page 513.
† See ENGINEERING, vol. xxiv., page 307.

* See ENGINEERING, vol. xxiii., page 310.

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Die Dynamo-elektrische Maschine, eine deutsche Erfindung.

Der Techniker aug 1 188[?]

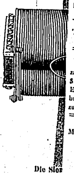
Wenn man in den technischen Blättern von den Fortschritten des elektrischen Lichtes und den stromerzeugenden Maschinen liest, so ist immer von Franzosen oder von Engländern die Rede; von Deutschen wird nur selten Erwähnung gemacht, als ob sie sich in dem interessanten Wettstreite erfindender Geister gar nicht betheiligten. Die Gramme'sche Maschine aber spielt hierbei die Hauptrolle. Und doch ist die dynamo-elektrische Maschine erwiesenermaassen *eine deutsche Erfindung* und existirt eine *deutsche* dynamo-elektrische Maschine, die *vor* der Gramme'schen dagewesen ist, und sich weit ökonomischer und besser bewährt hat, als diese und *alle* anderen ihresgleichen.

Gleich nach der Entdeckung der Magnetinduction durch Faraday wurden Maschinen zur Erzeugung von Inductionsströmen construirt, welche zweierlei Art waren; nämlich *magneto-elektrische*, bei denen *durch vorhandenen Magnetismus* vermittelst verbrauchter Arbeitskraft der elektrische Strom erzeugt wurde, und *elektro-magnetische*, bei welchen *durch vorhandenen elektrischen Strom* mit Hülfe des durch ihn erzeugten Elektromagnetismus Arbeitskraft hervorgebracht ward. Die erstere Art dieser Maschinen litt an dem Uebelstande, dass die Wirkung der Maschine nicht im Verhältniss zu ihrer Grösse zunimmt, da die Stahlmagnete sich gegenseitig schwächen. Auch konnten sie eine weitere Verbreitung deshalb nicht finden, weil zu grosse Massen von Stahl, Eisen und Kupferdraht erforderlich waren, um eine kräftige Wirkung hervorzubringen; wodurch sie zu schwer und theuer wurden. Endlich kam Dr. Werner Siemens darauf, diesen Uebelstand durch die *Construction des rotirenden Cylinder-Ankers*, welcher in der elektrischen Technik seitdem allgemeinen Eingang gefunden hat, einigermaassen zu vermindern und mit seiner Hülfe kräftige magneto-elektrische Maschinen von weit geringeren Dimensionen herzustellen. Zwei Jahre darauf bauten die Engländer Wilde und Ladd *nach diesem* Systeme verbesserte magneto-elektrische Maschinen. Dr. Siemens gelang es aber, im Jahr 1866 die Anwendung der Stahlmagnete gänzlich zu beseitigen. Nur mit der einem solch' ausgezeichneten Erfinder eigenen Beobachtungsgabe und Schlussfolgerungen kam er damit zu Stande, die *erste* sogenannte *dynamo-elektrische* Maschine herzustellen, mit welcher die Arbeitskraft direkt in elektrischen Strom umgewandelt wird und in welcher Magnetismus gleichsam nur als Zwischenprodukt, nicht aber mehr als eigentliche Quelle des erzeugten Stromes auftritt.

Einige Wochen, nachdem Dr. Siemens am 17. Januar 1867 der königl. Akademie der Wissenschaften die Begründung des Princips der dynamo-elektrischne Maschine mitgetheilt hatte, publicirte auch Prof. Wheatstone in England, ohne seine Arbeiten zu kennen, dieselbe Idee. Da aber Dr. Siemens die erste Veröffentlichung dieser Erfindung gemacht, und *schon im Dezember 1866 vielen Gelehrten und Technikern Berlins eine in Thätigkeit befindliche* elektro-*dynamische* Maschine *gezeigt* hatte, so gebührt ihm auch vollkommen und unbestreitbar die Ehre der Priorität, und demgemäss ist auch *das System der dynamo-elektrischen Maschinen unbedingt und ausschliesslich eine* DEUTSCHE ERFINDUNG.

Auf der Pariser Weltausstellung von 1867 hatte der Engländer Ladd bereits eine ziemlich genaue Copie der vorerwähnten dynamo-elektrischen Maschine mit Cylindermagneten ausgestellt, ohne den Ursprung derselben zu nennen.

In ähnlicher Weise verfuhr später Herr Gramme



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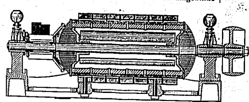
Inhaltsverzeichniss.

Main's Rändel-Vorrichtung für Drehbänke* — Geschichte des Porzellans. — Die dynamo-el[ek]trische Maschine, eine deutsche Erfindung.* — Canada's schutzzöllnerisches Experiment. — Seidenbau in den Ver. Staaten. — Karpfenzu[cht] in Washington. — Unsere Eisen- und Stahl-In[du]strie. — Ein amerikanischer Eisenbahnkönig. — Ein Ziegelstein-Fabrikations-Centrum. — Welt... Reformen im neuen Post-Gesetze. — Die Ca[nal-]Eisenbahn über den Isthmus von Panama. — E[ine] neue Anwendung der Elektricität.* — Miscell... Körting's Universal-Injektor*. — Neue Pro... Maschine für Gewebe*. — Die Fabrikation v[on] Phosphor. — Lansburgh's Whiskey-Rectifi[cir-]Apparat.* — Recepten-Kasten. — Miscellen. Bücherschau. — Briefkasten. — Anzeigen. — O[ffi]cielle Listen der Ver. Staaten Patente vom ... und 15. Juli — Geschäfts-Anzeigen.

Die mit einem * bezeichneten Artikel sind illustrirt.

... Länge nach bewickelt ist. Das Drahtgewinde



Die Siemens Dynamo-Elektrische Maschine. Längsschnitt des Cylinder-Ankers. Fig. 2.

besteht aus vier Abtheilungen von je zwei Lagen, so dass sechzehn Drahtenden zur Verfügung stehen. Diese sind mit einem sogenannten Commutator verbunden, welcher an dem der Kurbelseite entgegengesetzten Ende der Inductorachse angebracht ist. Die mit der Inductorachse rotirende Commutatorscheibe trägt acht isolirte kupferne Sektoren. Diesem Commutator stehen zwei mit federndem Drucke anliegende Contactrollen, die zur Aufnahme der inducirten Ströme bestimmt sind, in der Art gegenüber, dass sie von den bei der Drehung des Inductors vorüberrotirenden Sectoren des Commutators stets zwei diametral entgegengesetzt berühren. Diese am Rollenträger angebrachten und durch diesen in der Zeichnung verdeckten Contactrollen stehen mit den als Elek-

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LIGHTING BY ELECTRICITY.—No. III.

DYNAMO-ELECTRIC MACHINES—(*continued*).

NEXT to the Gramme machine in chronological order of introduction, though almost contemporary with it, was the dynamo-electric machine of Messrs. Siemens Brothers, which has so often been referred to in the pages of this journal, and which from the moment that it was introduced until the present time has occupied a leading position, and has not only maintained that high position in the face of a large number of more recent competitors, but is still the most powerful generator of electricity in existence, whether estimated by a comparison of its light-producing power with its bulk and weight of material, or with its absorption of motive power or cost of working.

The most remarkable characteristic of the Siemens machine is its extraordinarily small size and weight in proportion to its power, and nothing shows more strikingly the great advances that have been made in the construction of machinery for the induction of electric currents during the last twenty years than a comparison between Holmes's machine, which was first used at Dungeness lighthouse, and the modern Siemens dynamo-electric apparatus, which is installed at the twin lighthouses on the Lizard promontory; thus, while the Dungeness machine occupied no less than 484 cubic feet the Siemens machine takes up but little over $4\frac{1}{4}$ cubic feet, and the corresponding weights of the two machines are $5\frac{1}{4}$ tons for the Holmes to $3\frac{7}{8}$ hundredweight for the Siemens; again, while the Holmes machine produced a light equal to 670 candles the light from the Siemens apparatus is equal to 3620 candles; and with regard to the question of economy, while the apparatus at Dungeness had an illuminating power of 244 candles per horse power absorbed, that of the Lizard machine is 1034 and the cost of working per unit of light is .1294 at Dungeness to .0147 at the Lizard. We have thus the following proportions between the apparatus at the two stations of Dungeness and the Lizard respectively. Bulk, 114 to 1; weight, 28 to 1; light produced, 1 to 5.4; light produced per horse power, 1 to 4.24; and cost per unit of light produced, 1 to 0.113. The figures are interesting, comparing as they do the apparatus which was employed in the first application of Faraday's transcendent discovery to the illumination of the coast with the latest and most perfect apparatus which modern science has developed from that discovery.

As has been pointed out in preceding articles, when part of a closed electrical circuit is caused to move within a magnetic field so as to cut through the lines of magnetic force in a path more or less perpendicular to their direction, a current of electricity is induced in the circuit, the strength of which depends upon the combination of a variety of causes of which the principal are the intensity of the magnetic field and the favourable presentation to its inductive influence of those parts of the circuit which are moving within it. All mechanical generators of dynamic electricity, whether their currents be induced from permanent or from electro-magnets, or from a magnetic field excited by their own action and by the circulation of their own currents, depend for their action upon the great principle first discovered by Faraday and investigated so fruitfully by Ampère, Arago, Lenz, and others, and the efficiency

Engineering april 1879

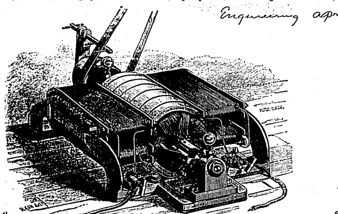


FIG. 1.

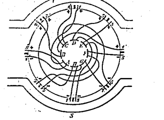


FIG. 4.

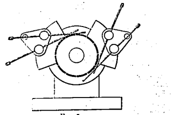


FIG. 5.

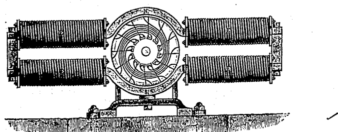


FIG. 2.

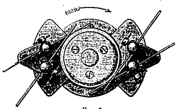


FIG. 6.

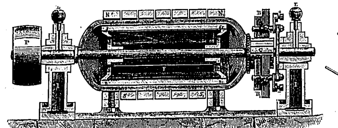


FIG. 3.

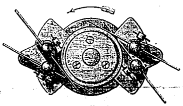


FIG. 7.

SMALL DYNAMO-MACHINES.

[1885.]—Mr statements with regard to small dynamo-machines in recent numbers of ENGLISH MECHANIC have called forth several communications, which I feel in duty bound to notice more directly into a subject which it has been above my province to enter into in these pages. The five communications, referring to the letter that appeared in last week's issue, would indicate that I must first of all draw a clear and distinction between dynamo-machines and electro-magnetic engines.

A magneto-machine is an apparatus in which a system of coils or armatures is made to pass alternately before the two or more poles of a system of permanent magnets, in such a manner that by means of magnetic induction from the poles of the permanent magnets currents are induced in the armatures, and that in the whole circuit in which the system of armatures may form a portion. The armatures generally consist of a number of steel, and sometimes of soft iron wires wound upon them. Good machines of that kind are made by Messrs Elliott, and by Mr Apps, of Hatton Garden, to refer to such machines which I beg to be understood.

Dynamo-machines differ from the former in so far as the inducing systems consist in temporary or electro-magnets, and that there are no coils of wire and consequently no currents are made or broken. There can on be magnetized insulated copper wire, according to the strength of which a weak greatly less under the influence of electric currents than soft iron. Hence it is impossible to excite a machine of that description by means of a battery of a few cells only. On the other hand, the power of permanently magnetized iron to retain its magnetism is well known, and after being completely magnetized, will manifest a very considerable power for a long time or remanent magnetism for a great length of time.

Cast iron contains a considerable amount of carbon, and the amount of that admixture of carbon stands in a ratio almost to the residual magnetism, but indirectly with the extent to which it can be magnetized. In other words, cast iron can be magnetized as highly as well annealed wrought iron, but the former will retain a greater portion of its magnetism.

We all know, from experience that magneto-machines which consist of, put in a spare No. 20, or No. 22, work well.

The most perfect of all dynamo-machines, the Gramme ring, has cores of annealed soft iron, and in order to obtain the very highest possible amount of magnetism it has been found necessary to make the bars and uprights large. [illegible]

[illegible] Gramme ring [illegible] this cause. In corroboration of this I need only refer each of our readers who may not access to the machines to look at the drawings in Tunzini's book.—[See pages 81, 85, 91, and 101.]

In the large Varley-Wallace machines also, the cores, uprights, and bases are all made of unusually heavy castings. Special reference has been made to the "light-house" contrary light in the small cores in Weston machine, each core only weighing 5 lbs. Another point which I would ask my reader to look at is Weston machine, and observe what extreme care has been taken in the proportions for securing a great amount of residual magnetism. The cores are all fixed in a heavy circular cast-iron frame, and the latter again is fixed on a heavy cast-iron frame. Now, "Anglo-Dane," no doubt, has experimented with the machines for electro-magnets, whether they were to be wound on the extreme pole-ends only, or to be wound on the centre of the legs, provided there are three complete of turns. It is clear then, and "Anglo-Dane" will agree, that we have to call to mind, in the Weston machine, are only the extreme poles, and the heavy cast-iron frame, and base form part of the magnets, and serve to retain residual magnetism, both by their shape and mass.

In the face of these facts it would be idle to dwell and useless, to dispute the importance of the residual magnetism, or what comes to the same, a constant supply of magnetic energy, and I think that in the following lines I may prove the truth of my own statements against those of Mr. Holme, out of the mouth of his own witness, my esteemed opponent.

Mr. Holme says—"We do not seem to know that the current from a large machine is distributed through the whole of the magnetic circuits, and consequently them varyingly power as he supposes, small magnets would do, with very expensive current sent round them from the armature." I have carefully tested this statement by various machines and by means of telephones, and found that the contrary is true of the latter, that the current is distributed. Mr. Holme has [illegible] Gramme machine, which is a very perfect contact-breaker, and found the current to be more continuous, he simply proves my own assertion that a perfection of action of a dynamo-machine depends largely on the accuracy of the current which is employed to excite the system of field magnets; and this is the very point I urged in the first argument supplied by Mr. Edison. I beg to state that the most powerful machines, as well as the permanent electro-magnets in them, are those periods of magnetization are altogether independent of the contact-breaker and the coils of the field-work armatures. Such machines are Wilde's and Siemens's, the improved machine, in each of these machines Fontaine, pp. 68 and 70) the current produced by the machine is not employed for exciting the powerful magnets of the large machine, which produces its actual work. In all these machines all the currents are against an intensified permanent magnetism of the large magnets attached to the machine, and the field-magnets with these in the armatures of the machine. In all these machines such machines as there were no magnets of wrought iron. But let us never forget that the second of either of these machines are powerful permanently permanent magnets, and that it would not work at all without them. Siemens and Wilde, in fact, of the dynamo-machine pure and simple. From the fact that the latter machine is very readily excited that he increased the winding of a dynamo-machine in it is of the very greatest importance to have field-magnets or inductor magnets of which the energy does not vary, or, if it varies, that the greatest attainable, and therefore with the greatest current strength in the armatures.

Now, the question arises as to whether, with the present knowledge of electricity and magnetism, we are able to produce small magnets, the energy of which we can predict with certainty, or at any approximate in any reasonable proportion to the work expended in producing these currents.

I have had occasion to experiment on large and small magnets, and have come to the conclusion, and others, and the result of my experience was expressed in my last letter, that the magnetic force can be found to depend on the [illegible] construction of such small machines as "Anglo-Dane" is making, which, as I believe, are less expensive than "No more tyre could make such a machine." Mr. "Anglo-Dane's" statement is near the actual truth. Such machines as "Anglo-Dane" has constructed, and I have tested several of them, and sent them ten to work them, and found that they carried out as fairly as intended by the [illegible] proportion whatever with the work expended. Experiments have also been contributed in an exceedingly [illegible] full of contradictions and unintelligible assertions. Written by "Orange," the gentleman who so far fails in fact as to altogether neglect to observe that accurate measurements on an exceedingly softer core to a corresponding value always freely signs his name with his commercial [illegible] He advises me of soldering machines [illegible]

SOME RECENT ELECTRICAL "NOVELTIES."

Electrician Aug 14/1880

It is always curious and sometimes surprising to find how fairly the idea of a recent invention has been mooted or its principle propounded by some other mind which lived before the time was ripe for the realisation of its schemes. "Nothing new under the sun" is a proverb to which these inventive times is ever giving proof. Edison's "Ore Separator" is a contrivance which has been again and again shown to be no novelty, but few are aware how old it really is—at least, in idea. It actually belongs to the last century; and, for aught that we know, may have entered into the idle dreams of Tubal Cain. In an English patent of date June 16, 1762, No. 1,891, William Fullarton, of Ayr, in Scotland, describes a new process for "separating iron from iron stones and other ores of that metal, of smelting it into the state of pig or cast iron, and of reducing or refining it into the state of malleable or forged iron." The patent was granted in the old style by King George III. for "His Kingdom of Great Britain, called England, His Dominion of Wales, and Town of Berwick-upon-Tweed, and also His Plantations abroad." There is a long time ago, but not before "telegraphs were thought about," for Charles Marshall, writing from the same district in Scotland, had long before (in 1753) suggested the principle of the electric telegraph; and Lesage, in 1774 had actually operated a frictional telegraph of the kind planned by Marshall.

Fullarton's patent goes on to describe the method of ore separation adopted by him. This consisted in crushing the iron ore by grinders, stamps, or mills worked by hand, horse, steam, water, wind, or other power, and, in the next place, of separating all "earthly (sic) impure, and extraneous matters from the metallic particles by all or any of the following apparatuses, namely, by washing, levigating, lotturing, winnowing, and by the application of magnetic attraction, according to the nature and qualities of the different stones and ores." The materials thus purified are put into the furnace and smelted.

The electrical railway of Dr. Werner Siemens finds a forerunner in the "Pneumatic Traveller" of Thomas Pain, patented on March 1, 1834, No. 6,510, for the propulsion of vessels, carriages, &c., on canals, railways, or common roads. This invention relates to a pneumatic railway in which magnetic attraction may be employed, and which may either form a "complete system of railway in itself," or be applied to common railways or canals.

An extended tunnel, tube, pipe, or conduit is laid down, which contains a piston. On one side of the piston the air is exhausted from the tube by suitable stationary engines placed at suitable distances along the line. To the piston is attached "a vehicle or machine," called "the dynamic traveller" which is in connection with a car on the outside of the tube, called "the governor," to which the wagons to be propelled are attached. In the pneumatic railway itself the rails are cast on the sides of the tube; but in its application to common railways the canals the tube is laid down between the rails, or at the margin of the canal. The connection between the dynamic traveller and the governor is made either by means of a longitudinal "pneumatic valve," through which a spiritual wire runs, or by magnetic attraction. To apply magnetic attraction effectively, the dynamic traveller carries a frame of horseshoe magnets, set transversely, with their poles placed as near to the under surfaces of the tube as possible. A similar combination of similar magnets inverted is attached or suspended under the body of the governor, and in order to enable the space between the poles of the magnets in the two frames to be as small as possible, the upper part of the tube has a copper plate fitted air-tight into the upper instead of a valve. In the dynamic traveller soft iron may be used instead of magnets, and electro-magnets may be used.

As regards the production of motive power by electricity, we have the patent of Miles Berry, a communication from Edwin Williams on behalf of Terence Davenport, dated June 8, 1857, No. 7,286. This invention describes a means of obtaining rotary power by "galvanic" magnetism alone, or "galvanic" force in combination with "permanent" magnets. The device in question consists of a number of electro-magnets fixed radially on a rotating shaft, and segmental permanent magnets, or electro-magnets, fixed to the frame supporting the rotating shaft. The motion of the rotating magnets is made to take place by the attraction of their poles towards the poles of the fixed magnets of opposite name. To effect this the rotating electro-magnets are made to change their polarity at proper times by the motion of plates (connected to the circuit of the electro-magnets) against segmental plates, corresponding in number and position to the number and position of fixed segmental magnets; which segmental plates are connected in a suitable manner with the poles of a galvanic battery.

EDISON'S ORE SEPARATOR.

Electrician July 17/1880

In our "Report" for last week we elected an American statement to the effect that an apparatus identical with Edison's vaunted ore separator had been in use in that country for some years. It is satisfactory to find that the Americans have themselves found out the ancient character of that latest bantling from Menlo Park. But the same device has been before the world in France for the last twenty years at least in Froment's machine for separating magnetic oxide from copper ore. Froment is the well-known mechanical electrician of Paris, and his apparatus consists of a hopper, through which the ore was poured, and a powerful electro-magnet, which was placed underneath so as to attract the magnetic particles of sand aside from the rest of the nonmagnetic copper ore. The contrivance is in fact, essentially the same as Edison's. No doubt there are several English patents describing the same arrangement; but Froment's is, as far as we are aware, the first instrument of its kind.

A similar device has been used for some years in America for extracting the bits of wire left in grain from the wire bands of the binding machines so commonly employed by American farmers. In fact, magnetism has been applied in the same way to a great variety of purposes.

The ore separator which was to cover Mr. Edison with the wealth of Ribonds, and transform him into a rival of Mr. Mackay, the owner of the "Big Bonanza" mine, is an old affair refurbished up, and though it may make the New York interviewers gape, and tickle the sensation palate of unobservant Yankees, it will, we imagine, hardly pay for its own manipulation in gold extracting. The proportion of "black sand" or magnetic oxide in gold "tailings" is, we are assured by an experienced gold miner, so very small, that its separation from the rest of the ore will make hardly any appreciable difference in the expense of extracting the small percentage of gold from the residue by washing over mercury. Had the black sand formed a considerable proportion of the whole "tailings" there might have been some value in the magnetic separator. As it is the game is not worth the candle.

BIBLIOTECA NACIONAL

différent sensiblement que lorsqu'on fait abstraction de la résistance. En désignant par E la force électromotrice de la pile employée, par r celle du fournant tellurique, par R la résistance de la pile, par r la résistance connue, par r la résistance inconnue du sol, par i la résistance totale du circuit complété par le sol, par r et r' les résistances développées sur le rhéostat dans les expériences faites avec les deux sens du courant, l'intensité électrique dans les deux circuits du galvanomètre pourrait être représentée par deux expressions de forme différente qui, au moment où la déviation deviendrait nulle, devraient avoir la même valeur et qui conduiraient aux deux équations :

$$\frac{Ei}{R(i-i')+i'r} = \frac{i'(ei+r)}{R(i-i')+ir} \quad \text{ou} \quad Ei=i(i'-e)\,r.$$

$$\frac{Ei}{R(i-i')+ir} = \frac{i(ei'+r')}{R(i-i')+i'r} \quad \text{ou} \quad Ei=i(i'+e)\,r$$

d'où

$$i = \frac{2ir'}{r-r'} \qquad \text{et} \qquad r = \frac{2ir'}{i-2i'} - 1$$

ment d'un plateau de fonte monté sur un axe horizontal, et supportant un système de ressorts destinés à recevoir l'effort transmis par une machine motrice. Cette transmission a lieu par le moyen d'une courroie sans fin et d'une poulie folle sur l'axe de l'instrument, mais qui entraîne le plateau par l'intermédiaire d'un ruban d'acier. Dès que la machine est mise en mouvement, la tension de la courroie se transmet d'abord à ce ruban qui agit sur le système des ressorts; le plateau est, entraîné, et une poulie montée à l'autre extrémité de l'arbre entraîne à son tour le récepteur dont on veut mesurer le travail résistant.

La figure ci-après montre les organes principaux du dynamomètre.

A est le bâti de l'appareil.

B la poulie (ponctuée sur la figure) qui reçoit le mouvement de la machine motrice.

C la poulie transmettant le mouvement au récepteur.

D la poulie folle qui permet d'arrêter le dynamomètre sans arrêter le moteur.

E le plateau de fonte supportant le ruban d'acier G et le système F des ressorts.

H le compteur de tours.

I l'enregistreur ou le totalisateur.

Il s'agit maintenant de faire comprendre de quelle manière on observe l'effort transmis par le moteur. Une plaque d'acier qui comprime les ressorts et à laquelle est fixé le ruban, est liée à une crémaillère parallèle au plan du plateau, engrénant avec un pignon fixé à l'intérieur de l'arbre qui est creusé à la fois transversalement et dans le sens de l'axe. Avec le même pignon engrène une seconde crémaillère, à angle droit de la première, prolongée par une tige qui vient servir à l'extrémité de l'arbre en marque sur une règle divisée le déplacement des ressorts.

La moyenne de ces déplacements mesure, dans un cas donné, l'effort qui s'exerce au point de tangence du ruban d'acier et du plateau. Le compteur de tours donnant d'ailleurs le chemin parcouru, on a les deux facteurs du travail, et une table des plus simples donne immédiatement ce travail exprimé, soit en kilogrammètres, soit en chevaux-vapeur.

Dans certains cas, on peut avoir quelque intérêt à connaître le trace et, pour ainsi dire, le procès-verbal des mesures effectuées. A cet effet, M. Morin remplace le compteur de tours par un enregistreur qui trace sur une bande de papier le diagramme du travail produit ou consommé.

Il y a d'autres circonstances où l'on a besoin de connaître après une durée quelconque de marche, plusieurs jours ou même plusieurs semaines, le travail total fourni ou absorbé; c'est, par exemple, le cas des Industriels qui louent de la force motrice. L'emploi d'un compteur à roulette résout le problème. Combinant enfin les mouvements de la roulette avec ceux d'un indicateur de régime, M. Morin parvient, de la manière la plus simple, à donner, *à chaque instant*, l'indication du travail en kilogrammètres.

On voit, par ce rapide exposé, qu'aucun des points de vue sous lesquels on peut envisager les mesures dynamométriques n'a été laissé de côté par l'habile et persévérant électricien auquel est dû l'appareil dont nous nous occupons.

Il est bien évident que si l'on veut obtenir des résultats suffisamment exacts avec un appareil de ce genre, il faut tenir compte du travail absorbé par le dynamomètre lui-même. Dans ce but, nous avons établi la théorie rigoureuse de son fonctionnement, et cherché ensuite les simplifications dont il sera permis, nécessaire même, d'user dans la pratique.

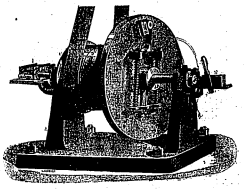
Si l'on désigne par F l'effort en kilogrammes indiqué par l'instrument dans une expérience faite sur un récepteur; par F' l'indication correspondante au cas où l'appareil fonctionne à vide, c'est-à-dire sans entraînement du récepteur, on a pour l'expression du travail absorbé :

$$z = N\,r\,(F - k\,F')$$

Formule où N est le nombre de tours du plateau par minute, r son rayon, et où k est un coefficient dépendant des réactions qui s'exercent sur les coussinets. — Pour faciliter les applications, j'ai calculé la table suivante, qui donne les valeurs du facteur k dans des limites suffisamment étendues :

F	k	F	k
0	1,00	60	1,09
10	1,01	70	1,1
20	1,1	80	1,11
30	1,1	90	1,1
40	1,1	100	1,0
50	1,1	110	1,0

Il y aurait aussi à tenir compte de la force centrifuge due au déplacement du système qui comprime les ressorts; mais une analyse très-simple montre qu'entre les limites de vitesse, où l'on se tient ordinairement, l'effet de la force centrifuge



ou compensé par les frottements inévitables de l'instrument.

En résumé, deux grands avantages paraissent attachés à ce nouveau dynamomètre. Le premier est de mesurer le travail pendant toute la durée de la marche, ce qui permet d'apprécier et de découvrir toutes les variations de travail produites par diverses causes accidentelles ou systématiques; le second c'est d'éviter, pour chaque mesure, l'arrêt des machines en fonctionnement dans un atelier. Ces deux points sont d'une importance capitale en toute circonstance, mais particulièrement en ce qui touche aux applications de l'électricité.

Nous devons dire, en terminant, que nous n'avons en aucune façon le dessein d'opposer l'appareil dont il est ici question à celui qui a été si ingénieusement réalisé par M. le général Morin et si habilement appliqué par M. Tresca. La similitude de nom des deux auteurs nous impressait, à elle seule, le devoir de faire cette déclaration; mais en dehors de cette raison, qui est toute de convenance, il y a une autre considération, c'est que le dynamomètre du Conservatoire des arts et métiers est et restera l'appareil scientifique auquel on a recours dans les circonstances où la plus haute précision est de rigueur. Mais comme son prix élevé, et la difficulté de son emploi ne permettent guère de l'introduire dans la pratique courante, nous pensons que l'auteur du nouveau dynamomètre a rendu un véritable service aux industriels, aux ingénieurs, aux électriciens, à tous ceux enfin qui ont besoin au monde d'établir, dans l'ordre physique ou mécanique, un rapport suffisamment exact entre la dépense et le produit.

Ch. Tellier.

MOYENS DE MESURER

LA FORCE MOTRICE DÉPENSÉE PAR LES MACHINES

A LUMIÈRE

La Lumière électrique

DYNAMOMÈTRE DE ROTATION DE M. MORIN

Journal 15 1879

L'appareil dynamométrique qui fait l'objet du présent article ne renferme rien qui s'applique exclusivement à l'électricité, mais il est d'un emploi si simple et si sûr, qu'il paraît devoir jouer un rôle important dans l'étude du rendement des diverses machines qui servent à transformer le travail mécanique en chaleur ou en lumière. A ce titre, il y a peut-être quelque intérêt à représenter aux lecteurs, particulièrement compétents, d'un journal consacré à la théorie et aux applications de la lumière électrique.

Le dynamomètre de M. J. Morin se compose essentielle-

(1) Pour obtenir le chiffre exact de la résistance de la terre dans ces conditions, il n'a fallu faire un calcul du moyen duquel les effets du courant tellurique étaient éliminés, et pour cela, j'ai eu recours aux formules d'Ohm appliquées aux deux circuits du galva-

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MACHINE DYNAMO-ÉLECTRIQUE

DE M. BURGIN

La Lumiere Electrique Aug 15 1879

Préoccupé comme M. de Méritens de la perte d'action résultant, dans l'anneau Gramme, de l'éloignement du noyau de fer des pôles inducteurs, M. Bürgin a cherché à en opérer le rapprochement, en le faisant ressortir des hélices à des intervalles plus ou moins rapprochés. Pour y parvenir, il compose cet anneau de six anneaux distincts montés parallèlement les uns à côté des autres sur le même arbre, et ayant chacun pour noyau magnétique un cadre carré de fils de fer sur les côtés duquel sont enroulées les hélices induites. Ces hélices sont enroulées en fuseau sur les côtés de ce cadre de manière à ce que les quatre parties anguleuses des noyaux se trouvent à peu près au niveau des spires extérieures de ces différentes hélices, et puissent par conséquent passer à très-petite distance des pôles inducteurs. De plus, ces cadres sont disposés entre eux de telle façon que les parties nues et anguleuses des noyaux se trouvent en retrait les unes par rapport aux autres, de manière à se présenter selon une spire d'hélice. Il en résulte que les actions aimantantes s'effectuent successivement, et que les courants dus à cette action aussi bien qu'à celle échangée sur les fils des hélices, sont toujours de même intensité dans les différentes phases de chaque révolution de l'anneau. L'enroulement des hélices induites est d'ailleurs effectué en sens inverse pour les hélices consécutives, afin d'obtenir des courants de même sens dans chaque moitié de l'anneau. Enfin ces hélices sont réunies à un collecteur exactement de la même manière que dans les machines Gramme et Siemens, ce qui permet d'obtenir, comme dans ces machines, des courants continus.

L'inducteur a d'ailleurs la même disposition que celui des machines Siemens, et le courant induit le traverse en totalité comme cela a lieu dans ces machines.

Les expériences faites devant moi à Genève dans les ateliers de M. Turetini, qui est le constructeur de ces machines, ont montré qu'elles ont à peu près le même pouvoir lumineux, pour une vitesse donnée, que les machines Gramme du modèle ordinaire; mais elles ont l'avantage de s'échauffer infiniment moins. En fait, on peut dire qu'elles ne s'échauffent pas du tout. Sous le rapport de la construction, elles présentent également quelques avantages. Ainsi, grâce aux parties nues des noyaux magnétiques, on peut fixer avec précision les anneaux sur l'axe de rotation, ce qui est difficile avec l'anneau Gramme.

En somme, cette machine est très-intéressante et promet beaucoup.

TH. DU MONCEL.

MR. EDISON'S EXPERIMENTS.

Sun Sept 3 1879

AMERICAN SAVANTS INSTRUCTED BY THE MENLO PARK INVENTOR.

The Phenomena of Electrically Heated Metals in Vacuo—Curious Results of the Experiments Made in his Laboratory—The Paper Read by his Mathematical Assistant.

SARATOGA, Sept. 2.—Nine new members were voted in at the meeting of the Association for the Advancement of Science to-day.

The following is the paper prepared by Mr. Edison:

In the course of my experiments on electric lighting I have developed some striking phenomena arising from the heating of metals by flames and by the electric current, especially wires of platinum and platinum alloyed with iridium. These experiments are in progress.

The first fact observed was that platinum lost weight when heated in a flame of hydrogen, that the metal colored the flame green, and that these two results continued until the whole of the platinum in contact with the flame had disappeared. A platinum wire four-thousandths of an inch in diameter and weighing 306 milligrammes was bunched together and suspended in a hydrogen flame. It lost weight at the rate of a fraction less than one milligramme per hour as long as it was suspended in the flame. When a platinum wire is stretched between two clamping posts and arranged to pass through a hydrogen flame, it is colored a light green, but when the temperature of the wire is raised above that of the flame by passing a current through it, the flame is colored a deep green. To ascertain the diminution in the weight of a platinum wire when heated by the electric current, I placed between two clamping posts a wire five thousandths of an inch in diameter and weighing 260 milligrammes. This wire, after it was brought to incandescence for twenty minutes by the current, lost one milligramme. The same wire was then raised to incandescence: for twenty minutes it gave a loss of three milligrammes. Afterward it was kept incandescent for one hour and ten minutes, at which time it weighed 258 milligrammes, a total loss of eight milligrammes. Another wire, weighing 312 milligrammes, was kept moderately incandescent for nine consecutive hours, after which it weighed 301 milligrammes, showing a total loss of forty-two milligrammes. A platinum wire twenty-thousandths of an inch in diameter was wound in the form of a spiral one-eighth of an inch in diameter and one-half an inch in length. The two ends of the spiral were secured to clamping posts, and the whole apparatus was covered with a glass shade 2½ inches in diameter and three inches high. Upon bringing the spiral to incandescence for twenty minutes that part of the globe in line with the sides of the spiral became slightly darkened; in five hours the deposit became so thick that the incandescent spiral could not be seen through the deposit. This film, which was most perfect, consisted of platinum; and I have no doubt but that large plates of glass might be coated economically by placing them on each side of a large sheet of platinum, kept incandescent by the electric current. This loss in weight, together with the deposit upon the glass, presented a very serious obstacle to the use of metallic wires for giving light by incandescence, but this was easily surmounted, after the cause was ascertained. I coated the wire forming the spiral with the oxide of magnesium, by dusting upon it finely powdered acetate of magnesium; while incandescent the salt was decomposed by the heat, and there remained a strongly adherent coating of the oxide. This spiral so coated was covered with a glass shade, and brought to incandescence for several minutes; but, instead of a deposit of platinum upon the glass, there was a deposit of the oxide of magnesia. From this and other experiments I became convinced that this effect was due to the washing action of the air upon the spiral; that the loss of weight in and the coloration of the hydrogen flame were also due to the wearing away of the surface of the platina by the attrition produced by the impact of the stream of gases upon the highly incandescent surface, and not to volatilization, as commonly understood; and I venture to say, although I have not tried the experiment, that metallic sodium cannot be volatilized in high vacua by the heat derived from incandescent platinum; any effect that may be produced will be due to the washing action of the residual air. After the experiment last described I placed a spiral of platinum in the receiver of a common air pump and arranged it in such a manner that the current could pass through it, while the receiver was exhausted. At a pressure of two millimetres the spiral was kept at incandescence for two hours before the deposit was sufficient to become visible. In another experiment at a higher exhaustion it required five hours before a deposit became visible. In a sealed glass bulb, exhausted by a Sprengel pump to a point where a quarter of an inch spark from an induction coil would not pass between points one millimeter apart, was placed a spiral, the connecting wires passing through the glass. This spiral has been kept at the most dazzling incandescence for hours without the slightest deposit becoming visible.

I will now describe other and far more important phenomena observed in my experiments. If a short length of platinum wire one-thousandth of an inch in diameter be held in the flame of a Bunsen burner, at some part it will fuse, and a piece of the wire will be bent at an angle by the action of the globule of melted platinum; in some cases there are several globules formed simultaneously, and the wire assumes a zigzag shape. With a wire four-thousandths of an inch in diameter, this effect does not take place, as the temperature cannot be raised to equal that of the smaller wire, owing to the increased radiating surface and mass. After heating, if the wire be examined under a microscope, that part of the surface which has been incandescent will be found covered with innumerable cracks. If the wire be placed between clamping posts and heated to incandescence for twenty minutes, by the passage of an electric current, the cracks will be so enlarged as to be seen with the naked eye; the wire, under the microscope, presents a shrunken appearance, and is full of deep cracks. If the current is continued for several hours these effects will so increase that the wire will fall to pieces. This disintegration has been noticed in platina long subjected to the action of a flame by Prof. John W. Draper. The failure of the process of lighting invented by the French chemist Tessie du Motay, who raised sheets of platinum to incandescence by introducing them into a hydrogen flame, was due to the rapid disintegration of the metal. I have ascertained the cause of this phenomenon, and have succeeded in eliminating that which produces it, and in doing so have produced a metal in a state hitherto unknown, and which is absolutely stable at a temperature where nearly all substances melt or are consumed; a metal which, although originally soft and pliable, becomes as homogeneous as glass and as rigid as steel. When wound in the form of a spiral it is as springy and elastic when at the most dazzling incandescence as when cold, and cannot be annealed by any process now commonly known, for the cause of this shrinking and cracking of the wire is due entirely to the expansion of the air in the mechanical and physical pores of the platinum, and the contraction upon the escape of the air. Platinum as sold in commerce may be compared to sandstone in which the whole is made of a great number of particles with many air spaces. The sandstone upon melting becomes homogeneous and no air spaces exist.

With platinum or any metal the air spaces may be eliminated, and the metal made homogeneous by a very simple process. This process I will now describe. I had made a large number of platinum spirals, all of the same size and from the same quality of wire; each spiral presented to the air a radiating surface of three-sixteenths of an inch; five of these were brought by the electric current up to the melting point, the light was measured by a photometer, and the average light was equal to four standard candles for each spiral just at the melting point. One of the same kind of spirals was placed in the receiver of an air pump, and the air exhausted to two millimetres; a weak current was then passed through the wire to slightly warm it for the purpose of assisting the passage of the air from the pores of the metal into the vacuum. The temperature of the wire was gradually augmented at intervals of ten minutes until it became red. The object of slowly increasing the temperature was to allow the air to pass out gradually and not explosively. Afterward the current was increased at intervals of fifteen minutes. Before each increase in the current the wire was allowed to cool, and the contraction and expansion at these high temperatures caused the wire to weld together at the points previously containing air. In one hour and forty minutes this spiral had reached such a temperature without melting that it was giving a light of 25 standard candles, whereas it would undoubtedly have melted before it gave a light of five candles had it not been put through the above process. Several more spirals were afterward tried, with the same result. One spiral which had been brought to these high temperatures more slowly gave a light equal to 30 standard candles. In the open air this spiral gave nearly the same light, although it required more current to keep it at the same temperature. Upon examination of these spirals, which had passed through the vacuum process, by the aid of a microscope, no cracks were visible; the wire had become as white as silver, and had a polish which could not be given it by any other means. The wire had a less diameter than before treatment, and it was exceedingly difficult to melt in the oxyhydrogen flame. As compared with untreated platinum, it was found that it was as hard as the steel wire used in pianos, and that it could not be annealed at any temperature.

My experiments with many metals treated by this process have proved to my satisfaction, and I have no hesitation in stating that what is known as annealing of metals to make them soft and pliable is nothing more than the cracking of the metal. In every case where a hard drawn wire had been annealed a powerful microscope revealed myriads of cracks in the metal. Since the experiments of which I have just spoken I have, by the aid of Sprengel mercury pumps, produced higher exhaustion, and have, by consuming five hours in excluding the air from the wire and intermitting the current a great number of times, succeeded in obtaining a light of eight standard candles from a spiral of wire with a total radiating surface of 1-32 of an inch, or a surface about equal to a grain of buckwheat. With spirals of this small size which have not passed through the process, the average amount of light given out before melting is less than one standard candle. Thus I am enabled by the increased capacity of platinum to withstand high temperatures to employ small radiating surfaces, and thus reduce the energy required for candle light. I can now obtain eight separate jets, each giving out an absolutely steady light, and each equal to 16 standard candles, or a total of 128 candles, by the expenditure of 30,000 foot pounds of energy, or less than one-horse power. As a matter of curiosity I have made spirals of other metals, and excluded the air from them in the manner stated. Common iron wire may be made to give a light greater than platinum not heated. The iron becomes as hard as steel and just as elastic. Nickel is far more refractory than iron. Steel wire used in pianos becomes decarbonized, but remains hard, and assumes the color of silver. Aluminum melts only at a white heat.

In conclusion, it may be interesting to state that the melting points of many oxides is dependent on the manner of applying the heat; for instance, pure oxide of zerconium does not fuse in the flame of the oxyhydrogen blowpipe, while it melts like wax and conducts electricity when on an incandescent platinum spiral which is at a far lower temperature; on the other hand, oxide of aluminum easily melts in the oxyhydrogen flame, while it only vitrifies on the platinum spiral.

The following is an abstract of the paper read by Francis R. Upton, who is Mr. Edison's mathematical assistant. In defense of the title of the paper "Test of Faradic Machines," he called attention to the need of a new term to cover both dynamo and magneto machines, in the naming of which there is so much uncertainty at present. This confusion was found troublesome in experimenting where the same machine could be either a magneto or a dynamo, as the connections happened to be made; and it was then that the name was proposed by Mr. Edison. If these machines could be called "Faradic," in honor of Faraday, it would be in the nature of a monument built to the memory of the discoverer and first expounder of the principles on which they rest, at the instance of the inventor who had used the discoveries with so much success. This monument would be an enduring one, for in the near future many thousands of these machines will be in use for lighting purposes and for the transmission of power.

The methods pursued at Mr. Edison's laboratory were fully described, by which the value of the machines were tested. An account was given of the defects of existing dynamometers, some of which varied from ten to twenty per cent. in their readings. As the mechanism in a dynamometer has no other function than to weigh, the absurdity of the present forms was pointed out, which were either very poor spring balances or scales, with rotating bearings, none being of a nature that a merchant would think of selling goods with, though they had been used for selling energy.

In the form adopted the power was weighed on a platform scale, the principle is extremely simple, that if the speed and strain on a belt are known the power may be calculated by multiplying the two together. The belt was passed under a pulley, in the same manner as in the case of an ordinary block, this being attached to the large weight on the platform of the scale, and the weight it lifted measured. So sensitive was the apparatus that the power taken by the brushes resting lightly on the commutator could be detected when the circuit was open, while its range was from one one-hundredth of a horse power to ten horse power.

Some tests were given of the Gramme machine, showing that with a constant field the electromotive force became much less as the resistance in the circuit was reduced, and pointing out the relations between the strength of the field and the currents obtained, as well as the changes due to variation in the speeds.

The new machine of Mr. Edison was shown to give back ninety-two per cent. of the power it received in the shape of electricity. The constants used for determining this were the following: The resistances were a standard box from London; the electromotive force of a Daniel's cell was assumed as one and eight hundredths volts, and the foot lbs. given off by a unit of current, one Weber, acting over one Ohm was taken as forty-four and three-tenths.

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This result is very remarkable, being nearly ten per cent. greater than from any other machine. In making the measurements an electro-dynamometer made after the drawings of Prof. Trowbridge of Harvard College was used, and this was spoken of as an instrument of great practical utility in measuring strong currents.

A method was proposed for measuring the energy in the carbon arc, based on the principle that the distribution of work in an electric circuit is proportional to the fall of tension; and the same method proposed for studying the laws of transmission of power by the Faradic machines. This criterion was given to judge a machine by: to have the smallest resistance with the greatest electromotive force, the power consumed in the magnets and the cost of machine and spark on the commutator being considered. It was also stated that Mr. Edison had obtained from a machine running at 700 revolutions in a minute a tension equal to 125 cells of Daniel's, the armature having only six-tenths of an Ohm resistance, and only one-sixth of a horse power being consumed in the magnet.

[illegible] un journal on un abonnement de [illegible]
Les [illegible] à l'électricité et à la dynamite

L'Électricité fait connaître une [illegible] d'un genre nouveau.

Le [illegible] de guerre anglais, le *Vengeur*, a été envoyé sur les côtes d'Irlande par un autre navire l'*Iron Duke*. Désapprouvé de la relever, le gouvernement, après la résolution de faire sauter l'épave avec de la dynamite. Cette mission difficile, confiée au *Volontaire*, a parfaitement réussi à l'aide de torpilles explosionnées par l'étincelle électrique.

Les effets ont été extrêmement énergiques, comme on s'y attendait ; mais ce que l'on ne prévoyait point, c'est l'énorme quantité de poissons de toute nature qui avaient été foudroyés et qui furent trouvés flottants à la surface de la mer. Les marins de l'équipage du *Volontaire* auraient pu faire une pêche si abondante que le pont en aurait été encombré s'ils avaient ramassé tous les cadavres flottants dans le voisinage du navire.

On peut conclure de la richesse de cette pêche miraculeuse, que les torpilles pourraient être parfaitement mutilées, lors du passage d'un banc de harengs ou de morues sur un haut-fond. L'essai n'a point encore été tenté ; mais il mériterait d'autant plus de l'être que les pêcheurs pourraient être prévenus télégraphiquement ou par pigeons de l'arrivée prochaine des poissons dans les parages qu'ils fréquentent.

C'est là l'incompressibilité presque absolue de l'eau qu'est due l'énergie de cette action destructive, car les poissons reçoivent ainsi un choc équivalent à un coup de marteau, dont l'énergie décroît en raison inverse du carré de la distance au centre d'ébranlement.

S'il l'on voulait employer pratiquement cette méthode, on devrait répartir sur un espace plus ou moins grand un certain nombre de foyers.

L'expérience seule indiquerait la masse de dynamite qu'il faudrait employer à chaque centre d'explosion, masse qui serait plus ou moins grande elle-même suivant la profondeur de l'eau.

La condition la plus essentielle à remplir, pour arriver au maximum d'utilisation, serait la simultanéité absolue de l'explosion.

A new machine of Mr. Edison's invention, designed to turn power into electricity? is said to give back 92 per cent. of the power expended in the form of electricity. All these results point to a speedy solution of the problem of electric lighting, if it can be solved.

Chic Journal Oct 1879

THE SIEMENS-ALTENECK ALTERNATING CURRENT DYNAMO-MACHINE.

THE general construction of this machine is shown by figs. 1 and 2, fig 1 being a longitudinal section, and fig. 2 a front view. On the brass A are fixed the two iron frames B, carrying each a number of electro-magnets C, C (of which 16 are shown in the drawings), and bearings for the shaft E. On this shaft is fixed a disc D, carrying a number of coils c, of elongated shape, as shown by the dotted lines in fig. 2. These coils are wound in the plane of the disc or cores D of elongated shape. The electro-magnets C have their facing polar ends extended by fixing on them tangential iron plates F, and these plates and the coils c are so proportioned, that each coil has advanced over about half the width of the plate from which it is retreating. The coils of the magnets C are so connected that the two polar-fields facing one another are always of opposite polarity, also the polar-fields contiguous to one another are of opposite polarity, and thus the coils c, in passing through the successive fields, have alternating currents induced in them.

The collection of the currents induced in the coils c, by the passage of the latter through the magnetic fields of alternate polarity and the combination and commutation of these currents, and of such portions of them as may be employed for exciting the electro-magnets C, C, is effected in the usual way by contact rings H and the commutator G, provided with tangential contact brushes K, K. Such commutation of the currents through the coils C would be required if the apparatus were used as a direct current machine.

In using the apparatus as an *alternate* current machine, the electro-magnets C, C are excited by a separate dynamo-machine of the ordinary Siemens construction. The general view of this dynamo-machine, and also of the machine just described, which are together capable of burning 16 Jablochkoff candles, are shown by figs. 3 and 4 respectively.

The dynamo-machine, if used separately, will produce a light equal to 1,400 standard candles.

FIG. 1.

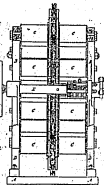


FIG. 2.

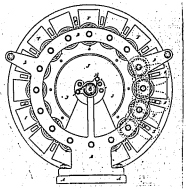


FIG. 3.

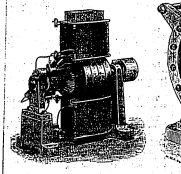
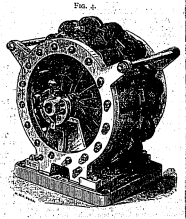


FIG. 4.



bear so intimate a relationship. The vote of thanks having been carried by acclamation, Mr. Crookes, in a brief acknowledgment, said that it was difficult to say which afforded to the scientific investigator the greatest pleasure, the discovery of new philosophical truths or the bringing them before such an audience as the one he saw before him.

Engineering Aug 29

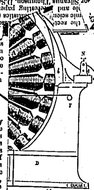
LIGHTING BY ELECTRICITY.—No. IV.

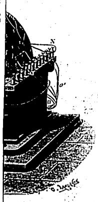
DYNAMO-ELECTRIC MACHINES—(*continued*).

WE have in former articles described the early magneto-electric machines of Holmes and of the Société l'Alliance* and the single current machines of Gramme† and Siemens.‡ Each of these machines is typical of a class, the last named forming a class by itself. We now come to speak of an order of machines to which the name multiple circuit has been applied, and to which order belong the machines of Lontin, Wallace-Farmer, and Wilde, as well as the multiple circuit machines of Gramme and Siemens.

In the Lontin machine, which we illustrate on the next page, the revolving armature is in the form of a star-shaped wheel consisting of a central boss P, Fig. 1, into which are fixed ten or more radial bars of soft iron, circular in section but slightly conical in form, marked in the drawing D D D. Each of these radial spokes is wound with a coil of insulated copper wire, the ends of which are connected together in series, and to a cylindrical commutator. The armature wheel is fixed on a shaft and revolves in the magnetic field of two powerful electro-magnets A A fixed vertically into a base-plate of iron by which they become the two limits of a "horseshoe" electro-magnet. The cores of the radial magnetic inductors as they revolve approach very close to and recede from the poles of the inducing magnets A A, being at their point of closest proximity when their axes pass the line X X, Fig. 1. By Lenz's law, a coil approaching a north pole of a magnet has a current of electricity induced in it in one direction, and when receding from the same pole the induced current is in the opposite direction, and a coil receding from a north pole has a current induced in it in the same direction as a similar coil approaching a south pole, and *vice versâ*. Bearing these laws in mind, and referring to Fig. 1, it will be seen that when the machine is revolving in the direction of the arrows, all the radial bobbins above the horizontal line X X are receding from the left hand or south pole of magnet A A and approaching the right hand or north pole, while those below the line X X are doing just the very reverse, that it is say, they are receding from the north pole and approaching the south pole; the currents induced, therefore, in all the bobbins above the line X X are similar in direction to one another, but inverse to those below the line X X. The coils in the arrangement shown in the figure are coupled together in series as in the Gramme machine, and each pair of contiguous coils is connected to a sector P of the cylindrical commutator, there being as many sectors as there are bobbins, and insulated from one another by thin strips of ebonite N N N. Against the surface of this commutator collectors *a a* are pressed by means of springs, the one taking

* See ENGINEERING, vol. xxvii., page 513.
† See ENGINEERING, page 61 *ante*.
‡ See ENGINEERING, page 101 *ante*.





...larity. Enveloping this re-... ...o-magnets and fixed to the ... is a crown of flat electro-... B B, having their ends pre-... of the machine, and there-... electro-magnets attached to ... There are as many of these ... are radial magnets, and it ... construction of the machine ... is set in motion a series of ... electricity will be induced in ... as the revolving magnets, ... approach to and recede from ... xed coils are connected by ... he terminal screws *m* of the ... ting switching apparatus M ... the perspective view of the ... is portion of the apparatus ... any lesser number of the

outside induction coils can be diverted into a number of different circuits; the number of such external circuits depending upon the size and construction of the machine, and upon the number of the induction bobbins that are capable of producing the currents required. In the machine, as shown in Fig. 3, the bobbins are coupled up in pairs, so that twelve circuits may be fed by the twenty-four bobbins. Attached to the shelf, on which the commutator switches are fixed, are twenty-four terminal screws, twelve above it marked *m*, and twelve below it marked *m'*, and by manipulating the twelve bell-crank switches I, any number of the upper terminals may be connected to any number of the lower. Thus as any of the bobbins may be connected by wires to any of the upper terminals, and the lower terminals may be connected to any of the outside circuits, the arrangements of the connexions of the bobbins, and the coupling up of the circuits, is under perfect control, and any circuit may be completed or thrown out of the machine instantaneously by a movement of the switches. The wires *o* (Fig. 4), attached to the terminals *m'*, lead to the different lamp circuits, and the wires *g'*, attached to the terminals N, are the return wires from the same circuits. To the terminals F F are attached the wires leading from the exciting machine, the current of which is transmitted to the coils of the rotating electro-magnets A A by the two contact pieces *a a*, which are maintained in close contact against the contact cylinders, one of which is shown in the figure, and to which the coils of the electro-magnets are connected.

The Lontin system is that which was employed at the St. Lazare terminus in Paris of the Western Railway of France for illuminating the goods platform, waiting hall, and front of the station by the electric light last year, and it supplied the light to every alternate light round the balcony of the Paris Hippodrome, it being tried against the Jablochkoff system, which was in the intermediate lamps. It was also the Lontin machine that was employed for the electric lighting of the exterior of the Gaiety Theatre in London, and is interesting for that reason as having been the first practical application of electricity to street lighting that was ever made in this country.

Scientific American Supplement, Vol. VII., No. 164,
Scientific American, established 1845.

NEW YORK, SEPTEMBER 20, 1879.

MORIN'S ROTARY DYNAMOMETER.

THE apparatus ordinarily used for measuring the work performed by a motor is Prony's brake, and the results obtained by this are very accurate. For measuring the work of machines actuated by a motor, dynamometer friction or tension plates are employed, but they are open to the objection of complication. M. Morin, then, has just produced a genuine service to all manufacturers by contriving a simple and practical apparatus for the purpose of measuring the work of machines used either in small workshops or large manufactories.

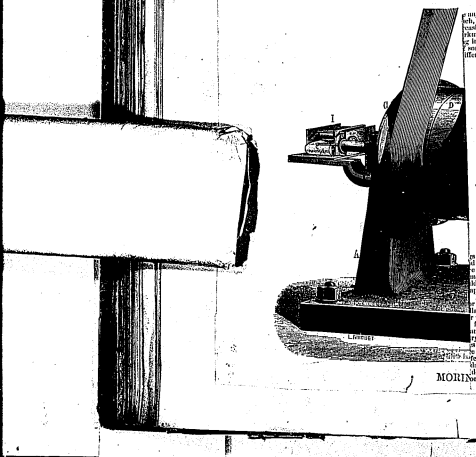
This new dynamometer (the illustration and description of which we borrow from the *Revue Industrielle*) consists of a flat cast iron disk mounted on an independent axle, and carrying a system of springs designed for receiving the effort transmitted by a motor machine. The power is transmitted by means of an endless belt and a shifting pulley on the shaft of the instrument, but which moves the flat disk through the intervention of a steel ribbon. When the machine is set in motion, the tension of the belt is transmitted to the extremity of the axle, and marks the movements of the spring upon a divided scale.

We thus know the effort, expressed in kilogrammes, that is exerted at the tangential point of the steel ribbon and the flat disk.

The whole have just seen, an apparatus for marking the number of revolutions is placed at one of the extremities of the axis of the apparatus, and an automatic register, placed at the other extremity of the same axis, traces upon an unrolling paper ribbon a diagram of the work produced and employed.

One of these two apparellees may be replaced by a totalizer, to make known, after any length of movement whatever, the power furnished by the motor, or the resistance offered by the machine actuated by it.

Morin's dynamometer resolves, as simply as it does correctly, every question relating to the force developed by all motor machines, as well as the work absorbed by the machines which are actuated by them. Two great advantages connected with this new apparatus deserve to be particularly noticed. The first is, that it measures the work, not



only at any given moment while the machine is in movement, but it continues to do so during the whole time the machine is in operation—two collateral causes to be ascertained. The second is, that of avoiding the stoppage of all the machines in operation (as required by the use of all other known dynamometers) when it is desired to observe the dynamometric effects.

The apparatus will occupy a place, then, that has never as yet been filled in experimental mechanics, and there will be no doubt as to its success. Its very low price places it within the reach of all classes of buyers, and its solidity as well as its simplicity permits of its being placed in any hands, even in those of employes who have had little mechanical experience.

FIG.

[illegible] any constant but other connected with it. [illegible]belt, it is an indication that *there is a defect in* [illegible] casional offensive smells also usually reveal [illegible]thermidity, incorrect methods, bad ventilation, [illegible]g in the quality of materials used, or in the proj[illegible] some of the various parts.

[illegible] different means of allowing escape of sewer [illegible]

[illegible] n frequently exist for a long time without bei[illegible] ll as people may become so habituated to t[illegible] e of bad smells as not to notice them, it is e[illegible] unch of the plumbing and of the soil pipes [illegible] ld be *readily accessible to frequent inspection*, [illegible] ventilation at ends of the proper points. [illegible] Inside the house, the drains should be of [illegible] well tempered lead joints, and not be so l[illegible] ther floor that they cannot be seen.

[illegible] o a healthy, vigorous person from breathi[illegible] far as the specific diseases are concerned, [illegible] on is commonly supposed; yet it is a risk of [illegible] ry that it should, of course, be avoided. If [illegible] s from a general sewer system, especially wh[illegible] so badly constructed as many in our citi[illegible] fective drains, allowing filth to accumulate a[illegible] danger is ordinarily much greater than fr[illegible] decomposition has begun; and the absence [illegible] ons not so constantly furnish a warning of [illegible]

MORIN

THE SIEMENS DYNAMO-ELECTRIC MACHINE.

TO THE EDITOR OF ENGINEERING.

SIR,—I have to thank Mr. Upton for the courteous tone of his criticism of the paper which I read before the Institution of Mechanical Engineers. In reply I would remark:

1. That the value of a Daniell's element was taken as nine-eighths of a volt as a rough mean of published results.

2. My paper does not pretend to minute accuracy, but rather to give rough easily obtained results of *the right order*, and that I would more accurate results may be obtained by those who will arrange apparatus with a single aim to the greatest accuracy, and who will not purposely gave in the Table results, in which it was apparent that the estimated power of the current was in excess of the estimated power applied. It may be well to mention some of the causes of irregularity, they are:

3. The varying temperature of the coils of the machine itself.

4. The uncertainty of the correction for temperature in the brass coils introduced in the main circuit. In a permanent laboratory there would be no fear or few fears as large a scale, but they would be on the same principle, that is, many comparatively thin wires would be used in order to obtain a large cooling surface.

5. The resistance of the lead line rose rapidly, and the consequent heating of the wire, when the current was of any intensity from this cause. The leading of the wire, which was German silver, introduces a much smaller error.

6. The main object of my paper was to show what ought to be ascertained concerning any machine, in order that our knowledge of it might be complete in kind, and sufficiently to insure the use of the electro-motive force should be known for the use of all constructors, and that the most contented capabilities of a dynamo-electric machine should at least include the resistance of the parts of the machine, the electro-motive force for a given speed, when the current is very powerful, and the total resistance which overpowers the machine, by the maximum current, this last was a little more than four-tenths.

7. I trust that the practical interest to the publication of the mass of valuable results which have been accumulating in Mr. Elliott's laboratory, and trust they will not be long delayed.

J. HOPKINSON.

4, Westminster Chambers, Victoria-street, July 23, 1879

97

IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES.*

By Mr. W. Lahn.

My object in this communication is to describe in a few words the peculiarities and improvements in the construction of Weston's Dynamo-Electric Machine. The general appearance and arrangement of the Field Magnets may be seen in the annexed engravings, where fig. 1 is a perspective view of the machine, and fig. 2 a similar view of

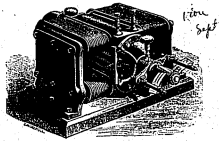


Fig. 1.

the armature. The pole pieces are composed of iron plates placed side by side in a mould, but separated a uniform distance from each other. The iron magnets on which the wire is to be wound are cast on to legs or projections on the ends of the plates. The two cast-iron ends and uniting plates form one magnet, the upper and lower magnets are alike, and when joined together by some perforated vertical supports, the inner curved edges of the field plates embrace about two-thirds of the circle in which the armature is made to revolve. The armature, which is seen at fig. 2, is built up of plates which are somewhat like a cogged wheel in shape. These plates are stamped out of sheet iron, and when mounted on the shaft are separated from each other at uniform distances. The radial projections are then arranged in lines, so that the whole forms a very broad cogged wheel, or cylindrical structure having longitudinal grooves with transverse spaces at regular distances. The longitudinal grooves are for carrying the wire, and

Fig 2.

it will be observed from the nature of the structure that the wire lies in channels three sides of which are iron; so that the mutual effect upon each other is increased as much as possible. The ends of the wires are connected to the field magnets and commutator in much the usual way, the currents travelling in one direction only. The commutator is fitted on a portion of the shaft, which projects beyond the bearings. This admits of its easy removal, and a new one being replaced in three minutes.

Another important feature in the construction is the arrangement for ventilation. The separation between the pole plates of the field magnets, the perforation in the vertical supports of the magnets, and the light framework of the armature, are all for this purpose. The air enters the centre of the armature, and is driven out between the layers of wire through the spaces formed by the separated plates of the armature and the field magnets, and thus prevents any part from becoming unduly heated. Machines of this description are made of various sizes and strengths, and give from one to sixteen lights in single circuit.

THE WESTON DYNAMO-ELECTRIC MACHINE.*

By Mr. Lahn.

My object in this communication is to describe in a few words the peculiarities and improvements in the construction of Weston's Dynamo-Electric Machine.

The Field Magnets.—The general appearance and arrangement of these may be seen in the diagram,

FIG. 1

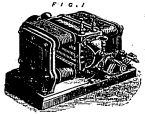


Fig. 1. The pole pieces are composed of iron plates placed side by side in a mould, but separated a uniform distance from each other. The iron magnets on which the wire is to be wound are cast on to legs or projections on the ends of the plates. The two cast-iron ends and uniting plates form one magnet; the upper and lower magnets are alike, and when joined together by the perforated vertical supports the inner curved edges of the field-plates embrace about two-thirds of the circle in which the armature is made to revolve.

FIG. 2.

The armature, Fig. 2, is built up of plates which are somewhat like a cogged-wheel in shape, see Fig. 2. These plates are stamped out of sheet-iron, and when mounted on the shaft are separated from each other at a uniform distance; the radial projections are then arranged in lines, so that the whole forms a very broad cogged wheel, or cylindrical structure, having longitudinal grooves with transverse spaces at regular distances. The longitudinal grooves are for carrying the wire, and it will be observed from the nature of the structure that the wire lies in channels, three sides of which are iron; so that the mutual effect upon each other is increased as much as possible. The ends of the wires are connected to the field magnets and commutator in much the usual way, the currents travelling in one direction only. The commutator is fitted on a portion of the shaft, which projects beyond the bearings; this admits of its easy removal, and a new one being replaced in three minutes.

Another important feature in the construction is the arrangement for ventilation; the separation between the pole-plates of the field magnets, the perforation in the vertical supports of the magnets, and the light framework of the armature, are all for this purpose. The air enters the centre of the armature, and is driven out between the layers of wire through the spaces formed by the separated plates of the armature and the field magnets, and thus prevents any part from becoming unduly heated. Machines of this description are made of various sizes and strengths, and give from one to sixteen lights in single circuit.

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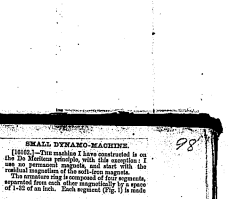
SMALL DYNAMO-MACHINE.

[1868.]—The machine I have constructed is on the De Meritens principle, and is intended for use as permanent magnets, and short with internal inequities of the soft-iron magnets.

The armature ring is composed of four segments, separated from each other magnetically by a space of 1-32 of an inch. Each segment (Fig. 1) is made



of eight plates of steel-tape 2.32in. thick, placed on one another and riveted together, and wound with five layers of silk-covered copper wire No. 16, then screwed to the face of a brass disc and made to revolve between the horns of the two iron-ring magnets, by which means we get the currents reversed by the magnetisation and demagnetisation of the iron-rings as well as the inductive effect on the magnetism of the steel magnets, and thus you can do as a regular Gramme machine. The armature ring is only 4in. in diameter outside, and 3in. inside. The electro-magnets are very small, the cores being only 3in. long and 2in. diameter, and wound with four layers of No. 16 cotton-covered wire. They are arranged so that the poles are alternately N and S, and the armature ring, which revolves between the soft-iron horns (Fig. 2 side view, Fig. 3 front), they being screwed on to the end of each pole. One end of each segment will then be at the same time opposite the end of a pole, and the other between the horns of a magnet, with an air-space about 1in. of No. 20 Gramme copper wire on it to it is, but with larger magnets it would do much better. The segments all being wrapped the same way, the currents generated in each of the same lines are opposite, and have to be made to run in the same direction round the armature before going to the electro-magnets. I get the best effect by coupling the wire of the segments, so as to get the electromotive force of two and the quantity of two, the same as you would a battery of four cells. The residual magnetism of the poles is so small, that neither pole will affect a small pocket-compass at the distance of 1in. from it, and the machine will run at about 600 revolutions a minute the wires are changed instantly on closing the circuit. If any further particulars are wished for, I shall be happy to give them through these columns.

Hatfield, Mass. Chas. Cutteris.

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DE MERITENS'S NEW MAGNETO-ELECTRIC

Jan. 8 1878 NE 043 23/679

Jumored by the number of little lamps that this machine is capable of lighting, it might be thought that it formed the most powerful magneto-electric generator for a given motive force. It might, in fact, with a motive force not exceeding one horse power, suffice to keep three Jablochkoff candles lighted indefinitely, without requiring of the motor a velocity of over 700 revolutions per minute, and without the production of any appreciable heat. But the light furnished by these candles does not seem to be so strong as that from candles fed by the Gramme machine; and until we have more accurate measurements we cannot definitely judge of the relative power of this generator. The machine is magneto-electric, and furnishes, like the Alliance, reversed currents; but to produce the same effect it requires only eight Alvarez magnets instead of forty-eight, and only a fourth of the motive force; at least this is what M. de Meritens asserts.

The advantages derived from the use of this kind of a machine are due as the fact that to the induction currents set up in the ring of the Gramme machine are added those which are produced in the ordinary magneto-electric machines.

That we may understand this, let us imagine a Gramme ring (Fig. 1) divided for example into four sections, magnetically insulated from each other, and consequently forming four arched electro-magnets placed end to end. Let us imagine that the iron core of each of these sections terminates at each of its extremities in a plate of iron, A B, forming as it were an outspreading of its poles; and let us suppose that all the coils are fed by a proper source, C D, form a solid ring around which are arranged permanent magnets, N, S, N, S, whose poles alternate with each other. Now let us see what will happen when this ring shall have made a movement of rotation; and let us first see what will be the result, for example, of the approximation when the outspread pole, B, moving from left to right, nears N. At this moment an induced magnetic current will be developed

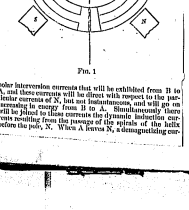

FIG. 1

in the electro-magnetic helix, A B, as in the Clarke machine. This current will be instantaneous and in an inverse direction to the Ampère currents of the inducing magnet; and it will be very powerful because of the proximity of B to the pole N. But the ring in moving forward will set up a series of magnetic displacements between the pole, N, and the core, A B, and which will give rise to a series of

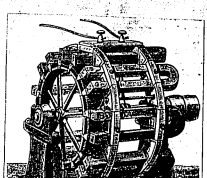

FIG. 2.

rent will be set up, equal in energy to and in the same direction as the inducting current read[illegible] from the approximation of the outspread pole, B, to the pole, N. The effect is then produced, in fact, at a different extremity of the magnetic core, and the helix is submitted to the action of induction in an inverse manner. We have, then, inverse induced currents of the inductor caused by the approaching

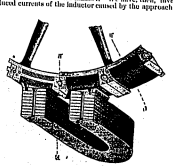

FIG. 3.

and receding of the appendages, B and A; direct induced currents during the passage lengthwise of the core, A B, before the inductor; and direct induced currents resulting from the passage of the spirals before A in other words, we find in this combination all the causes of induction united.

It will be observed that the action that we have just studied with regard to a single section may likewise take place at the same time in all the others, and that to this are also added the currents resulting from the lateral reaction of

polar intervention currents that will be exhibited from B to A, and these currents will be direct with respect to the particular currents of N, but not instantaneous, and will go on borrowing in energy from B to A. Simultaneously there will be joined to these currents the dynamic induction currents resulting from the passage of the spirals of the helix before the pole, N. When A leaves N, a demagnetizing current

the poles, A and B, on the neighboring cores. In order to still further increase the effects of induction, M. De Meritens forms the core, A B, and the appendages, A and B, of plates punched out of thin iron, as seen in the figure, and juxtaposed to the number of fifty in bundles, each plate being one millimeter (0·04 of an inch) thick. The wires of the helices, moreover, are so wound that they can be submitted to tension, in quantity, or in series, according to the conditions under which they are to be applied. In the theoretical figure which we have considered, we have given only four sections; but in point of fact there are a larger number, and in the model of which we have spoken there are sixteen of them, and these may be readily distinguished in the figure (Fig. 2). They are mounted on a bronze wheel fitted to the shaft of the motor. Above this wheel are found the inducing magnets placed horizontally, and firmly fitted into two bronze skeleton frames (Fig. 3). A very slight inspection of the way in which the induced ring is placed will at once show that it could not possibly have been constructed in a better manner. Indeed, as each section is separate, it can be taken out by itself, and in wire consequently wound upon it without any trouble. Those who know the difficulties attending the winding of the Gramme ring will see the precedent advantage. The second point, viz. the fact of the magnetic insulation of juxtaposed plates, which may be cut out at a single blow of the punch, also presents an immense advantage; for this system dispenses with the precision that is necessary in constructing thole-rings, which are always so difficult to keep perfectly round. Finally, there is neither a commutator nor collector in this machine, and consequently no loss of current.

We have seen that the currents furnished by this machine could light three to four Jablochkoff candles; but it has been found equally possible to light regulators, and in the latter case it has been found possible, too, to separate the carbons as far as 5 centimetres (2 inches) apart without extinguishing the light. These results are certainly very important.—*Ch. de Mosnel, in La Nature.*

SMALL DYNAMO-MACHINES.

To the Editor of the Electrical Review.

SIR,—I see the editor of *Engineering* has made bulls of 70 Gorman silver wire." I was mistaken as to the size, and having got a little time to spare, I have tried it more exactly, and find the wire is 0·0135 inch in diameter. I have also found it will be best to bind. I think one great cause of failure in these small dynamo machines is that the resistances of the armature and the magnets are not in proper proportion to one another. In my machine, firstly, when the two magnets are joined up in one circuit, the end of one set of coils to the terminal, and the end of the other magnet coils to the frame, and the 4 armature coils joined up in the same way give 1·42 Ohm; the result is that the machine will not work. Secondly, joining up the armature coils, two for quantity and two for E.M.F., their resistance becomes 0·71 Ohm, and the machine works splendidly. Thirdly, joining the electro-magnetic coils in multiple arc, their resistance becomes 0·71 Ohm, and the machine will not work till (fourthly) I have connected up all the armature coils for quantity, reducing their resistance to ·19 Ohm, and then not so well as in second case. Therefore, I think it safe to say that there must be a certain proportion between the two, and the nearer we get to 1 to 1 the better. Also, I believe one reason the armature should have the least resistance, and that a current of great quantity rather than E.M.F. is necessary. "Ohm's" difficulty (No. 1682) may be greatly owing to this, and although his machine will run very well as an electro-motor, and give a powerful current (at high E.M.F.) when the armature coils are changed by battery, it will still not be able to work as a dynamo.

I am afraid that [illegible] so far away my letters may arrive after someone else has been over the same ground, and, therefore, not be worth the setting up.

In conclusion, I would say, Do not give up any machine you may have on hand, as the theory is right, and with patience they can be made to work. Especially those where the currents resulting from the magnetization and demagnetization of the armature, as well as the Gramme effect on the wire can be utilized, viz., the Brush (American) Wilde, De Meritens, and Lontin machines.

Duxbury, Mass., Sept. 1. CHAS. CUTTRISS.

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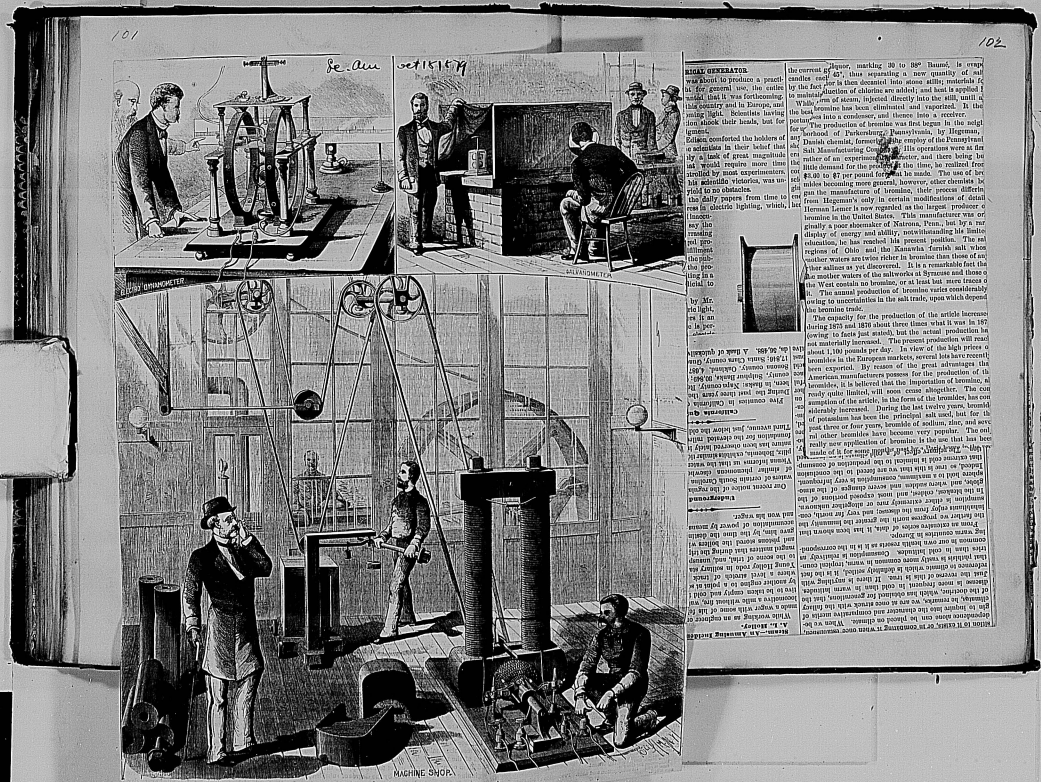

EDISON'S ELECTRIC GENERATOR.—[See page 101.]

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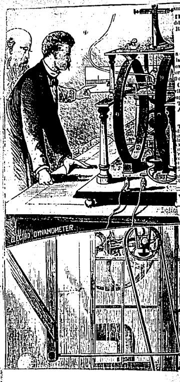

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NEW YORK, SATURDAY, OCTOBER 18, 1879.

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Electrical [...]

THE PRODUCTION OF BROMINE IN THE UNITED STAT[ES]

The only important source of bromine in the United St[ates ...] the liquid which remains after the extraction of salt, i[...] [wh]ich is known in the salt-making industry as the "mot[her liqu]ors." The *Moniteur Scientifique* gives a short descript[ion of t]he process employed in separating this important elem[ent from] the saline liquors. The latter, when first pumped [...] from borings to 12° Baumé, allowed to settle, t[...] the pit, mark 9° Baumé. They are evaporated [...]ated by steam. The first crystallization forms [...]e evaporated to the crystallizing point in woo[den tubs ...] commerce. The tubs, five in number, are placed [...] and every day the liquor is decanted from one [...]—from No. 1 to No. 2, then to No. 3, and so on. The crystallized salt is removed from each tub [...]s off the liquid. When the brine reaches tub No [...] it has become mother liquor, and consists principally [of] chlorides of calcium, magnesium, sodium, and a lit[tle] chloride of aluminum, with varying proportions of bromi[des] of sodium and calcium. Tub No. 1 is filled every day w[ith] fresh brine, so that the process becomes continuous. T[...]

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EDISON'S ELECTRICAL GENERATOR.

When Mr. Edison said he was about to produce a practical economical electric light for general use, the entire business world took it for granted that it was forthcoming. Gas stocks tumbled both in this country and in Europe, and the people waited for the coming light. Scientists having had experience in this direction shook their heads, but for the most part suspended judgment.

Delay on the part of Mr. Edison comforted the holders of gas stocks, and confirmed the scientists in their belief that he had undertaken not only a task of great magnitude and difficulty, but one that would require more time and means than could be controlled by most experimenters. But Mr. Edison, flushed by his scientific victories, was undaunted and determined to yield to no obstacles.

Unfortunately, however, the daily papers from time to time printed reports of progress in electric lighting, which, from their extravagance and inaccuracy, placed Mr. Edison, to say the least, in an extremely embarrassing position as regards his alleged promises and the expected fulfillment of them, besides misleading the public as to the true nature of the problem to be dealt with, resulting in a reaction of feeling prejudicial to Mr. Edison's just fame.

At present little is said by Mr. Edison concerning his electric light, excepting that he considers it an assured success, and that he is perfecting the details of his electric lighting system as rapidly as possible.

It is not our purpose just now to enter into a description of Mr. Edison's electric lighting system as a whole, but to describe his new electric generator—one of the most important factors of the system—and also to describe his new electrical motor used in driving light machinery for domestic and industrial purposes.

The new generator resembles in some respects other well known forms, but it differs from them all in several very important particulars; for instance, the field magnets are immense, being about 54 inches high, and weighing about 1100 lb. The magnet cores—of wrought iron—are 6 inches in diameter, and 36 inches long; they are mounted upon heavy cast iron blocks, $10\frac{3}{4}$ inches high and 9 inches wide, and are connected at the top by a wrought iron yoke, 6 inches high and 7 inches wide. The cores are wound with 3 layers of No. 10 cotton covered wire, the ends of which are connected with binding posts on the base of the machine. The two blocks upon which the cores rest, as well as the bearings of the armature, are supported by a cross-shaped brass casting.

The armature which revolves in the cylindrical space between the poles of the field magnet is shown in section in Fig 2. It consists of a wooden cylinder, A, mounted on a $1\frac{1}{2}$ inch shaft, and having attached to its ends soft iron plates, B, between which there are several layers, D, of No. 20 soft iron wire wound circumferentially. Outside of the iron disks, B, there are vulcanized-fiber disks, C, having their peripheries notched to receive the several coils, E, of insulated wire wound lengthwise on the cylinder and connected with copper bars, F, of the commutator cylinder, G. There are 41 $\frac{41}{1000}$ in. wires in each strand, and each strand passes lengthwise around the cylinder on diametrically opposite sides, the opposite ends of all of the wires in each strand being soldered to commutator bars on opposite sides of the commutator cylinder. There are 40 strands surrounding the armature, and the commutator cylinder is pressed on opposite sides by copper wire brushes which take off the current. The armature shaft has a 10 inch pulley with a 5 inch face, and the speed of the machine is about 500 turns per minute. Although the current from the armature may be used to excite the field magnet, Mr. Edison finds it more economical to charge the field magnet by means of a separate machine. In fact, he intends to charge a battery of such generators with a single Faradic machine of this form.

An important fact has been developed in the course of Mr. Edison's experiments with this generator. He finds that by connecting the ends of the field-magnet by a copper wire for a moment when the machine is started, the field magnet soon attains its maximum charge, which it retains so long as the generator is in continuous operation. It requires a minute or more to fully charge the immense magnets, and when charged their influence is far reaching and powerful. The internal resistance of the armature is only $\frac{1}{2}$ ohm, and Mr. Edison claims that he realizes 90 per cent of the power applied to this machine in effective external current. It requires but 5 horse power to drive it, and the current generated is sufficient to make 40 lights of sixteen candles each. The economy of this machine is shown by the fact that one man may turn it with sufficient rapidity to maintain the electric arc of a Jablochkoff candle.

While this generator in general principle is the same as in the best of the well known forms, still there is an all-important difference, which is, that it will convert and deliver for useful work nearly double the foot-pounds of energy that any other machine will under like conditions. It has been shown by Hopkinson that the Siemens machine, which is generally recognized as the best form yet devised, converts from the belt to the circuit 93 per cent of the energy, but later corrections reduce this to 88 per cent; from these results many scientists have inferred and stated that there was little margin for improvement in the generating machine. Now the energy converted is distributed over the whole resistance; hence if the resistance of the machine be represented by 1, and the exterior circuit by 9, then of the total energy converted, $\frac{9}{10}$ will be useful, as it is outside of the machine, and $\frac{1}{10}$ lost in the resistance of the machine.

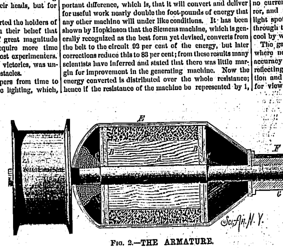


FIG. 2.—THE ARMATURE.

The Siemens machine, and nearly all other machines in use, make the external resistance equal to that of the machine; hence one half of the energy only is useful, and any attempt by these inventors to increase the exterior resistance, so as to change the distribution of energy to obtain more exterior work, results in reducing the power of the machine to convert energy. Therefore, efforts toward economy in one direction are met in the other direction by loss in the interest account due to the necessity of using a greater number of machines to convert a given amount of power.

In Mr. Edison's generator 5 horse power is transferred upon a resistance of 5 ohms, of which a $\frac{1}{2}$ ohm is in the machine, thus delivering $\frac{9}{10}$ of the total current upon a circuit exterior to the machine; thus nearly the maximum economy is attained when other machines, under like conditions, will scarcely give any current at all.

In dealing with the electric light problem, Mr. Edison has very properly devoted a large share of time and attention to the production of an economical generator, as it is the very foundation of the system. It bears the same relation to electric lighting that the cheap production of gas does to gas lighting. It is as important to generate electricity cheaply as to use it economically. Mr. Edison meets squarely both ends of the question, and is carrying on his experiments on a gigantic scale; being encouraged by new developments he continues his researches in expectation of still better things. His electric generator he considers complete; his electric lamp, although in good usable form, is slowly improving, and will not be introduced to the public so long as Mr. Edison thinks it can be improved.

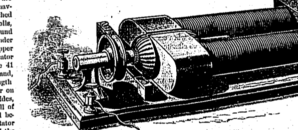


FIG. 3.—EDISON'S ELECTRIC MOTOR.

The lower view in our large engraving represents one end of the Menlo Park machine shop, showing the 80 horse power engine in the engine room beyond. One of the new electric generators is shown on the right, and the dynamometer with which the power tests are made is shown on the left. Not far from the generator is placed an electric dynamometer, shown in one of the smaller views at the top of the page.

This electrical dynamometer is the invention of Prof. J. W. Trowbridge. Mr. Edison has, however, improved it and adapted it to his own purposes. As there is no [iron] nor magnets in the apparatus it may be used in th[e vicinity] of the generator without being influenced by its ma[gnetism].

The electrical current traverses the two large sp[irals of] copper ribbon, and also the smaller spiral, whose bifil[ar sus]pension keeps it at right angles to the larger spirals [when] no current passes. The smaller spiral carries a small [mir]ror, and the readings are taken from a distant scale, t[he] light spot serving as an index. The circuit is completed through the smaller spiral by means of mercury cups kept cool by water running through their hollow walls.

The galvanometer tests are made in a distant building; where neither jars nor magnetic influence can affect the accuracy of the readings. The galvanometer (Thomson's reflecting) is placed on a table resting on a brick foundation and is inclosed by a dark chamber having apertures for viewing the scale. The development of the new electric generator has required months of careful investigation by aid of these two instruments, and it is only after making hundreds of alterations and experiments that the improvement has been wrought.

Fig. 3 shows Mr. Edison's new electric motor intended for running sewing machines, small elevators, lathes, and other light machinery, by connecting it with the same wires that furnishes the current for the electric lamps. Its construction differs but slightly from the electric generator. The armature is arranged parallel with the magnet instead of transversely, and the magnet is formed of a single casting. In other respects it is like the generator, having the same form of armature, also commutator cylinder and brushes. The engraving represents the motor about one fourth of its real size.

Whatever may be said or thought in regard to Mr. Edison's progress in electric lighting, it cannot be denied that he has made important discoveries which must tend to cheapen the electric light generally, and when he shall have completed his electric lighting system we hope he will reap the reward merited by his untiring perseverance.

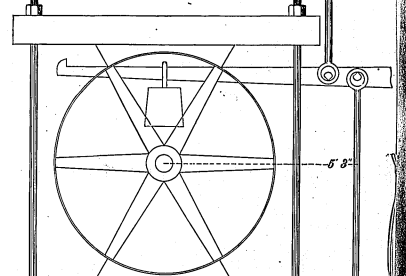
Some Engine Tests.

(*Letter Received March 2nd, 1878.*)

I enclose you the results of the tests on Engine Tests made at the St. Louis Exposition last fall, with a sketch of the dynamometer that was used. I have also made an attempt to draw isothermal lines on two of the cards given in the report, and to locate the terminal pressure as nearly as possible on the third. The outside lines on the cards *A* and *B* are mine, and the inside lines are as they appear in the report. The short line projecting from the right of card *D* was also on addition.

Three entries have been made for this test, which was made Thursday, September 12th, 1878. The three engines tested will be designated as *A*, *B* and *C*.

A was a horizontal frame, iron jacketed, slide crank, steam chest on the side of the cylinder, with variable expansion, balanced slide working on the back of the main slide on what is known as Hyde's system, the change in cutting-off being made by a right and left hand screw, changing the lap of the



Dynamometer used in the St. Louis Engine Tests.

expansion slide. The cylinder is lagged and covered, but not steam jacketed, governor acting on throttle.

B was a cylinder 10"×20" lagged and covered, but not steam jacketed, with strong horizontal frame; the main feature of the engine being an automatic or governor cut-off, consisting of an expansion slide on the back of the main slide, worked from an auxiliary center connected with the main shaft by spur gears. The change in cut-off is effected by changing the load of the expansion slide, which is done by the governor acting through a bevel sector, steam chest on the side. The remainder of the engine is of ordinary proportions. Slide crank.

C was a cylinder 13"×24", horizontal trough frame, common slide valve, steam chest on top, bent rock shaft. Cylinder covered, governor on throttle, disk crank.

The percentage numbers given by the compilers are the average of the individual tests on the different points. The testing apparatus consisted of a dynamometer shown herewith, designed by the Scientific which proved a very reliable piece of apparatus, an engine counter, a standard steam gauge, a Fahrenheit scale, a tank for weighing the feed water, and, as a small scale and three

meter for testing the dryness of the steam. A Hickard's Indicator had been provided by the committee, but upon agreement with the exhibitors a Thompson Indicator was used. The test was made three hours in duration.

Referring to the *A* card we find an average effective pressure of 23.4 lbs., a terminal of 23 lbs. corresponding to a value of 1063.3 according to Zeuner, and figuring it out according to Engineering Papers I we have a water consumption of 15.3 lbs. per I. H. P. per hour. The point of cut-off due to the terminal pressure is very nearly $\frac{1}{4}$ stroke. The clearance is assumed to be about 3 per cent., in both *A* and *B* cards, in *C* perhaps 8 or 10 would not be far off. The actual water consumption of the *A* engine, per report, was 15.5 lbs. per I. H. P. per hour. The *B* card shows a water consumption of 28 lbs., and the point of cut-off due to the terminal pressure is about $\frac{1}{3}$ stroke.

The *C* card shows 30·05 lbs. average effective pressure, 32 lbs. terminal corresponding to nearly 37 lbs. water per I. H. P. per hour. The actual consumption of this card, per re-

space of the brake, it being held in a horizontal position by the scales. The distance from the center of engine shaft to the center of scale attachment was 5′ 5″, or rather a radius corresponding to a circumference of 31 ft. The engine was started with the brake loose; and after it got up to its speed the desired load was applied by tightening the break blocks on the pulley. The resistance occasioned by the friction could thus be weighed with considerable accuracy. The question was asked a member of the committee how the power was calculated with this instrument, but the information was politely withheld. The calculation is simple and reveals itself on a second thought—the base of the calculation being that force, time and velocity equal the power, the weight shown by the scale to be considered the force and the velocity, the speed which it would travel if fixed to revolve with the shaft. For example, take an engine making 100 turns per minute and balancing 200 lbs. on the scales, which is virtually a force of 200 lbs. traveling 33 ft. every revolution of the engine, or 3,300 ft. per minute, which equals

$$\frac{33 \times 100 \times 200}{33{,}000} = 20 \text{ H. P.}$$

The object in attaching the scales 5′ 5″ from center of shaft was to facilitate the calculation in case the engine ran 90, 100, 150, etc., as in this case it is only necessary to add 1,000 by the revolutions per minute to the weight by this quotient, in the above sample it would be

$$\frac{1000}{100} + 10, \frac{200}{10} = 20 \text{ H.P.},$$

which is easily calculated without the aid of paper and pencil.

J. H. Dubbs.

Sept. 18, Cleveland, O.

---

duce current in the coils of the field magnets, and these currents are all in such a direction as to increase the already existing magnetism."

If this action is exact (and, it will be found to be strictly a corollary from the law of Lenz, and this principle may be applied to De Meritens', Alliance, Lontin's, Gramme's machines, and also to the Siemens-Hefner drum and the Siemens with the connection of the field magnets with a magnetizing armature, and still retain the increasing action and reaction which takes place in three machines as presently constructed.

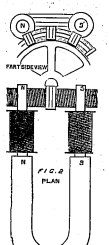


Fig. 2 shows how I apply this principle to the De Meritens machine, by attaching coils and soft iron pole-pieces to the permanent magnets; only one magnet is shown. Current will be induced in these coils by the motion of the segments on the shaft, and will be increased by the reaction upon the current from the segments. By attaching pole-pieces and coils to the permanent magnets of the Alliance machine, you can more than double its power in the same way.

I have modified the Gramme ring, and field-magnets, so that this principle may be applied to it also.

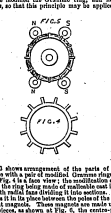


Fig. 3 shows arrangement of the parts of the machine with a pair of modified Gramme rings, of which Fig. 4 is a section. The magnets are on each side of the ring being made of malleable cast iron, and with radial fans dividing it into sections. Fig. 3 shows it in its place between the poles of the four straight magnets. These magnets are made up of three pieces, as shown at Fig. 5, the centre-piece being hard steel, the ends of soft iron. This construction is not, perhaps, indispensable, but secures a large amount of residual magnetism: the

commutator is of the same construction as the Gramme.

The action of this machine is very similar to the action of the Gramme, with this difference: the coils on the magnets are not connected to any ring or armature for magnetizing them.

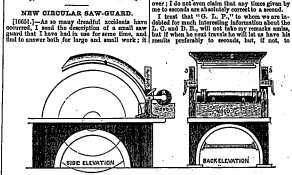
The field magnets are magnetized by the current induced in their coils by the inductive effect of the coils on the rings, as they revolve in the magnetic field of the magnets, and by the reaction on each ring and core through the coils on the magnets; and the same increasing action and reaction takes place-as in all other machines, although in the same position and not made in any machine for this purpose.

Orkney, Dec. 1. Hamlin Kennedy.

NEW CIRCULAR SAW-GUARD.

[16553.]—As so many dreadful accidents have occurred, I send the description of a small saw guard that I have had in use for some time, and find to answer both for large and small work; it

consists of a protecting frame of sheet-iron, G, hinged upon two standards SS, so as to work freely for almost any size of wood; there is a roller at bottom, R, which presses against the wood to be cut, and keeps the guard down; the guard can be safely raised up by attendant, as it is supported by cut themselves (unless removing guard); two elevations are shown in plan made smaller than working, as it would take up too much room if shown in your copy; the saw is shown in large circle than in work, for clearness; the dark-shaded parts represent cast iron. D. Tervin.



SPEED OF TRAINS.

[16552.]—In J. A.'s letter on p. 695 he has answered my letter, November 1st, p. 325, but I cannot find that I have stated in any of my letters that speeds not worked out in seconds are not trustworthy," as stated by "T. P." With the latter's views on p. 313 I am more in agreement, but in these days of competition with the speeds of two of the principal railways, it would be unwise to trust to figures alone. In writing letter on p. 291, Vol. XXVIII., supposing my doubts as to the trustworthiness of speeds *for short distances*, when the times have not been taken to seconds, I had then in my mind "if L. P.'s" timing of a train, which I had seen, was correct, as in the letter signed "G. D. P." on p. 147 of this volume he has to repeat these remarks esp. 147, but if I have wrongly ascribed to "T. P." the authorship of that letter I willingly acknowledge my error.

Now, "G. D. P." in his last letter states "that in any case it was impossible to miss more than two 'posts' in a second." In his letter on p. 291, Vol. XXVIII., he gives 2 miles run in 72 min. = 55·45 miles per hour; 2 miles run in 71 min. = 56·33 miles per hour; 2 miles run in 70 min. = 57·14 miles per hour. Between 55·45 and 57·14 miles per hour, or between 2 miles run in 72 min. and 2 miles run in 70 min., a difference of 2 minutes, or 120 seconds, might give 2 miles in 2m. 35sec., or in 2m. 55sec., or 20 seconds. Now, supposing the 2 miles were actual, and not assumed, figures, 2m. 35s. = 155 seconds, that we have 1 mile from Bromley to Shortlands run in 1 minute, a speed of 88; in this case it must be twelfth of a minute, when the possible error is not more than 1 seconds, he will become a reliable authority on the question of speeds.

My difficulty lies in not knowing the exact position of the engine when "G. D. P." and "T. P." observed that, and, consequently the ascertainment of relative the posts and of being unable to record some exceptionally fast runs. V.

G. W. R. LOCOMOTIVES.

[16553.]—I was pleased to see the letter of "T. P." on G. W. R. engines. This list, on account of its two gauges and its extensive absorption of other lines, presents a type of engine not found in any other railway on the kingdom, and although the principle of improvement has taken place in them, yet I think at present it is much behind several other companies in that respect.

The long, comparatively broad-gauge engines which run the "Flying Dutchman" belong to a past era in locomotive construction, and although they have in their favour that they working almost entirely loads—the latter a most important consideration—are locked out, they will be found greatly inferior to G. N. or Midland engines.

The only suitable cylindrical engine I know is No. 230, a six-coupled narrow-gauge goods, but I have not had an opportunity of seeing it, although arrangements can be made to which the cylindrical are placed.

Several new narrow-gauge single engines, and 70, drivers, have just been built at Swindon. These engines have not any frame, and are made entirely from 1/2.

"T. P." will find some information as to measurements of driving-wheels, &c., of G. W.

LOUTIN'S DYNAMO-ELECTRIC MACHINES.

The dynamo-electric machine recently invented by M. Louis Antoine Loutin, of Paris, is just now acquiring considerable notice in France, and chiefly because of a series of experiments lately carried out with it at the Lyons Railway station, Paris. Loutin has made some important improvements in dynamo-electric machines. In 1875, he patented in England a plan for turning the whole of the electricity produced in the revolving armature, or bobbin, of a machine into the existing electro-magnets, instead of only a portion, as had hitherto been done. This of course renders the exciting magnets very powerful in a short time, and the magnetic resistance to the rotation of the bobbin increases in a few moments to such a degree that it is almost impossible to overcome it. The circuit is then broken by an ordinary commutator, and the special circuit in which useful work is required to be done, such as the apparatus for producing arc-light, electro-plating, etc., is inserted so as to form part of the circuit. The action of the machine then becomes normal and continues so, the superabundant energy of the current being utilized in chemical decomposition. M. Loutin proposed to himself all the applications which might result from this new mode of employing the current from any sort of dynamo-electric machine, whether in the production of chemical, magnetic, heating, or lighting effects. He also proposed to use this class of machine, in which all the current is centred into the inducing electro-magnets, or, in other words, which have a single circuit, such as powerful breaks. When the

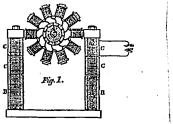


Fig. 1.

circuit is open the bobbin turns without any difficulty, but as soon as the circuit is closed by the slightest contact it exercises considerable resistance to rotation. A machine exciting 100 lamps, for example, requires but the weight of a child to turn it; when the circuit is open, but six or eight horse power will be insufficient to overcome the resistance to turning when the circuit is closed. All this effect is brought about by the simple act of making a contact. The machine itself immediately generates the magnetism necessary to produce this magnetic break-power, which may be applied in various ways.

In 1876 (Patent Nos. 386 and 3584) Loutin patented in England further improvements of magneto electric machines. One defect in machines is the great heat developed in the bobbin or bobbins, which is due to overfrequency of the induction in them. To overcome this objection Loutin multiplies the number of bobbins or parts of the revolving armature. He constructs the armature in the form of a wheel provided with a central boss and spokes of soft iron, and mounted on a shaft in which rotary motion can be imparted. This wheel is represented in Fig. 1 at A. Each soft iron spoke of the wheel has a coil or bobbin of insulated wire on it, and is, in fact, an electro-magnet, which becomes a source of induced electricity when the wheel is revolved between the poles of a fixed electro-magnet, B B, as shown in the figure. The residual magnetism of the cores of B B is sufficient at first to generate a feeble current in the bobbins when the wheel is revolved, and a portion of this current sent in one direction by a commutator is diverted in the usual manner into the electro-magnets B B, in order to intensify them so that they may in turn induce more powerful currents in the bobbins. Loutin reserves the right of employing one or several of these induction wheels on the same shaft, or coupling them opposite one or more series of electro or permanent magnets. When two wheels are fixed to the same shaft, one of them can supply currents exclusively for feeding the electro-magnets, and the currents from the other can be used for external work. When there is only one wheel on the shaft, as a portion only of the current generated is employed to feed the magnets, the remainder can be turned to other purposes. If these currents are required to be invariable in direction, a commutator or collector is used, otherwise the electricity may be collected by friction or contact clups. When commutators are used, one for each bobbin, or at most each pair of bobbins, is placed on the shaft, and to each are attached the two extremities of the wire of the bobbin or pair of bobbins corresponding. When collectors are used all the bobbins on the wheel are connected up in series so as to form a completely closed circuit. The result is that all the bobbins which are approaching a pole of the electro-magnet are inversely electrified to those entering from the same pole. A metal strip or rubber is placed opposite this pole of the electro-magnet to collect by contact the electricity generated in the bobbin at the instant that its polarity becomes reversed, a similar rubber being applied at the other pole of the electro magnet to form the second pole or electrode of the machine by which the induced current is led away. It will be seen that if the arms of the wheel are sufficiently numerous the induced current will be continuous and even in quality. Commutators are liable in powerful machines to rapid destruction by the oxidizing and volatilizing heat of the sparks emitted. M. Loutin avoids this satisfying effect a presence of air by inclosing the commutators in a bath of non-drying oil. This precaution is not necessary with small machines.

Various modifications of this machine are described by Loutin, who also points out that it can be efficiently utilized as an electric motor. Whether the wheel be placed between the poles of a permanent or an electro-magnet, if actuated by a battery or a dynamo-electric current it possesses considerable motive power

The most valuable of Loutin's improvements seems to be his plan of constructing dynamo-electric machines in such a manner that the inducing electro-magnets shall have a rotary motion, while the induced bobbins remain stationary, thus reversing the ordinary method of working. Fig. 2 is a representation of a machine of this kind. An induction wheel, A A, revolves in front of the poles of a series of electro-magnets, B B. The bobbins of the induction wheel are not fed with the currents they themselves produce in the electro-magnets by the current of a spare magneto-electric machine, but through them, and on rotation of the wheel they induce in the surrounding bobbins B B a series of currents which may be utilized without employing any collector or contact of any kind. For example, in a machine having fifty induced bobbins fixed round it could be fifty sources of electricity, which could be used either separately or combined. A special application of this plan is the production of any desired number of electric lights, and it is this form of

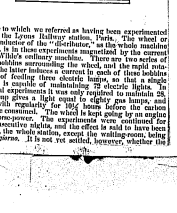


Fig. 2.

machine to which we referred as having been experimented with at the Lyons Railway station, Paris. The wheel or armature, inductor of the "distributor," as the whole machine is called, in these experiments magnetized by the current from a Wilde's ordinary machine. There are two series of twelve bobbins surrounding the wheel, and the rapid rotation of the latter induces a current in each of these bobbins capable of feeding three electric lamps, so that a single machine is capable of maintaining 72 electric lights. In the actual experiments it was only required to maintain 28. Each lamp gave a light equal to eighty gas lamps, and works with regularity for 1000 hours before the carbon wicks are consumed. The wheel is kept going by an engine of 40 horse-power. The experiments were continued for forty consecutive nights, and the effect is said to have been splendid, the whole station, except the waiting-room, being lit up *a giorno*. It is not yet settled, however, whether the Railway company will agree to the increased expenditure of this method over gas in order to secure the better light.

Another modification of this plan, similar to that described, patented in England in 1876, consists in prolonging the core of the inducing electro-magnets B B of the machine shown in Fig. 1, so that one or more additional coils of insulated wire, or bobbins, C C, can be placed upon them. These will be fed with A in this machine is turned into an inductor, by means of the currents already induced in it by the electro-magnets B B. It will be by rotation induce currents in the additional bobbins, C C, which can be led away, and utilized for the production of separate electric lights as shown, or combined together. These bobbins yield rapidly alternating currents, because the induction in them is due to the successive recession of each bobbin of the inducing wheel. This machine is, therefore, handy as yielding alternating currents from the fixed bobbins, and unvarying currents from the movable ones.

By the use of the distributor and the method last described, either separately or conjointly, currents can be taken off with either for tension or quantity, either wholly or partially, alternating or uniform, and without employing any collector for the alternating currents.—*Engineering.*

GRANDES

EXPÉRIENCES DE LUMIÈRE ÉLECTRIQUE

Faites au Mont-Valérien

La première idée de l'application de la lumière électrique à l'art militaire remonte à la guerre d'Italie en 1859.

Une Société fut formée à cette époque pour exploiter, en vue de cette application, la pile de Grenet, et l'on put voir circuler dans les rues de Paris une voiture portant une pile et une lumière électriques.

La paix de Solférino mit fin à ces expériences dont, avec les moyens alors connus de produire l'électricité, on aurait pu attendre des résultats pratiques sérieux.

En 1867, à l'Exposition universelle de Paris, l'Autriche avait envoyé une parabole métallique de grande dimension, ayant une lampe électrique à son foyer; à côté étaient exposés plusieurs dessins, montrant diverses applications qui pouvaient être faites de cet appareil à l'attaque ou à la défense des places ou à d'autres opérations militaires.

Les premières applications pratiques que nous connaissons datent de la guerre franco-allemande, du siége de Paris. On n'obtint, à cette époque, aucun résultat saillant. Cela tient, d'une part, à ce que, pendant cette opération militaire, les attaques par l'artillerie n'eurent lieu qu'à de grandes distances et à ce que les tentatives d'attaque de vive force furent extrêmement rares; d'autre part, à ce que les moyens dont on disposait pour produire la lumière et la projeter à distance étaient hors de proportion avec la portée des engins d'artillerie. Les producteurs d'électricité étaient des plus et la machine de l'Alliance (la machine de Gramme était à peine inventée); les appareils : des projecteurs, des réflecteurs paraboliques ou sphériques de petits diamètres; quelques combinaisons plus ou moins ingénieuses de lentilles, et un projecteur lenticulaire « L. Sautter, Lemonnier et Cie ».

Malheureusement, les machines du l'*Alliance*, à cause de leur poids considérable, ne se prêtent point à accompagner l'armée dans des mouvements stratégiques, et l'immobilité de leur stationnement diminua dans une proportion considérable les résultats qu'elles étaient appelées à rendre.

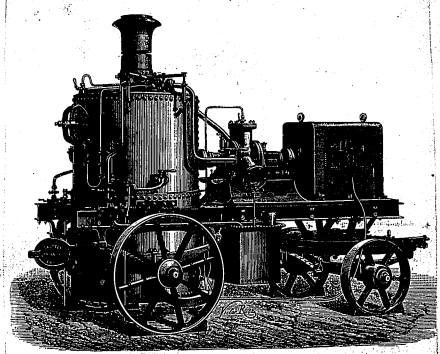
Le principal résultat de ces patriotiques efforts fut donc de démontrer qu'il était nécessaire d'avoir des appareils mobiles pouvant opérer hors de l'enceinte et la place et susceptibles d'accompagner certaines opérations. A cet effet, on étudia des piles portatives très-ingénieuses d'ailleurs, mais dont les dimensions encore encombrantes ne permettaient pas un emploi courant.

Si la lumière électrique employée dans ces conditions ne paraît pas aux assiégés d'une grande utilité, les assiégeants n'en jugèrent point ainsi, car, dès cette époque, les Allemands s'en occupèrent. En 1873, nos ennemis envoyaient à l'exposition de Vienne, dans leur section, un appareil de projection de lumière électrique approprié aux usages de la fortification ou de la côte que l'on veut éclairer.

Cet appareil, décrit en détail dans le *Mémorial de l'officier du génie*, se compose d'un miroir en verre concave-convexe, à surfaces sphériques de rayons différents. La face convexe est recouverte d'argent et est réfléchissante.

Entre le miroir et le foyer est interposée une lentille concave-convexe dont la concavité est tournée vers le foyer lumineux. Son rôle est de recueillir au profit du miroir une plus grande quantité de rayons de la source lumineuse et d'augmenter ainsi l'amplitude du champ éclairé.

Le faisceau qui sort de cet appareil, quand la lampe est au foyer de la lentille, est parfaitement limité par une circonférence presque sans pénombre.



Machine de Gramme portative, système Sautter-Lemonnier et Cie

Il n'a de divergence que celle due à la dimension de la source lumineuse, c'est-à-dire 2 degrés 1/2 environ.

Les expériences ont eu pour but d'essayer à quelle distance l'on peut éclairer soit un espace étendu, soit un espace restreint; enfin, de constater qu'on peut déterminer à l'avance pendant le jour, avec un chercheur, les points dangereux dont l'exploration nocturne offrira de l'intérêt pendant la nuit.

On est parvenu à rendre visible à 3,400 mètres le clocher de Saint-Cloud avec le plus petit des types adoptés. Avec le plus grand, on a éclairé les tours du Trocadéro dont la distance, n'est pas moindre de 7,800 mètres et les moindres détails se trouvaient visibles à merveille.

Le champ éclairé à 3,300 mètres de distance avait une largeur de 300 mètres sur laquelle on pouvait compter les fantassins envoyés à dessein dans la zone éclairée.

Tous les officiers d'artillerie présents ont hautement manifesté leur satisfaction et déclaré que la lumière électrique avait désormais sa place marquée dans les grandes opérations stratégiques de la guerre offensive aussi bien que défensive.

Cette belle et grandiose expérience aura certainement un retentissement considérable dans les armées de toutes les nations

HALLEZ D'ARROS

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about 205 degrees, the special feature of this heater with the fact that exhaust steam is not mixed with the being that the exhaust steam is not mixed with the feed-water; that the water is heated after passing through the pump, thereby getting rid of the difficulty of pumping very hot water; and that the entire whole of the heating surface over which the feed water passes can be exposed for cleaning in less than five minutes by the removal of two small covers.

The heating wires from the machines to the lights in the Reading-room are brought over the roof of the buildings to the lantern on the top of the dome, being a distance of about 200 yards, whereas the leads for the other lights are laid partly in the basement and partly in pipes underground.

EDISON'S ELECTRIC GENERATOR.

When Mr. Edison said he was about to produce a practical economical electric light for general use, the entire business world took it for granted that it was forthcoming. Gas stocks tumbled both in this country and in Europe, and the people waited for the coming light. Scientists having had experience in this direction shook their heads, but for the most part suspended judgment.

Delay on the part of Mr. Edison comforted the holders of gas stocks, and confirmed the scientists in their belief that he had undertaken not only a task of great magnitude and difficulty, but one that would require more time and means than could be controlled by most experimenters. But Mr. Edison, flushed by his scientific victories, was undaunted and determined to yield to no obstacles.

Unfortunately, however, the daily papers from time to time printed reports of progress in electric lighting, which, from their extravagance and inaccuracy, placed Mr. Edison, to say the least, in an extremely embarrassing position as regards his alleged promises and the expected fulfilment of them, besides misleading the public as to the true nature of the problem to be dealt with, resulting in a reaction of feeling prejudicial to Mr. Edison's just fame.

At present little is said by Mr. Edison concerning his electric light, excepting that he considers it an assured success, and that he is perfecting the details of his electric lighting system as rapidly as possible.

It is not our purpose just now to enter into a description of Mr. Edison's electric lighting system as a whole, but to describe his new electric generator—one of the most important factors of the system—and also to describe his new electrical motor used in driving light machinery for domestic and industrial purposes.

The new generator resembles in some respects other well known forms, but it differs from them all in several very important particulars; for instance, the field-magnets are immense, being about 54 inches high, and weighing about 1,700 lbs. The magnet cores—of wrought iron—are 6 inches in diameter, and 36 inches long; they are mounted upon heavy cast iron blocks, 10½ inches high and 9 inches wide, and are connected at the top by a wrought iron yoke, 6 inches high and 7 inches wide. The cores are wound with 3 layers of No. 10 cotton covered wire, the ends of which are connected with binding posts on the base of the machine. The two blocks upon which the cores rest, as well as the bearings of the armature, are supported by a cross-shaped brass casting.

The armature which revolves in the cylindrical space between the poles of the field-magnet is shown in section in Fig. 1. It consists of a wooden cylinder, A, mounted on a 1½-inch shaft, and having attached to its ends soft iron plates, B, between which there are several layers, 10, of No. 20 soft iron wire wound circumferentially. Outside of the iron discs, B, there are vulcanized fibre discs, C, having their peripheries notched to receive the several coils, E, of insulated wire wound lengthwise on the cylinder and connected with copper bars, F, of the commutator cylinder, G. There are 48 coils inch wires in each strand, and each strand passes lengthwise around the cylinder on diametrically opposite sides, the opposite ends of all of the wires in each strand being soldered to commutator bars on opposite sides of the commutator cylinder. There are 40 strands surrounding the armature, and the commutator cylinder is pressed on opposite sides by copper wire brushes which take off the current. The armature shaft has a 10-inch pulley with a 3-inch face, and the speed of the machine is about 700 turns per minute. Although the current from the armature may be used to excite the field-magnet, Mr. Edison finds it more economical to charge the field-magnet by means of a separate machine. In fact, he intends to charge a battery of such generators with a single Parsell engine of this form.

An important fact has been developed in the course of Mr. Edison's experiments with this generator. He finds that by connecting the ends of the field-magnet by a copper wire for a moment when the machine is at rest, the field-magnet retains almost its maximum charge, which it retains so long as the generator is in continuous operation. It requires a minute or more to fully charge the immense magnets, and when charged their influence is far reaching and powerful. The internal resistance of the armature is only ¼ ohm, and Mr. Edison claims that he realizes 90 per cent. of the power applied to this machine in effective external current. It requires but 3 horse-power to drive it, and the current generated is sufficient to make 40 lights of 16 candles each. The economy of this machine is shown by the fact that one man may turn it with sufficient rapidity to maintain the electric arc of a Jablochkoff candle.

While this generator in general principle is the same as in the best of the well-known forms, still there is an all-important difference, which is that it will convert and deliver for useful work nearly double the foot-pounds of energy that any other machine will under like conditions. It has been shown by Hopkinson that the Siemens machine, which is generally recognized as the best form yet devised, converts from the belt to the circuit 92 per cent. of the energy, but later corrections reduce this to 83 per cent.; from these results many scientists have inferred and stated that there was little margin for improvement in the generating machine. Now the energy converted is the product over the whole resistance; hence if the resistance of the machine be represented by 1, and the exterior

elements face seen saturate, et qu'alors le courant excitateur est déjà trop puissant. On pourra le réduire avec avantage en employant un plus petit nombre de bobines dans le circuit des excitatrices.

Nous voici arrivés à un résultat important qui, je l'espère, est clair pour vous tous et dont vous voudrez bien vous souvenir, à savoir que :

Une machine dynamo-électrique, avec un excitateur séparé, marchant à grande vitesse par l'action d'un moteur à vapeur ou d'un moteur à eau, à haute ou basse pression, et envoyant un faible courant par un conducteur, même assez fin, à un électro-moteur placé à distance, tournant aussi à une grande vitesse, et magnétisé par un excitateur séparé, constitue une disposition économique pour la transmission de la force à distance.

Cette phrase résume le problème de la force motrice à distance par l'électricité. M. Ayrton, passant alors à l'application, a examiné la question au point de vue d'une installation spéciale, comme à Sheffield, par exemple.

Il a montré, chiffres en main, que le profit augmenterait en proportion du nombre et de la puissance des machines.

Les autres applications de l'électricité n'ont pas été non plus oubliées par le savant professeur.

Les applications de l'électricité à l'éclairage et au chauffage ont été rapidement passées en revue. L'expérience que nous allons faire sera intéressante, et qu'elle ait ou non pleine réussite, elle aura le mérite d'être inédite.

Par exemple, avec le courant électrique qui nous est envoyé par les ateliers de MM. Walker et Hall, le pain chauffe cette fonte boîte de fer à vous, de manière qu'en le plaçant dans un vase d'eau, cette eau, comme vous pouvez le voir, est amenée très-rapidement à l'ébullition. De même, le chauffeur a mis du charbon dans le feu, rue Howard, et l'eau bout ici à Albert Hall.

La conférence de M. Ayrton s'est terminée par quelques explications sur les expériences de laboratoire électrique faites à Seemalac. Relativement à la distribution du courant électrique, l'orateur a exposé le principe des régulateurs de courants dont le but est de maintenir l'intensité constante dans un circuit donné lorsque l'on établit plusieurs dérivations sur une même source électrique.

Dans les villes où la force motrice produisant l'électricité serait fournie par des chutes d'eau, M. Ayrton veut utiliser les grandes crues pour emmagasiner le travail. Pour cela des machines dynamo-électriques seraient mises en mouvement par les eaux en excès qu'on devrait laisser perdre sans produire de travail en toute autre circonstance. Le courant de ces machines traverserait un voltamètre décomposerait de l'eau, et les gaz dégagés seraient emmagasinés à *haute pression* pour être utilisés plus tard comme force motrice ou source de chaleur, en opérant à nouveau leur combinaison.

M. Ayrton a calculé que la quantité de travail que représente un pied cube d'hydrogène à la pression de 20 atmosphères, se combinant avec un demi-pied cube d'hydrogène à la même pression, représente environ 110,000,000 de foot-pounds, soit le travail de soixante chevaux, pendant une heure, ou le travail d'un cheval pendant soixante heures.

Démontrer l'une solution aux grandes questions par le courant électrique, dit M. Ayrton, nous pouvons donc non-seulement de nous approvisionner d'énergie, mais encore de faire cet approvisionnement sous sa valeur économique.

Nous retrouvons ici, sous une forme plus scientifique et plus pratique, l'idée qui avait fait entrer la société des machines de l'Athénée, idée dont les résultats, sous leur forme primitive, furent absolument nuls.

Dans l'hypothèse de M. Ayrton, on veut seulement *emmagasiner* une force que les circonstances obligent à laisser *perdre*. A ce point de vue, la question mérite d'être étudiée.

Nous avons cherché, dans cet exposé incomplet de la remarquable lecture du savant professeur, à bien marquer les points essentiels de la grande question qu'il a agitée. Nous nous réservons d'y revenir plus tard pour en marquer les détails et en signaler les progrès.

M. Ayrton croit qu'il faut attendre au siècle prochain pour que l'idée de la distribution de la force motrice par l'électricité se réalise. Est-ce que les vingt années qui nous en séparent ne suffisent pas pour résoudre la question?... Après avoir constitué la lumière et la chaleur par le gaz, le pensée par les fils télégraphiques et les tubes pneumatiques, la parole par les conducteurs téléphoniques, ne pourrons-nous pas achever l'œuvre en distribuant l'électricité qui animera chez nous la *force motrice*, cet élément indispensable du travail. M. Ayrton a été trop observé. Le progrès marche à pas de géant et les découvertes qui se succèdent si rapidement depuis quelques années nous montrent qu'*une c'est possible*. Qui osera le premier?

E. HOSPITALIER.

Scientific American
1878

MACHINE DYNAMO-ÉLECTRIQUE
D'EDISON

Nous donnons ci-dessous, d'après le *Scientific American* du 28 octobre, d'intéressantes informations sur la machine électrique à laquelle s'est arrêté le célèbre Edison, après avoir, comme on le sait, expérimenté longtemps les meilleurs types de Siemens, Gramme, Brush, Wallace, etc.

En réalité, comme système de machine, il nous paraît incontestable, que l'inventeur du phonographe a tout simplement réalisé un composé éclectique des systèmes de Siemens et de Gramme.

La brièveté est, commeil dit d'ordinaire, des fils, identiquement celle de Siemens, mais, recelant avec raison, croyons-nous devant la difficulté mécanique du type Siemens dans le noyau magnétique un fer, il a été conduit à adopter l'excellente disposition du noyau magnétique de Gramme en fil de fer cerclé. Enfin, il a emprunté encore, aux dernières

circuit by ½ than of the total energy converted; ½ will be useful, as it is outside of the machine, and ½ lost in the resistance of the machine.

"The Siemens machine, and nearly all other machines in use, make the external resistance equal to that of the machine; hence one-half of the energy only is useful, and any attempt by these inventors to increase the exterior resistance, so as to change the distribution of energy to obtain more exterior work, results in reducing the power of the machine to convert energy. Therefore, efforts toward economy in one direction are met in the other direction by loss in the interior. Hence the so-called necessity of using a greater number of machines to convert a given amount of power.

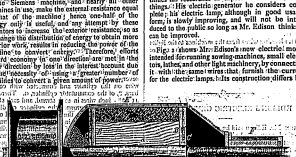

FIG. 1.

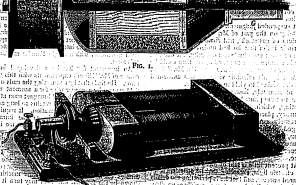

FIG. 2.

Mr. Edison's generator stores power in the form of electricity of high tension, and then converts it into that of low tension, thus delivering it to the consumer upon a circuit exterior to the machine; thus nearly the maximum economy is gained when other machinery under like conditions will scarcely give any current at all.

In dealing with the electric light problem, Mr. Edison has very properly devoted a large share of time and attention to the production of an economical generator, as it is the very foundation of the system. It bears the same relation to electric lighting that the cheap production of gas does to gas-lighting. It is as important to produce electricity cheaply as to use it economically. Mr. Edison seems equally both ends of the question, and is carrying on his experiments on a gigantic scale, encouraged by new developments, his continuous researches in expectation of still better things. His electric generator he considers complete; his electric lamp, although in good usable form, is slowly improving, and will not be introduced to the public so long as Mr. Edison thinks it can be improved.

Fig. 2 shows Mr. Edison's new electric motor intended for running sewing-machines, small elevators, lathes, and other light machinery, by connecting it with the same wires that furnish the current for the electric lamps. Its construction differs but slightly from the electric generator. The armature is arranged parallel with the magnet instead of transversely, and the magnet is formed of a single casting. In other respects it is like the generator, having the same form of armature, also commutator, cylinder, and brushes. The engraving represents the motor about one-fourth of its real size.

Whatever may be said or thought in regard to Mr. Edison's progress in electric lighting, it cannot be denied that he has made important discoveries which must tend to cheapen the electric light generally, and when he shall have completed his electric-lighting system we hope he will reap the reward merited by his untiring perseverance.

The Scientific American.

...vivante fixes aussi intensément, et qu...
trop puissant. On pourra le ré...
un plus petit nombre de bobines
Nous voici arrivés à ce no...
clair pour vous faire et dont
à savoir que :

Une machine dy...
un excitateur sépar...
vitesse par l'action...
on d'un moteur à...
pression, et transmet...
un conducteur, même...
moteur placé à dis...
à une grande vitesse...
excitateur séparé, co...
économique pour l...
force à distance.

Cette phrase résume le p...
distance par l'électricité. M. A...
tion, a examiné la question a...
spéciale, comme à Sheffield,...

Il a montré, chiffres en m...
en proportion du nombre d...

Les autres applications de...
plus oubliées par le savant p...

Les applications de l'électri...
ont été rapidement passées e...
allures clair a produit grand e...
M. Ayrton :

Par exemple, avec le courant...
tes ateliers de MM. Walker et...
bobine de fil à deux, de manière...
cette eau, comme vous pouvez le...
à Hendon. En outre, le c...
tes, rue Howard, et vous tout le...

La conférence de M. Ayrto...
cupations sur les expérience...
à Semalae. Relativement à la...
trique, l'orateur a exposé l...
courants dont le but est de...
dans un circuit donné lorsque...
et une même source électriq...

Dans les villes où la force...
serait fournie par des chutes...
les grandes crues pour emmag...
machines dynamo-électriques...
par les eaux en excès qu'on d...
duire de travail en toute autre...
machines traversant un voltam...
les gaz dégagés seraient emmag...
utilisés plus tard comme force...
en opérant à nouveau leur con...

M. Ayrton a calculé que la...
sente un pied cube d'hydrogè...
phères, se combinant avec un...

machines de Siemens le collecteur cylindrique à brosses opposées que Siemens avait lui-même emprunté à Gramme.

Edison (3) a suggéré rendu le courant d'excitation de la polarité inductrice indépendant du courant de ses lampes, ce qui, toutes choses égales d'ailleurs, a le grand avantage de rendre la force électro-motrice beaucoup plus facilement constante et d'exiger une moins grande perfection du nombre de tours de la machine.

Il y a lieu de signaler un point fort intéressant sur lequel

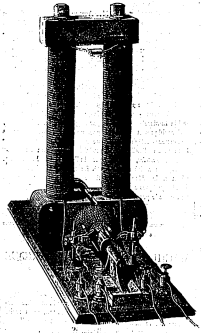

Fig. 1.

nous insisterons un peu : M. Edison a mis judicieusement en pratique le désidératum théorique que nous mettions en avant dans notre article du 15 août 1879, n° 5 de ce journal (quatre derniers paragraphes de la page 94).

Nous nous exprimons ainsi :

« ... Il n'y aura donc pas d'empêchement théorique à réaliser un fonctionnement de machine magnéto-électrique permettant de recueillir extérieurement, en chaleur régénérée, la majeure partie du travail dépensé, *le nerf électrique, par exemple*, du résultat de la transformation du travail moteur en courant.

« Sans doute, si l'on voulait appliquer une organisation de cette sorte, je suppose, à la production de la lumière avec arc voltaïque (je prends l'arc comme type des dispositifs, reconnaissant la chaleur régénérée, exposés à intliger des variations accidentelles considérables de la résistance extérieure, contact des charbons par exemple), la chose pourrait être dangereuse en ce sens que, lors d'une grande diminution de la résistance extérieure, le fil constituant la résistance intérieure de la machine serait aussitôt échauffé, pourrait même être brûlé, et cela d'autant plus sûrement que, dans la construction de la machine, on aurait mieux réuni à la rendre apte à supporter juste la circulation électrique du régime prévu, avec un minimum de poids de métal conducteur.

« *Cependant, dans les cas où la résistance extérieure totale peut être maintenue sûrement entre des limites rapprochées, il n'y aura pas lieutité à poursuivre simultanément toutes ces possibilité de maxima relatifs et spécifiques, et il est permis de supposer que ce pourra être précisément le cas pour les systèmes de production de lumière basés sur l'incandescence réalisée dans des conditions de constance suffisante des résistances exploitées.* » ...

Cette affirmation nous avait attiré quelques animadversions; or, s'il faut en croire les informations du *Scientific American*, on va voir que M. Edison vient d'atteindre en partie cet objectif, et tout le monde admettra que la réalisation matérielle est le meilleur des arguments en faveur des croyances théoriques.

Tout en rendant justice à M. Edison, le lecteur pensera sans doute, avec nous, qu'il n'y a d'ailleurs pas de raison pour que l'emploi des mêmes principes, avec les systèmes des autres bonnes machines, avec ceux des machines Gramme, par exemple, ne permette pas d'atteindre les mêmes valeurs de ce que nous avons appelé le rendement relatif thermique.

Gaud.

Lorsque M. Edison annonça qu'il allait produire une lumière électrique économique, pratique et d'un usage général, tout le monde des affaires, sans exception, accueillit cette nouvelle comme une chose certaine. Les actions du gaz baissèrent considérablement tant en Amérique qu'en Europe, et chacun attendit l'apparition de la nouvelle lumière. Les hommes de sciences, qui avaient pu apprendre par expérience ce qu'il fallait penser de cette découverte, reconnurent la vérité, mais la plupart observèrent leur jugement.

Les lecteurs de M. Edison rendirent le courage aux détenteurs de fonds de gaz en confirmant les savants dans leur croyance qu'il avait entrepris non-seulement une tâche très-grande et très-difficile mais encore une tâche qui réclamerait plus de temps et de moyens que ceux dont pouvaient disposer la plupart des expérimentateurs. Mais M. Edison, entouré par ses visiteurs scientifiques, était infatigable et résolu à ne reculer devant aucun obstacle.

Malheureusement, cependant, les journaux quotidiens imprimaient de temps à autre des détails sur les progrès de l'éclairage par l'électricité, qui, par leur extravagance et leur inexactitude, plaçaient, pour ne pas dire plus, M. Edison dans une position extrêmement embarrassante en ce qui touchait ses promesses et leur accomplissement, sans compter qu'elle égarlaient le public quant à la véritable nature du problème à résoudre; il en résultait une réaction de sentiment qui portait préjudice à la juste renommée de M. Edison.

(3) Revenant ainsi sur-disant en arrière par rapport à l'idée de la réunion des deux courants, comme Wilde, Wheatstone, Ladd, etc.

A présent, M. Edison dit : peu de chose concernant sa lumière électrique, sauf qu'il la considère comme un succès assuré, et qu'il perfectionne les détails de son système d'éclairage électrique aussi rapidement que possible.

Ce n'est pas notre intention, pour l'instant, d'entrer dans une description détaillée du système d'éclairage électrique de M. Edison, mais seulement de décrire son nouveau générateur électrique, un des facteurs les plus importants du système, ainsi que son nouveau moteur électrique qui sert à mettre en mouvement de petites machines pour les usages domestiques et industriels.

Le nouveau générateur (fig. 2) rappelle, sous quelques rapports, d'autres machines bien connues, mais il diffère de celles-ci sous plusieurs rapports très-importants; par exemple les aimants de champ sont immenses; ils ont environ 3½ pouces de hauteur et pèsent environ 1,100 livres. Les noyaux d'aimant ont 6 pouces de diamètre et 36 pouces de longueur; ils sont munis sur de bonnes bases en fer fondu, de 10 3/4 pouces de hauteur sur 9 pouces de largeur, et sont reliés au sommet par une culasse en fer de 6 pouces de hauteur sur 7 de largeur. Les noyaux sont entourés de trois couches d'un fil métallique n° 10 couvert de coton; dont les bouts sont mis en communication avec des barres d'attache sur la base de la machine.

Les deux blocs polaires ainsi que les supports de la bobine reposent sur une plaque en laiton en forme de croix.

La bobine-armature qui tourne dans l'espace cylindrique compris

Fig. 2.

entre les pôles de l'inducteur est représentée dans la figure 2. Elle consiste en un cylindre creux A, monté sur un axe de 1 1/2 pouce, et ayant, attachées à son extrémité, des plaques de fer doux B, entre lesquelles se trouvent plusieurs couches D, d'un enroulement de fil métallique de fer doux n° 20. A l'extérieur des disques en fer B, il y a des disques volcanisés C, qui ont leurs périphéries entaillées afin de recevoir les diverses bobines E, de fil métallique isolé enroulé dans le sens de la longueur sur le cylindre et reliées à des barres de cuivre F de système commutateur G.

Il y a 42 fils de $\frac{22}{100}$ de pouce dans chaque tours de spires, et chaque tours fait longitudinalement et diamétralement le tour du cylindre. Les bouts opposés de tous les fils métalliques des tournes sont soudés à des barres métalliques aussi nombreuses aux sections opposées du cylindre commutateur; ces sections sont au nombre de 40, et des brunes, opposées, en fil de cuivre, y recueillent le courant. L'axe de la bobine porte une poulie de 20 pouces de diamètre et de 3 pouces de largeur, la vitesse de la machine est d'environ 800 tours par minute. Bien que le courant provenant de la bobine puisse être employé pour exciter l'aimant, M. Edison trouve plus économique de charger l'aimant à l'aide d'une machine séparée; en fait, il se propose de charger une batterie de ces générateurs avec une seule machine.

Un fait important à dit occuper dans le cours des expériences de M. Edison avec ce générateur. Il a trouvé qu'en reliant les bouts de l'aimant à l'aide d'un fil en cuivre, pendant un moment, lorsque la machine est mise en mouvement, l'aimant atteint bientôt sa charge maxima, qu'il conserve aussi longtemps que le générateur est en fonction. Il faut une minute ou davantage pour charger complétement les immenses aimants, et lorsqu'ils sont chargés leur influence d'aimantation est puissante. La résistance intérieure de la bobine n'est que de $\frac{1}{100}$ ohm, et M. Edison prétend qu'il réalise 90 pour 100 de puissance, soit en appliquant à cette machine, un courant extérieur efficoll. Il ne faut qu'une force de 5 chevaux pour la mettre en mouvement, et le courant produit est suffisant pour produire 40 lumières de 160 candles chacune. On jugera de l'économie de cette machine par ce fait qu'on sait fournir pour la tourner avec une rapidité suffisante pour maintenir l'arc électrique d'une bougie Jablochkoff.

Bien que ce générateur, en principe général, soit analogue aux meilleures connus, il présente cependant une différence très-importante : c'est qu'il peut convertir et livrer, pour un travail utile, près du double des livres-pieds d'énergie que fournirait toute autre machine dans des conditions semblables. Ilquilconque a montré que la machine Siemens, qui est généralement reconnue comme étant la meilleure que l'on ait encore imaginée, convertit, en tout, déjà la bobine jusqu'aux circuit extérieur, 92 p. 100 de l'énergie, mais les dernières corrections réduisent ce chiffre à 85 p. 100. D'après ces résultats, plusieurs savants ont déclaré qu'il n'y avait guère de différence entre les pôles de l'inducteur est représentée dans la figure 2. Elle consiste en un cylindre creux A, monté sur un axe de 1 1/2 pouce, et ayant, attachées à son extrémité, des plaques de fer doux B, entre lesquelles se trouvent plusieurs couches D, d'un enroulement de fil métallique de fer doux n° 20. A l'extérieur des disques en fer B, il y a des disques volcanisés C, qui ont leurs périphéries entaillées afin de recevoir les diverses bobines E, de fil métallique isolé enroulé dans le sens de la longueur sur le cylindre et reliées à des barres de cuivre F de système commutateur G.

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La machine Siemens, et presque toutes les machines en usage, rendent la résistance extérieure égale à celle de la machine; il est clair qu'une moitié seulement, $\frac{1}{2}$, de l'énergie est utile, et que toute tentative faite par ces inventeurs pour augmenter la résistance extérieure, de manière à changer la répartition d'énergie pour obtenir plus de travail extérieur, ne fait que réduire la puissance totale de transmission d'énergie que possède la machine; les efforts qui tendent à l'économie sont ainsi directement contrebalancés par ceux qui tendent à l'économie sont contrebalancés par ceux qui tendent à l'économie pour faire diriger par suite de la nécessité qui élimine perte dans l'autre direction par suite de la nécessité qui élimine perte dans l'emploi un plus grand nombre de machines pour produire plus d'énergie au plus grand nombre de machines pour produire plus d'énergie au même prix de puissance donnée.

Dans le générateur Edison, la résistance est une puissance de 5 chevaux est employée sur une résistance de 5 ohms, dont 1/2 ohm est dans la machine, livrant ainsi $\frac{10}{11}$ du courant total sur un circuit exté-

Dans le générateur Edison, la résistance est une puissance de 5 chevaux est employée sur une résistance de 5 ohms, dont 1/2 ohm est dans la machine, livrant ainsi $\frac{10}{11}$ du courant total sur un circuit extérieur à la machine; l'économie la plus grande maxima est ainsi atteinte par rapport d'autres machines, dans des conditions semblables, donnerait à peine quelque courant.

Un correspant du problème de la lumière électrique, M. Edison a consacré une grande partie de son temps et de son attention à la production d'un générateur économique, attendu qu'il y voit la base même du système. C'est, pour l'éclairage électrique, ce que représente dans l'éclairage au gaz, la production à bon marché du gaz. Il est aussi important d'engendrer l'électricité à bon marché qu'il l'est de l'employer économiquement. M. Edison aborde carrément les deux termes de la question; il poursuit ses expériences sur une échelle gigantesque, et, encouragé par de nouveaux progrès, il continue ses recherches dans l'attente de résultats encore meilleurs.

Il considère son générateur électrique comme étant complet; la lampe électrique, bien qu'elle soit déjà propre à un bon usage est perfectionnée lentement et ce sera peu présentée au public tant que M. Edison croira qu'elle peut être perfectionnée davantage.

A l'atelier de Menlo Park, la puissance motrice est prise sur une machine à vapeur de 80 chevaux, et l'on mesure dynamométriquement le travail mécanique consommé par les machines électriques en essai.

Le dynamomètre employé pour la mesure du courant est une invention du professeur J. W. Trowbridge. M. Edison l'a cependant perfectionné et adapté à ses propres usages. Comme il n'y a ni fer ni aimants dans l'appareil, on peut s'en servir dans le voisinage du générateur sans qu'il soit influencé par ses aimants.

Le courant électrique traverse deux grandes spirales de ruban de cuivre, et aussi une plus petite spirale intermédiaire dont la suspension bifilaire le maintient à angle droit des grandes spirales lorsqu'aucun courant ne passe. La petite spirale porte un miroir, et les lecteurs sont faites sur une échelle éloignée par l'observation d'un point lumineux.

Le circuit est complété à travers la plus petite spirale au moyen de coupes de mercure maintenues fraîches à l'aide d'eau qui coule à travers leurs parois creuses.

Les essais galvanométriques se font dans un bâtiment spécial à cabri de toutes les influences qui pourraient affecter l'exactitude des lectures. Le galvanomètre réflecteur de Thomson est placé sur une table qui repose sur des fondations en brique, et est renfermé dans une chambre obscure qui a des ouvertures pour que l'on puisse voir l'échelle.

Le perfectionnement de ce nouveau générateur électrique a exigé des mois d'attentive investigation au moyen de ces deux instruments, et ce n'est qu'après avoir fait des centaines de changements et d'expériences que le type de l'appareil a été arrêté.

M. Edison a aussi établi un nouveau moteur électrique destiné à faire marcher des machines à coudre, de petits élévateurs, des tours et autres légers mécanismes, en le reliant avec le même fil conducteur qui fournit le courant pour les lampes électriques. Sa construction ne diffère guère de celle du générateur électrique. L'armature est disposée parallèlement à l'aimant au lieu de l'être transversalement.

Quoi que l'on puisse dire ou penser au sujet des progrès de M. Edison dans la question de l'éclairage électrique, on ne saurait nier qu'il ait fait d'importantes découvertes qui tendront à rendre la lumière électrique meilleur marché d'une manière générale; et, lorsqu'il aura complété son système d'éclairage par l'électricité, nous espérons qu'il recueillera la récompense due à sa persévérance (1).

(D'après le *Scientific American.*)

(1) Il est bien entendu que nous laissons toute responsabilité, comme il convient, au journal américain, pour ses informations qui nous reproduisons.

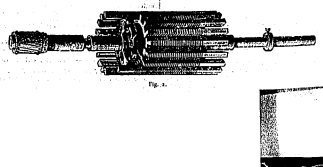


Fig. 2.

MACHINE DYNAMO-ÉLECTRIQU

DE M. WESTON

Ceux qui ont visité avec soin l'exposition de 1878 o
évidemment remarqué la petite machine dynamo-électriq
de M. Weston qui, dans la section américaine, était appliqu
à la galvanoplastie et semblait fournir des effets considérable
eu égard à ses petites dimensions. Cette machine, tourné
en raison de sa fermeture hermétique, n'avait pu être ex
prise du public intelligent, et je dois même dire que je n
pu obtenir aucun renseignement sur sa disposition intérieu
Ceux qui la faisaient fonctionner n'étaient sans doute p
plus au courant que ceux qui la voyaient, car on avait be
leur demander sur quel principe elle était fondée, on ne

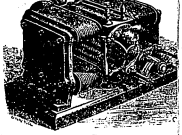


Fig. 1.

pendait qu'en montrant l'étincelle qu'elle pouvait produire
une lame de cuivre; en un mot on n'en savait pas plus
ceux qui regardent la figure qui accompagne à la huitième p
de nos annonces. Heureusement le journal *l'Iron*, du 27 s
tembre dernier, nous a enfin donné quelques détails sur c
machine, qui ne paraît être qu'une dérivation de celle de Lon
et dont nous donnons ci-dessous la représentation.

Effectivement, dans cette machine, l'organe d'induction
les Anglais appellent l'*armature*, est un véritable pignon d'
grenage en fer doux (voir fig. 2) dont les dents sont entour
des hélices isolées et sont assez éloignées les unes des au
pour laisser passer à un courant d'air qui, venant du centre
pignon, se répand dans les diverses parties de la machine p

THE SIEMENS DYNAMO-ELECTRIC MACHINE.

TO THE EDITOR OF THE SCIENTIFIC AMERICAN:

SIR,—Referring to your article on my brother, Siemens' dynamo-electric machine, and also to the method of winding the armature, the principle of winding is the same as the ring armature as a modification of the Gramme ring. The principle is best explained by the

diagrams. Fig. 1 is a transverse section of the Gramme ring. Now, instead of winding the wire through the ring wise, it seems the ring. Fig. 2, and make the commutator connections in the same way as they are made in the Siemens armature. In the Siemens armature

JOHN HENRY KNIGHT.

Wychcourt House, Farnham, Feb. 19, 1859.

DEPREZ'S ELECTRO-MAGNETIC ENGINE.

BY THE COMTE DE MONTGOMERY.

ACCORDING to Comte de Moncel (writing in *Le Lumière Electrique*), M. Marcel Deprez has succeeded in solving the problem of making an electro-magnetic motor capable of doing useful work in many industrial applications. We venture to say that the machine in question can compete with even a water-motor of 3 horse-power, and that without calling of gas and steam-engines into requisition. In Dr. Marcel Deprez's apparatus is hardly 6lb. long, by less than 6in. in breadth; it weighs about 25lb., and can supply a power of nearly 3 foot-pounds per second with five Bunsen elements. The cost of working it would be an extraordinary item, and has hitherto scarcely have been anticipated a few years ago. The electro-magnetic lines serving may be with perfect ease be worked by electricity without any cumbrous apparatus. The ingenious system contained a horseshoe magnet of eight plates 60in. in length, between the poles of which revolves the Siemens armature, a ring of soft iron with magnet over a length of 70in., fifty to the inch, and of 0·7 millimetre in thickness. The rotating magnets or electro-magnets are not alike; wise than by their polar extremities; and all the engine circles (circles) have been arranged on this principle; but M. Marcel Deprez thinking that the maximum machines the whole of the magnetism that the maximum magnet was not utilised, reasoned to extend the magnetic field, and consequently the effect performed by the magnetic power, by adding multiple-system to be fashioned; that is to say, in his present case, the armature of the magnet acted up to the neutral line. The electro-magnetic armature, instead of being placed transversely to

THE EDISON ELECTRICAL GENERATOR.

To the Editor of the Scientific American:

Your issue of November 15 contains a letter from Mr. Edison accompanied by a reply to the strictures contained in mine the 1st December.

I feel confident that so far as the opinion of thoughtful electricians is concerned, I might leave the matter as it is, and stands without detriment to my reputation; but I am not willing the general public should suppose I acquiesce in the statements made by Mr. Upton, or that my views are, in any great degree, modified by anything he advances.

Mr. Upton says I have "confounded the obtaining of a maximum current with the obtaining of a maximum of economical efficiency." Now I submit I have done no such thing. In my letter I have assumed that in dynamo-electric machines the electromotive force is a function of the external resistance, and decreases as the external resistance increases.

The article on page 240 says nothing about the electromotive force being constant. Mr. Upton, it is true, does say that this is the case with Mr. Edison's machine; but this is a mere assertion, the truth of which I do not only not concede, but positively deny.

I do not lose sight of the statements on page 242, that "although at most times the armature may be used to excite the field magnet, Mr. Edison finds it more economical to charge the field magnet by means of a separate machine." Then follows an intimation that such is his intention in the future.

Mr. Upton says, "according to the reasoning in the letter in question," it would be "mathematically absurd to connect a battery with a resistance often times greater than itself," and it undoubtedly would be if, as was beyond all question claimed on page 242, that *simply by so doing it necessarily rendered that battery four times as efficient as any other battery*, or if the electromotive force of the battery was a function of the external resistance, and decreased as the external resistance increased.

I now propose to re-examine some of the statements on page 242. I quote first: "The internal resistance of the armature is only ½ ohm, and Mr. Edison claims that he realizes 80 per cent of the power applied to this machine in effective external current." Second: "Now the energy converted is distributed over the whole resistance; hence, if the resistance of the machine be represented by 1, and the exterior circuit by 5, then of the total energy converted, 0·9 will be useful, as it is outside of the machine, and 0·1 lost in the resistance of the machine." Now, Mr. Upton, claiming for Mr. Edison's machine constant electromotive force, fully indorses both of the above statements, which I again pronounce mathematically absurd, and again assert that the statement, if true, proves beyond all doubt that Mr. Edison has discovered perpetual motion. For Mr. Edison and Mr. Upton both distinctly communicate the assertion that 0·9 of the power applied is available in effective external current, and concede that 0·1 is lost in the resistance of the machine. Consequently there is no escape from the conclusion that no power is required to overcome the inertia of the mass of metal comprising the armature, nor the friction of the journals, none is lost in the production of counts which are not available in the working circuit, and none in the production of spark and heat at the commutator, etc. etc. In other words, you have only to start the machine and it will continue to revolve for ever, and perpetual motion is accomplished fact.

Now if, as Mr. Upton leaves us to infer, the electromotive force is constant and independent of the resistance of the external circuit; there is no exception the conclusion that power has to be applied to move the field magnet, and in the absence of any information other than is afforded by Mr. Edison and Mr. Upton, we are obliged to assume that this power is supplied by a machine which furnishes the current for this purposes and *runs itself*. Perpetual motion is more than possible.

The question to be considered is: Is it true that a machine, in which the resistance of the armature circuit is only ½ ohm and the external resistance 5 ohms, *necessarily* more efficient than a machine in which the resistance of the internal and external circuit must be equal in order to obtain the maximum efficiency? I answer, no; Mr. Upton says yes, and introduces the expression $E^2(r+1)^{-2}$ R to prove his assertion and the efficiency of Mr. Edison's machine. It proves nothing.

It is true that Mr. Upton's statement differs materially from anything first stated, in that it takes into consideration the electromotive force as an element of efficiency. But what does it prove? Nothing more than was proven years ago by Jacobi and Favre, and the reference to a recent number of *La Lumière Electrique* is not the best that can be made.

There have been numerous machines built in which the resistance of the armature of the working circuit was only a fraction of that of Mr. Edison's machine, and the difference between the internal and external circuit much greater. One instance out of many may suffice.

Professor Trowbridge, of Harvard University, made tests of three well known machines, the results of which are published in the Philosophical Magazine for March, 1870. The results obtained are given in the following table:

Wilde Machine (Large Size).						
Resistance Of Circuit in ohms.	Current, per sec.	Speed of Engine per min.	Metre-grammes exerted per sec.	Equiv. of Current in grain's per sec	Eff. Resist.	Efficiency.
0·081	69·33	548	356,056	893,486	42·7	
0·181	57·35	548	294,512	739,000	52·7	
0·281	49·00	548	251,657	631,500	62·7	
0·607	30·25	539	155,125	389,366	71·1	
1·107	20·00	539	102,640	257,600	79·1	
1·607	14·50	539	74,420	186,800	86·1	
1·911	30·43	531	142,992	359,017	90·5	
2·411	24·00	531	112,811	283,200	93·5	
3·589	17·31	536	83,796	210,333	97·9	
4·589	13·64	536	65,975	165,600	98·9	
Gramme Machine (Large Size).						
0·675	96·0	472	580,745	809,416	40·3	
0·769	73·0	468	554,356	416,911	42·7	
0·781	71·0	466	544,387	409,377	54·9	
Siemens Machine (Large Size).						
0·273	72·4	364	281,326	670,264	19·0	
1·023	69·0	292·5	257,852	625,000	59·5	
1·273	60·0	292·5	223,452	542,000	69·5	

The resistance of the Gramme armature is 0·129 ohm; the resistance of the magnet, 0·213 ohm. The total resistance is therefore 0·341 ohm.

The total resistance of the Siemens machine is 0·281 ohm.

The Wilde machine differs essentially from the other two, the magnets not being included in the working circuit. The armature has two circuits, the one for exciting the magnet, and the other for working circuit. The resistance of the armature coils of the working circuit is 0·074 ohm. The resistance of the coils of the armature for exciting the magnets is 0·451 ohm. The coils of the field magnet have a resistance of 2·85 ohms.

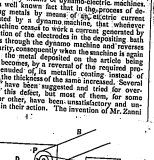
In this machine the resistance of the coils of armature of the working circuit was about one-fifth the internal resistance of the Gramme machine, and the ratio of the resistance of the internal to the external circuit, when the maximum efficiency was obtained, was not far from that given by Mr. Edison *for his generator* on page 242. Yet the efficiency was much less than the Gramme, in which the internal and external resistances were about equal when the maximum efficiency was obtained. It is therefore evident that there is something more than the matter of resistance to be considered in the building of dynamo-electric machines.

Mr. Upton also gives two examples of the performance of Mr. Edison's machine, but they neither prove the efficiency of the machine as a generator nor as compared with other machines.

The only proof of the efficiency of a machine is the ratio of the work done in the external circuit to the force power expended in driving the machine, and, other things being equal, it may

ZANNI'S PATENT MAGNETIC CUT OFF FOR DYNAMO-ELECTRIC MACHINES.

The object of this invention is to prevent a reversal of the polarity of the electricity employed in the process of the electro-deposition of metals, and it is a well known fact that in the process of depositing metals by means of the electric current generated by a dynamo machine, that whenever the machine ceases to work a current generated by the action of the electrodes in the depositing bath returns through the dynamo machine and reverses its polarity, consequently when the machine is again started the metal deposited on the article is being eaten, dissolved, or in a reversal of the requisite process, denuded of its metallic coating instead of having the thickness of the same increased. Several devices have been suggested and tried to overcome this defect, but most of them, for some cause or other, have been unsatisfactory, and uncertain in their action. The invention of Mr. Zanni



for effecting the object in view has been tested and proved to be thoroughly reliable in its action, and is therefore a very useful addition to the electroplater's plant.

The principle of the invention is shown by the fig.

B is the dynamo machine driven by the band *n*, which is connected with the source of power. On the same axle to which the driving pulley, *n*, of the machine is fixed, is also attached another pulley, *b*, which drives by means of a band, *b*, and pulley, *b'*, a small magneto machine, *c*; the circuit of this machine is closed through the electro-magnet, *m*. The armature, *i*, of the electro-magnet normally rests against the insulated stop, *i'*; but when the magnet is excited it is attracted against the stop, *i'*, thus completing the circuit of the wires, *m' m'*, which lead to the depositing bath through the wires, *n' n'*.

The action of the apparatus is almost self-evident: when the machine is at rest the circuit of *m' m'* is open, but when the dynamo machine, *b*, is rotated and with it the magneto machine, *c*, the current from the latter at once excites the electro-magnet, *m*, and attracts the tongue, *i*, against the stop, *i'*, thus closing the circuit of *m' m'*, the current then passing from the tongue, *i*, this back against the stop, *i'* thus opening the circuit and sending the current of the current from the depositing bath through the machine, *b*.

In the article on Zanni's in the *Journal* for December 15th, 1859, in a notice of Mr. Dingler's book on electric plating, we expressed our surprise that a simple form of chemical had not been adopted on electro-plating apparatus for the purpose of regulating the strength of the current. In the process of Mr. Zanni's we find that this has been suggested and patented by him together with the use of galvanometer in the circuit, by which the current strength could be seen.

Although fully recognising the efficiency of Mr. Zanni's "magnetic" cut off, we think the machine is not the same end could be effected in a simpler manner by working the electro-magnet, *m*, by a "direct" circuit from the machine *b*, the resistance of the electro-magnet being sufficiently high to avoid a drawing off more of the current than is actually required to excite the electro-magnet. The amount of current required to excite it, it is evident, would be but an infinitesimally small portion of the total current, and would therefore in no way diminish the efficiency of the machine.

Dynamo-Electric Machines in Telegraphy.

The Western Union Telegraph Company is announced to have lately taken their first steps to dispense with batteries in their telegraphic system, and extensive chemical factories which have hitherto been universally dependent on supply of them dynamo-electric machines driven by steam. And the facility in place of effecting this change is said to have been recognised, and have been found hardly at work upon it, no difficulty being anticipated, and have been indifferent success up to the present time. But, as it appears, with many

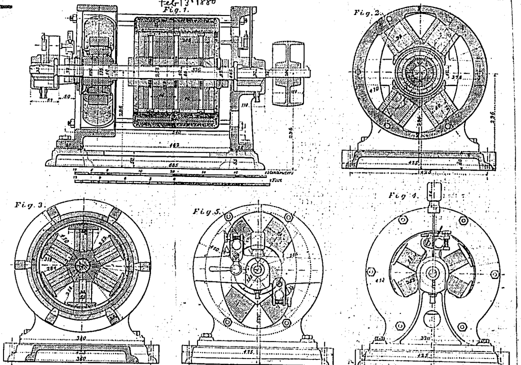
The importance of this innovation about being adopted by the Western Union Company will be seen from the following statistics. The profits of the following year cost of $6,923,055. In 1870, the company sent 14,450,823 messages, at a rates, to 24,079,106, and the cost had fallen to $6,160,250. By reason largely of improvements in the construction of batteries and of telegraphic apparatus, it cost $1,117, in 1870 the cost of battery per mile of wire had fallen to $0·36. By the introduction of the new style of wire and fallen to the batteries, and supplying the electric currents from dynamo-electric machines, it is confidently believed that the cost of working will be considerably surpassed by, from present indications, at least 50 per cent. We do not wish to be understood as implying that the public will be benefited in the least by any reduction of rate or of any of the improvements, past or present, by the adoption of that has hitherto been introduced by the Western Union Company, either the country; for the only thing that will bring this about will be the competition of a rival company strong enough to hold its own against the other; but the improvements are in a scientific and practical interest, that makes it out of the mouth of such considerations, inasmuch as it promises to work a thorough and speedy revolution in the economies of telegraphic the world over. On the account, a few words relative to the improvement itself will be of interest.

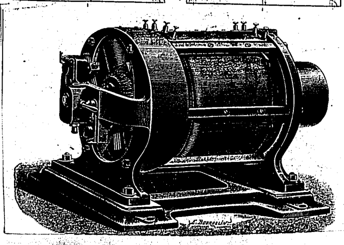
The efforts likewise made to supply electric current for telegraphic purposes, by using electric machines, were all alike in that they all sought to accomplish the object by using a single machine at high tension, and on this account they are believed to have failed of success. The new system, said to have been adopted by the Western Union Company, after a thorough test of its merits in San Francisco by Western Union Company, after the company in that city, consists of "a number of battery-rooms of connected in series, and having their field magnets excited by a current furnished by a single Siemens dynamo-electric machine, excited by a current

For the explanation of the details of the system in question, we must refer our readers to the columns of the technical journals. Three sets of these machines and engines are at present in use in the batteries of the Western Union Company, and have given much satisfaction; and a set of fifteen more are now constructing to entirely take the place of the batteries hereto in use in that company. What this means will appear from the statement that there are now on the top floor of the Western Union building, 14,000 gravity batteries, and 4000 bichromate elements, and in an adjoining building 4000 bichromate elements, all of which will, in a short time, be removed by steam, relieving the battery-rooms

THE GRAMME COMBINED EXCITING AND DIVIDING MACHINE FOR THE ELECTRIC LIGHT.

Engineering Feb 13 1880 (For Description, see Page 136.)





GRAMME'S COMBINED DYNAMO-ELECTRIC MACHINE.

We reproduce, from our contemporary, *La Revue Industrielle*, illustrations of a new form of dynamo-electric machine which has been recently introduced by M. Gramme. The machine differs considerably from the Gramme machine brought out in 1878, both in the greater amount of light it is capable of producing per horse power and in its lower first cost.

By reference to the engravings it will be seen that the arrangement of the machine is as follows: On a cast-iron foundation are fixed two plates of the same metal almost circular connected together by six square bolts and provided with bearings for the main shaft. One of these plates is furnished on the inner side with a circular rib on which are mounted the electro-magnets of the exciting apparatus. As in the earlier models the coil for the alternating currents rests on the square bolts connecting the end plates with packing pieces of hard wood. The six movable electro-magnets are fixed radially around a hexagonal sleeve which is bolted to the shaft. The armatures are held by the same screw as shown in the longitudinal section. The shaft carries on one side the small exciting coil, and on the other the induction coil. The bearings are wide, and in the larger machines a system of automatic lubrication is employed.

An arm carrying a wire brush shown in the section, Fig. 1, serves to place in communication the coils of the moving electro-magnets with the exciting circuit. The current is collected and transmitted by small brushes of silvered copper wire. The brushes are moved by means of a small endless screw. For regulating the power of the machine a copper wire, the length of which can be varied at will, is introduced between the excitor and the electro-magnets. The method of coiling the wire differs slightly from that adopted in the other machines, as instead of winding one wire two are coiled, in order to obtain by this mode of coupling tension currents for small lights, or quantity currents for large ones. Two types of this machine are now manufactured. The smaller weighs 616 lb. and supplies 12 candles of from 20 to 30 Carcel burners, or 8 candles of from 40 to 50 burners. The larger machine weighs 990 lb., and furnishes power of 24 candles of 20 to 30 burners, or 16 of 40 to 50. The following Table contains the results of some recent experiments:

Number of Revolutions per Minute.	Horse Power Expended.	Number of Lamps.	Power of each Light in Carcel Burners.
1400	5	12	28.5
1425	6	8	43.0
1200	4	6	48.5
1000	13	16	48.0
1020	13	16	51.5
1200	14	24	31.0

With a machine especially arranged for small lights, there have been obtained with a speed of 1250 revolutions 14 lights of 20 Carcel burners each, with an expenditure of power of 4.66 horse power. The candles employed had carbons 3 mm. (.12 in.) in diameter. In all the experiments made a much steadier light was obtained than that given by the machines employing an independent excitor.

A recent application of this machine has been made on board the Cosmos, a ship recently built by Messrs. A. J. Inglis and Co., of Glasgow and Greenock, for the Messageries Fluviales à Vapor in South America for running on the Rivers Plate and Uruguay. The machine employed is capable of producing 8 small or 12 large lights, and running at a speed of 1500 revolutions per minute maintains 8 lights of 50 Carcel power each, with an expenditure of 6 horse power. The lights are distributed as follows: Three in the upper saloon, three in the lower saloon, one on the landing of the stairway leading from the upper to the lower saloon, and one over the gangway. The machine, which is fixed on deck amidships and under the paddle-wheel shaft, is driven by a vertical engine with a cylinder 4½ in. in diameter and 4½ in. stroke. The experience obtained at the trial of this light was in every way satisfactory.

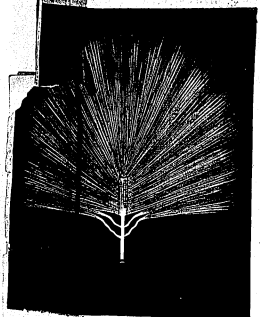


FIG. 363.—Electric Brush.

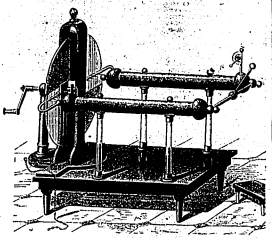


FIG. 370.—Rawsden's Electrical Machine.

FIG. 375.—Volta's Pistol.

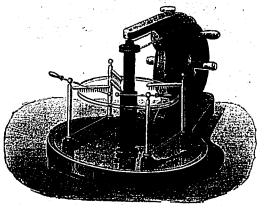


FIG. 337.—Holtz's Machine with Horizontal Plat e.

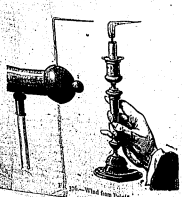


FIG. 376.—Wind-fan Plate.

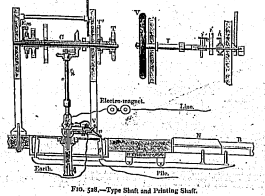


FIG. 538.—Type Shaft and Printing Shaft.

of the electro-magnet. When no current is passing, the influence of the steel renders these cores temporary magnets, and enables them to hold the moveable armature, A, against the force of an opposing spring. The current is in such a direction that tends to reverse the magnetism induced by the steel. It is not necessary, however, that it should be strong enough to produce an actual reversal, but merely that it should weaken the initial magnetism of the cores sufficiently to enable the opposing spring to overpower them. This is one of those cases in which a "balance" is apparent, and is a matter of interest and satisfaction.

The reciting-shaft consists of two portions, one of which (fig. 538), carries the fly-wheel, V, and turns uniformly under the action of the clock movement; the other which is next in front of the machine, remains at rest when no current is passing; but when the armature of the magnet rises, the two parts of the shaft become locked together by means of ratchet-wheel and click (not shown).

ENGLISH MECHANIC AND WORLD OF SCIENCE: No. 872.

Dec. 30, 1881.

NOTES ON THE PROPERTIES OF DYNAMO-ELECTRIC MACHINES.

By Prof. ELIHU THOMSON.

THE subject of the properties of dynamo-electric machines attracts, at present, considerable interest. Perhaps, therefore, the following observations may be of interest as exhibiting some unusual traits of their behaviour. The machines with which the experiments were made were of my own construction, and had an armature of spherical outline and two bipolar inductor magnet poles, constituting two nearly hemispherical cavities surrounding the armature. The field coils are two in number and surround the field cores and electro armature itself. The armature has three coils only wound upon it, and the commutator, three insulated segments of a ring, the slots between the segments subtending an angle of 60°. Each of the segment covers over 120° of the circle of the ring of the commutator. A full description of this machine and its performances is in preparation. The machine experimented with could sustain from four to six ten lights in series, at about 800 revolutions per minute.

The first experiments to be described illustrate the tendency of the machine to produce, as a motor, in reversing the current of the machine, and then suddenly stopped and immediately thereafter its circuit opened, when there appeared a small but distinct spark at the break. Other evidences of the circulation of current were obtained immediately after the complete stoppage of rotation. A smart shock could be felt by grasping the wires on each side of the break in the circuit at the time it was made.

The origin of this after-current or current after stoppage of the machine is, of course, the great, the gradual loss of magnetism of the field-magnet cores, which induces a current in the enclosing wire during the time that such magnetic change is taking place. The direction of the current induced is, therefore, the same as that which the machine would send if driven as a motor. The current, of course, endures only until the machine magnets have lost all current what is known as their residual or permanent magnetism.

A more curious effect, however, is produced by pulling the same machine, with its bearings perfectly free and well oiled, upon closed circuit and then reversing it as before at a moderate speed. The momentum acquired by the armature will be quickly thrown off its driving belt. The armature of the machine in this case rapidly comes to rest and then, singularly, takes about 1 of a turn in the opposite direction.

I have repeatedly verified this result, but cannot know whether it would be obtained with other dynamo-electric machines. The armature must be very light and free. Here, again, the contrary current not only stops the machine but reacts upon it so as to work it for a moment as a motor in the contrary direction—just as if a current had been applied from a source outside the machine. What, then, is the source of this current which is able to work the machine against friction? Clearly, it is the battery of current generated by and continued during the loss of magnetism of the field-magnets of the machine, and this current is, of course, in the same direction as when the machine was received by the applied power.

Another observation made with these machines was as follows:

A single machine driven by power was connected in two circuits in multiple arc, so as to drive them as motors; but these latter, although relatively nearly alike in properties, were of different sizes—the electromotive force of one being double that of the other, as in the experiments of Sprague. The smaller could maintain four, and the larger eight lights in series, the character of the arcs being alike. When joined up to the first machine as generator in parallel circuit as above indicated, both the other machines acted as motors and revolved. The speeds which they acquired, while not performing work, were nearly equal, and the speed at which they found is by approximately in the inverse *ratio of their electromotive forces in generators when driven at an equal speed.* This observation was repeated with other sizes, with results very nearly agreeing with the above statement. It would seem from the above that both machines, working as motors without load, adjusted their speeds of rotation so that the counter-electromotive forces developed by them are nearly equal and the current traversing each of them also nearly equal. The different electrical resistances of the two machines is no doubt a modifying influence; but it seems to have little effect and, in fact, appears to be in competition with the counter-electromotive forces developed under the conditions.

The effect of running the two machines in series as motors is very different. When so used, and with their shafts very free to turn, the larger, or one capable of producing the highest counter-electromotive force, runs at a comparatively slow rate, while the smaller runs at a high rate. If, however, the former or larger machine be made to perform mechanical work—that is, to furnish power—its running speed is, of course, retarded and the other machine turns with a speed depending on the amount of work abstracted from its companion.

Improvements in Electric Motors, Dynamo and Magneto-Electric Machines.

[1880. — I propose to confine myself to such of the warkards by me as are simple, cheap, and, when well made, efficient; specially for amateurs in possession of a handy lathe. I will first describe a machine of a simple form, on the double-acting principle. Fig. 1 shows plan; Fig. 2 a transverse section; Fig. 3 a perspective, without wire, of the making of the armature.—A A are two pieces of soft iron, fixed on a wooden, gun-metal, or brass bar as shown from the block, in the shape, B shows end view and plan. These are screwed on a shaft, being fixed by screw (fig. steel) to keep on shaft. C C, Fig. 6 shows slots of these spokes or shaft; Fig. 4 shows winding of wire and attachment to commutator, which is simply two segments, fig. commutator, which is simply two of gun-metal, the lower two ends go to one ring, the upper two to the other. The shaft is shown in section, fig. page. It must be centred as to be borne true; a fork or a drill for 1-16th hole; D D, fig. 6, to be turned up true as far as B, at one end, and No. at other end, to receive pieces, as then to be firmly bored in or screwed. The pieces are then to be put in places as true as possible, and secured with screws in the spokes. They should be bored with No. 10 cotton-covered wire, three layers, and wound in their places, and the wire commenced up to commutator. The whole is then to be mounted in rest between two steel centres, in a grooved head and or brass pulley for driving off.

The magnets (two composed of four each) are made of steel, tempered down to purple, each 4 inch thick, fig. 5, and 1 inch in length straight part of each, bent together after magnetising, as shown in sketch; pole pieces (fig. 5) of soft iron, 1 inch square, 2 inches long, 1/4 inch thick, to, as shown, so that the armature rotates freely, but as closely between the poles as may be without touching. The wire may then be wound on the magnets, three layers, No. 14 or 16; the bobbins of soft iron fitted on in place. Fig. 7 shows winding of two springs on magnets.

The springs are thicker, to make to press on the rings on the commutator, and from these springs

[1] The following is a copy of the Specification as it was left at the Patent Office:—

I, Wallenstein, Hoxton, in the County of Middlesex, Gentleman, do hereby declare that I am not at home at present but hope to be back in time to see you before dispatch.

Yours truly,

P.S.—I forgot to say what I have used by some post as to the Specification of the Improvements in Electric Motors, Dynamo and Magneto-Electric Machines.

Yours, JAMES EDMUND.

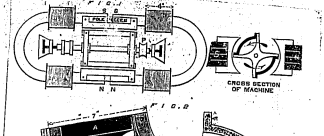
ELECTRICITY.—THE MICHIGAN PARALLELOID.

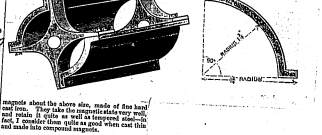
To the Editor of SCIENCE.

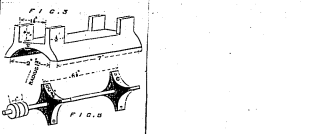
SIR,—The instructive pyrotechnical illustrations for the Centennial, as newly described in the recent notice of the Parallelograph, in connection with the Electric Light, suggest to me the propriety and practicability of a new device for the Michigan Parallelograph, to be called the Michigan Parallelograph, which I have constructed, and which will be exhibited at the Proceedings of the Royal Society for 1876. As I have published illustrations of the same described by Mr. Wallenstein, in the Scientific American, and in the Mechanics' Magazine, I have not thought it necessary to publish them in the Weekly Mirror. I hope to be present at the Centennial Exhibition, and shall be glad to see you there.

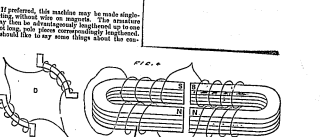
Yours truly,

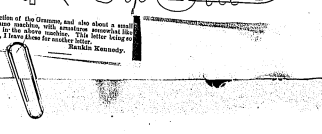
J. EDMUND.











wire may be led to the binding-screws; the wires from the magnets are also led to those screws, care being taken to join + spring and + end of magnet-wire together, and the same for the — spring and — end of wire to other, or magnet wires may be led to another two binding-screws. I have had magnets about the above size, made of fine hard iron wire. They take the magnetic state very well, and retain it quite as well as tempered steel—in fact I consider them quite as good when cast thin and made into compound magnets.

If preferred, this machine may be made single-acting, without wire on magnets. The armature may then be advantageously lengthened by one half long, pole pieces correspondingly lengthened. I should like to say some things about the construction of the Gramme, and also about a small dynamo machine, with armature somewhat like that in the above machine. This letter being so long, I have those for another letter.

Franklin Kennedy.

une série de conférences dans lesquelles serait résumé l'ensemble des notions relatives à la photographie.

Ces conférences, qui principalement pour but de faire connaître, par un enseignement oral et démontré, les méthodes photographiques que jusqu'à présent on ne pouvait étudier que dans les traités spéciaux.

Une large part y sera donnée aux notions élémentaires et aux différents procédés pratiques dont la connaissance est nécessaire pour les applications diverses de la photographie. M. Davanne, vice-président de la Société française de Photographie, a bien voulu se charger de cet enseignement.

Les conférences auront lieu les mardis à 8 heures 30 minutes du soir, à la Sorbonne, dans le grand amphithéâtre; elles commenceront le 2 décembre 1879 et continueront jusqu'au milieu du mois de janvier suivant; elles seront publiques.

CHRONIQUE D'HISTOIRE NATURELLE

Puissance germinative des graines.—M. C. de Candolle, de Genève, a expérimenté, de concert avec M. Raoul Pictet, l'action des températures très basses sur la faculté germinative des graines. Il a soumis, pendant deux heures, à une température inférieure à 80° centigrades, des graines des espèces suivantes : *Sinapis alba, Lepidium sativum, Artemisia annua, Mimosa pudica, Galactella dracunculoides, Silene pendula, Perilla Nankinensis, Hyoscyamus niger, Cobæa scandens, Ricinus communis, Fraxinus ajfinalis, Nicotiana acuminata*, et enfin le blé ordinaire.

Toutes ces graines, à l'exception de celles de *Perilla, Hyoscyamus* et *Nicotiana*, ont germé et poussé leurs premières feuilles aussi rapidement que d'autres graines des mêmes espèces, non soumises au froid, et semées en même temps.

Métamorphoses des batraciens urodèles. — Mlle de Chauvin a fait sur les Batraciens Urodèles un certain nombre d'expériences fort curieuses. La *Salamandra atra* est vivipare et met au monde des petits dépourvus de branchies, destinés à vivre immédiatement sur la terre; mais, avant leur naissance, ils ont passé par une phase pendant laquelle ils ont des branchies et une *queue natatoire*. Mlle de Chauvin a pris plusieurs de ces embryons dans le ventre de leur mère, et les a introduits dans l'eau pour voir s'ils continueraient à vivre sous cette forme larvaire. Les branchies embryonnaires tombèrent bientôt, mais, après une crise assez grave, il s'en reforma de nouvelles; la frange membraneuse délicate de la queue embryonnaire fut remplacée également par une autre plus ferme; le peau resta plus molle et moins noire que dans la *Salamandra atra* ordinaire. Toutefois, au bout de seize semaines de séjour dans l'eau, les branchies disparurent graduellement par résorption, comme cela a lieu dans le développement normal des autres Salamandres. Mlle de Chauvin parvint aussi à plier un jeune Protée à la vie terrestre, en le faisant séjourner pendant plusieurs mois dans de l'eau bouillie. Enfin, la métamorphose des Axolotls donna lieu à une observation curieuse. Un Axolotl, transformé presque complètement en Amblystome, fut remis dans l'eau ordinaire; ses branchies se développèrent de nouveau et la frange caudale se reforma, devenu ainsi à-la forme primitive, il fut replacé dans de l'eau bouillie, et il reprit, plus complètement encore que la première fois, la forme d'Amblystome.

R. Tuo.

L'ÉCLAIRAGE ÉLECTRIQUE

L'ensemble des appareils actuellement exposés par M. Lontin au Palais de l'Industrie comprend :

1° Une *machine excitatrice* ou *magnéto* à courants continus destinée à alimenter, à nourrir la machine à lumière.

2° Une *machine à lumière* à courants alternatifs dont la disposition permet de produire, à volonté, soit un petit nombre de foyers puissants, soit un grand nombre de petits foyers.

3° Un régulateur électrique à arc voltaïque qui permet d'établir plusieurs lampes dans un même circuit.

4° Un régulateur de courants pour l'incandescence à fil de platine, régulateur appliqué à une rampe à incandescence. Nous allons examiner rapidement ces divers appareils qui présentent un réel intérêt autant par leurs dispositions ingénieuses que par les applications dont ils sont susceptibles.

Machine excitatrice. Il est facile de comprendre le fonctionnement de cette machine en se reportant à la machine de Gramme dont nos lecteurs connaissent le principe. Sur une roue à laquelle M. Lontin donne le nom de *pignon magnétique* sont disposées quarante petites bobines B,B en dix rangées de quatre bobines chacune (fig. 1) ; dans chaque rangée les bobines sont disposées en hélice et sont garnies d'un noyau de fer à l'intérieur; elles constituent ainsi une série d'électro-aimants, qui, en tournant entre les pôles du grand électro-aimant ou inducteur A A, prennent des polarités dont le sens change à chaque demi-révolution. Les courants d'induction engendrés sont recueillis sur un *collecteur* analogue à celui de la machine Gramme par des balais formés de feuilles minces de cuivre qui frottent sur ce collecteur.

L'inducteur AA dont la cuisse forme le socle de la machine est excité par le courant même de la machine, c'est-à-dire que son fil est dans le circuit des bobines par l'intermédiaire des balais du collecteur. Le courant continu produit par cette machine est envoyé dans la machine à lumière.

Machine à lumière. La machine à lumière se compose d'une série d'électro-aimants 3ll (fig. 2) fixés, sur une couronne, les fils de chacun de ses électro-aimants aboutissent à un appareil nommé *manipulateur* dont nous allons examiner la fonction tout à l'heure. A l'intérieur de cette couronne d'électro-aimants tourne un pignon magnétique formé de 24 dents. Chaque dent est une lame de fer entourée de son hélice magnétisante.

Le courant de la machine excitatrice arrivant par F, vient par un fourteur sur une bague a reliée à l'une des extrémités du pignon magnétique.

Après avoir traversé les 24 bobines 3, il sort par une seconde bague et un second fourteur pour retourner à la machine excitatrice. L'enroulement du fil est tel que les pôles développés aux extrémités des

SUR LE RENDEMENT ÉLECTRIQUE

DES MACHINES GRAMME

Les machines dynamo-électriques considérées comme source d'électricité ne peuvent, à cause des conditions multiples de leur fonctionnement, être assimilées aux autres sources électriques, piles liquides ou piles thermo-électriques.

Nous avons entrepris à Silvertown, au mois de juillet dernier, grâce au bienveillant concours de M. Robert Gray, ingénieur de la C^e^ *India Rubber Works*, une série d'expériences pour établir, en dehors de toute considération théorique, les éléments électriques des machines dynamo-électriques placées dans certaines conditions de fonctionnement.

Nos expériences ont porté sur les machines Gramme du type A *dit type d'atelier*, modèles dont nous donnons ci-dessous une vue d'ensemble pour en rappeler le modèle à nos lecteurs.

Hâtons-nous de dire que des expériences semblables ont été déjà faites en France par MM. Mascart et Angot (*Journal de physique* 1878) et en Angleterre par le docteur Hopkinson (Institution of mechanical engineers). Les premières ont été faites surtout à un point de vue théorique, point de vue auquel nous ne pouvons nous placer ici; les secondes se rapportent à des machines Siemens, et c'est un travail analogue que nous avons voulu faire en France sur les machines qui, jusqu'ici, y sont le plus employées.

Les machines dynamo-électriques sont établies pour marcher à une vitesse donnée, vitesse qu'il convient de conserver pour faire produire à ces machines tout ce qu'elles peuvent donner sans nuire à la solidité et au bon entretien des organes qui les composent. Nous avons donc admis que la vitesse de rotation était constante et nous avons toujours ramené les éléments électriques à la vitesse normale (1,000 tours par minute) lorsque le compteur de tours indiquait une vitesse supérieure ou inférieure. Cette réduction est toujours facile, car on constate facilement par expérience que, toutes choses égales d'ailleurs, la force électro-motrice est proportionnelle au nombre de tours de la machine, même pour des variations de vitesse qui atteignent 500 tours par minute.

Nous nous sommes rendu compte par l'expérience des variations des éléments électriques des machines Gramme en faisant varier la résistance extérieure depuis 10 ohms jusqu'à une résistance extérieure nulle.

Dans une expérience, la machine tournant à une vitesse de 1,000 tours par minute, avec une résistance extérieure de 2,7 ohms, soit 1,8 fois la résistance intérieure, développait un courant de 25,5 webers d'intensité avec une force électro-motrice de 107 volts. Le travail total transformé en électricité était de 273 kilogrammètres, soit, 3,64 chevaux; le travail utilisable était de 179 kilogrammètres, soit 2,38 chevaux.

Dans ce cas, le rendement atteignait 65 p. 100. En tenant compte des frottements, des résistances passives etc., dont la [illegible] soit utilisable, n'est-ce pas [illegible] intermédiaires, mais les chiffres que nous venons de donner montrent entre quelles limites sont comprises les machines Gramme employées pour la lumière électrique.

E. HOSPITALIER.

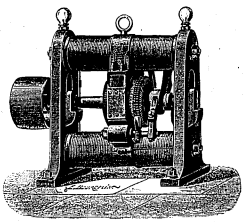
Résistance intérieure de la machine. — En mesurant par la méthode du pont de Wheatstone les résistances de la machine soumise à l'expérience, nous avons trouvé:

Résistance totale de la machine avant le fonctionnement	1,185
Résistance de la bobine *induit*, après avoir fonctionné quelque temps en court circuit	0,75
Résistance des électro-aimants dans les mêmes conditions	0,72
Résistance totale de la machine *chaude*	1,47

Ces résistances sont exprimées en *ohms*.

Ces chiffres montrent que la *résistance intérieure* de la machine varie dans de très-faibles limites, et que ces variations sont dues à l'échauffement du fil dont la résistance augmente avec la température.

Force électro-motrice. — La courbe I du diagramme montre la variation de la force électro-motrice lorsque la résistance extérieure augmente. Les résistances totales sont portées sur l'axe des abscisses à l'échelle de 1 centimètre par *ohm*, les forces électro-motrices sont portées en ordonnée à l'échelle de 1 millimètre par volt. Lorsque la résistance totale est supérieure à 2 fois la résistance intérieure, on voit que la force électro-motrice est à peu près constante et très-faible. Cela tient à ce que l'induction sur la bobine n'est produite que par le magnétisme rémanent des électro-aimants. Puis, cette force électro-motrice croît très-vite entre 6 ohms et 4 ohms de résistance totale, elle atteint une valeur de 107 volts et varie alors très-peu. Cela tient à ce que le courant qui traverse les électro-aimants les ayant aimantés à saturation, le champ magnétique reste constant et comme, d'autre part, la vitesse



de l'induit est elle-même constante, la force électro-motrice qui est proportionnelle à ces deux quantités ne peut plus varier que par l'échauffement du fil.

Intensité du courant. L'intensité du courant exprimée en webers est représentée par la courbe II du diagramme à l'échelle de 1 millimètre par weber.

On voit que cette intensité d'abord très-faible augmente ensuite d'une façon assez régulière pour des résistances totales variant entre deux fois et quatre fois la résistance totale de la machine.

Ces intensités ont été calculées par la formule :

$$Q = \frac{E}{R}$$

Q. Intensité en webers.
E. Force électro-motrice en volts.
R. Résistance totale en ohms.

Travail transformé en électricité. — Les chiffres que nous avons trouvés se rapportent à l'unité de temps, la seconde. La valeur du travail transformé en électricité est exprimée par la formule de Joule :

$$W = 10\ Q^2\ R.$$

Q et R ont les mêmes valeurs que ci-dessus.

W est le travail exprimé en *sup-ergs*. Pour réduire en unités françaises un kilogrammètre vaut 98,1 *sup-ergs*.

La courbe III du diagramme montre que le travail transformé en électricité qui en très-faible tant que la résistance totale dépasse 6 ohms augmente ensuite rapidement et régulièrement à mesure que la résistance diminue. L'échelle des courbes III et IV est de 1 millimètre pour 2 kilogrammètres.

grado che la corrente
e utilizzata per eccita-
gnor Edison, per de-
referisce caricare l'e-
macchina separata,
o una batteria di que-
macchina Faraday som-

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nto che, riunendo lo
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si conserva per tutto il
e resta in attività con-

lamita sol à di circa
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a dell'armatura à so-
ed Edison pretende
ella forza trasmessa a
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la macchina tutto l'e-
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ervato per mantenere
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genere come il Brush-
avviene più particolar-
Siemens: nessun sistema
, tanto razionalmente.
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ppia paragonata a tutte
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macchine, ottenendo in
meccanica. d'economia,
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elettrico di Edison; esso è stato fatto allo scopo di essere situato dappertutto, ove una forza poco importante sia necessaria, come quella per muovere una macchina da cucire, un tornio, un elevatore ecc. ecc.; basta per ciò di staccare il filo della lampada a di comunicare al piccolo motore: avete così la scelta sia d'illuminare, sia di far lavorare il vostro motore. Il disegno rappresenta la macchina a questo. Il diagramma rappresenta la macchina a motore. Il disegno rappresenta la macchina a 1/6 della grandezza reale.

La sua costruzione non differisce in niente per così dire dal generatore. L'armatura è situata in parallelamente all'elettro-calamita, invece d'essere trasversale, e l'elettro-calamita è fissa in un sol pezzo invece di essere in diverse sezioni, come nel generatore figura A. Tutto il resto è assolutamente simile al generatore avendo la stessa armatura e lo stesso commutatore con spazzolo di rame.

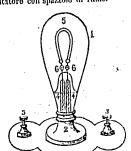


Figura B. Questo disegno rappresenta la nuova lampada d'Edison, la quale, come si vede, è molto semplice, ed è rappresentata mento 1/4 della grandezza reale.

(1) È il globo di vetro che ricovre tutto e nel quale si produce il vuoto.

(2) Base della lampa'a, per la quale base s' introducono i fili conduttori della corrente.

(3) Piccolo filamento di carta carbonizzata.

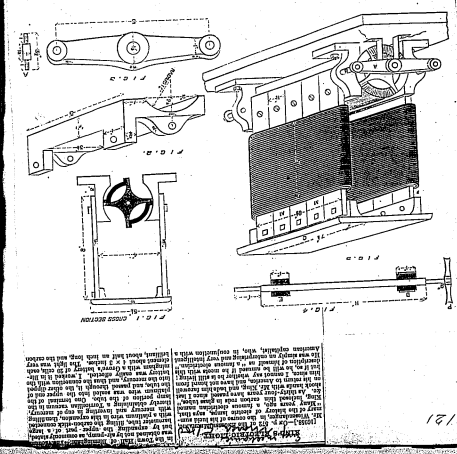
(5) (6) Fili di platino che conducono alle viti (4) (5) e di là al generatore.

Uno dei grandi vantaggi della luce elettrica è il non dare calore: e di più l'incandescenza nella nuo va lampada producendosi nel vuoto, l'aria non no è menomamente vitiata.

La qualità de' del conto comparato al gaz sarà di circa 60 a 70 per conto a miglior mercato per la nuova lamp.; ma: ciò che in gaz costerà 2,50 a 3 franchi vers. ubia al massimo a costare 1 franco, colla supe. verità incontestabile della qualità dell'illuminazio. ne.

La maniera della lampada d. Edison è delle più semplici; essa può essere reg. sta su Jasciato. La luce può essere a volonta. portata istantaneamente ad una grande intens. à ed essere ridotta ad una luce impercettibile.

E una fortuna che Edison abbia trovato il nuovo sistema di carbone fatto colla carta; stanza questo la quistione sarebbe ancora lungi dal essere risolta, perchè per farsi un'idea del c dero intenso che si produce colle due cor enti basterà dire che nel momento dell'accensione al punto luminoso il calore della corrente sensitiva è di 9800°.



MATTINO

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Gli annunci, le inserzioni di 3ª e 4ª pagina, le necrologie non si ricevono assolutamente nell'impresa di Pubblicità Deposito e Collocamento, Via Roma (Largo della Carità N. 79).

...sono di suscitare gravi discussioni. — Che ...abbia provveduto al maggior incremento dell'esercito, tutti sono d'accordo. Le discussioni sono circa ai mezzi. — Lon. Primerano, relatore della Commissione, vorrebbe che si provvedesse alle maggiori spese per l'esercito con un'operazione finanziaria, gl'interessi della quale soltanto sarebbero scritti sul bilancio della guerra. Ma i suoi colleghi della Commissione non sono tutti d'accordo coll'on. relatore, e anche su questo argomento finora non si conosce... — Vedremo se la Camera assenta a pronunciare il *Fiat Lux!*

Corriere della Sera

LA NUOVA SCOPERTA
di Thomas Aloa Edison

Edison, l'uomo illustre, che da tutti è considerato per non aver rivali, ha aggiunto testè, al suo genio e coi suoi lavoro incessante, al suo nome, nuovi, meravigliosi, la telegrafonia, difficoltà per quel che riguarda la scienza e incontestabile utilità per tutte le classi dell'umanità.

Or sono alcuni mesi allorchè si sparse la voce che Edison, il misterioso, avesse risoluto la questione della illuminazione elettrica, il unico prese gli azionisti del gas e le azioni ...addero in un momento a prezzi rovinosi per ...detentori. I freddi pensatori, che sono ...sommano, vegliono toccare prima di credere, ...on si allarmarono; aspettò ...ervano di nervi sensibili compra ...scrutivo quanto più conveniente per questo ultimo. Credendo ad una mistificazione e nella l'unanimità ...sione che la soluzione d'Edison fosse ...polta sotto le rovine dell'insuccesso, a poco ...poco la fiducia si ristabilì, gli uni si tolsero ...rono del loro speculativo ...rimento, gli altri ...lamentarono della loro momentanea debolezza; e non restò loro altro che giurare di ...la farsi più accalappiare.

Or sono alcuni mesi... quando avvennero i ...tti accennati lo persone interessate avrebbero dovuto accorgersi che le belle promesse ...on erano di quelle che ...chiare, concise, ...o senza fondamento emanavano sia dalla ...ampa lusingatrice, sia dalla cupidigia d'speculatori poco coscienziosi.

Ed dunque, naturale, che ora, quando il ...e inventore annunzia di aver compiuta l'opera ...a si abbia una certa ripugnanza a credervi, ...ppo essere stati da uno o da un altro più ...lo mistificati.

Quelli che vogliono vedere non aspettavano ...mai molto!

Il grido di vittoria che risuonò allora, lo riflettano, non venne da Edison; il quale ...progettare è molto serio per mettere fuori ...na falsa notizia. Egli, anzi, non avrebbe ...lon pubblicherebbe l'opera sua se non quando ...gli stesso non avrebbe più alcun dubbio sul ...efficacia di quella.

Oggi dopo lunghi e penosi lavori Edison fa la prima applicazione del suo sistema e solo dietro un maturo esperimento egli viene a farci di aver superate tutte le difficoltà, e questo collo prova alla mano; imperocchè la ...a luce è uscita dal suo laboratorio, è stata dotata a Menlo-Park; per conseguenza a ottoposta al giudizio del pubblico. E si noti ...ha i primi clamori che si giungono sono del ...ubblico e non di Edison; di più dunque fin ...ora registrare l'illuminazione elettrica come ...a'attualità all'ordine del giorno.

* * *

Due parole di Edison e del suo laboratorio.

Edison è figlio delle sue opere; ha esordito ...assai umilmente in questo mondo, e senza voler tornare molto indietro, lo troviamo impiegato in un ufficio telegrafico.

Là in pochi mesi la sua superiorità è talmente ammirata, egli fa invenzioni così preziose in telegrafia che ...ne trovano in Europa ...ispettore generale di tutta la Compagnia.

Edison è lontano ...a sua statura è al disopra della mezzana; quantunque non abbia che trentadue anni, i suoi capelli sono grigi; il suo sguardo penetrante fa ...avvedere le sue continue preoccupazioni; il suo pensiero è giorno e notte fisso ai suoi progetti; la sua osservazione si aggira pure e sempre su tali argomenti.

Egli non è veramente in casa sua che nel suo laboratorio, il quale è fornito del più completo ...rredo, della macchina a vapore di 80 cavalli ...sino all'utensile più delicato. Gabinetto di fisica, di chimica, ecc. ecc. tutto vi è: egli ha tutto l'occorrente per poter ...re i suoi lavori e studi progetti. Vi è un buon numero d'assistenti, i quali sono, di ...ordate, occupati in una quantità d'operazioni di natura assai diversa. L'apparecchio che è stato finito il giorno vien sperato provato la notte quando tutto è silenzio e quando non vi sono visitatori.

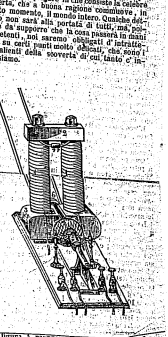
A malgrado queste grandi fatiche egli confessa la sua salute essere buona, le sue occupazioni essergli piacevoli e non soffrire del lavoro eccessivo a cui egli si dà.

La sua abitazione ed il suo laboratorio sono splendidamente siti sul fianco d'una collina, la quale sovrasta una vallata assai pittoresca; quella vista incantevole e quell'aria di montagna sono i migliori rimedii per gli spiriti senza riposo.

Edison può essere superbo della sua posizione nel mondo della scienza, perchè per la sua energia e la sua pertinacia egli si è assicurata una rendita che lo mette in grado di potere attuare sopra vasta scala gli esperimenti immaginati dalla sua prolifica intelligenza.

* * *

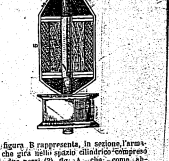
Ora che abbiamo detto più o meno chi è Edison andiamo con l'aiuto delle figure qui riprodotte a spiegare in che consiste la scoperta, che a buona ragione commuove, in questo momento, il mondo intero. Qualche dettaglio non sarà alla portata di tutti, ma poi competenti, noi saremo obbligati d'interessarci su certi punti molto ...ostici, che sono i più salienti della scoverta di cui tanto ci interessiamo.



La figura A rappresenta la nuova macchina dinamo-elettrica di Edison, quella cioè che produce il meglio, genera la corrente elettrica, che deve alimentare le lampade, i motori ecc. ecc.

(1) rappresenta le braccia dell'elettro-calamita; esso sono formate da un cilindro di ferro battuto di 0 metri e 15 c/o di diametro, sopra una lunghezza di 0 m. 20 c. ; questi cilindri sono montati sopra grossi ferro fuso (2) che formano i poli dell'elettro-calamita ; questi pezzi sono molto pesanti e le loro dimensioni sono 0 m. 27 di altezza per 0 m. 171 di larghezza ; i cilindri in ferro battuto (1) sono forati per aprire il passaggio ad un bottone, al quale rimbocca i pezzi di ferro (3) i cilindri, e la traversa (2) per non formare che un corpo solo : dei resti la madrevite che si veggono sulla traversa (2) indicano evidentemente come le differenti parti sono riunite.

I cilindri (1) di ferro sono ricoverti di tre strati di filo di cotone n. 10, isolati con cotone; le estremità di questi fili sono trattenute da viti che si osservano sulla base della macchina ; tutti i pezzi della macchina sono fissati sopra una placca d'ottone che ha forma di croce.



La figura B rappresenta, in sezione, l'armatura che gira nello spazio cilindrico compreso fra i due pezzi (3) *fig:* A. che ...come abbiam detto formano i poli dell'elettro-calamita; questa armatura consiste in un cilindro (3), largo (2) inondato sopra un'asse di ferro, (1) di 0 m. 038 di diametro. L'asse è fissato alle sue due estremità due dischi di ferro dolce, fra i dischi vengono disposti strati (4) di filo di ferro dolce n.° 20, i quali sono a 1 volti intorno all'asse (1), e fuori dei dischi in ferro sono applicati altri dischi di fibra vulcanizzata (3), tali dischi sono scanalati alla loro periferia per ricevere i fili di rame ricoverti di cotone (5), che sono avvolti longitudinalmente sul cilindro e poi fissati a certa distanza di loro per mezzo di cunicolature (7). Vi sono 41 fili di .42 ... in ogni fascio, ciascuno dei quali passa attorno al cilindro longitudinalmente sopra tali diametralmente opposte; la parte opposta di ogni filo dei diversi fasci sono ad essere saldate alle sbarre di rame del commutatore sopra tali appoggi dei cilindri di questo (7). Vi sono 40 fasci avvolgenti l'armatura ed il cilindro comprende 3 grandi dischi due tali estremità e un terzo in mezzo ...ove sono ...ti interrompono la corrente. L'asse (1) ...sua puleggia di 0 m. 23 di diametro per 0 m. 12 di superficie faciale, la quale puleggia comanda l'asse dell'armatura, di cui la velocità è di

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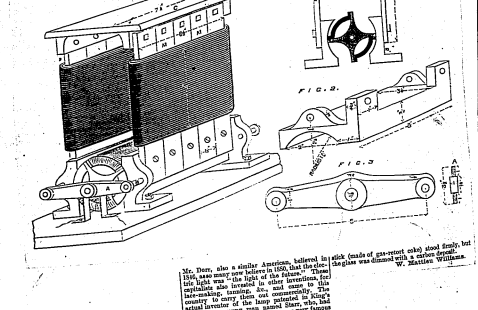

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LONDON, Dec. 23, 1878.

Mr. Vanderbilt, in the course of his brief visit to this city, was asked by the Associated Press correspondent to give his opinion of the invention of Mr. Edison, of Menlo Park, which has created so much excitement in this city and throughout the country. Mr. Vanderbilt said: "I have not had time to examine Mr. Edison's invention, but I have no doubt it is all right. I have known Mr. Edison for many years, and he is a very intelligent man. I have seen his electric light, and it seems to be a very good one. I have also seen the electric pen, which works well, and I have no doubt that Mr. Edison will succeed in his experiments with the electric light. I am not a scientific man myself, but I have a very high opinion of Mr. Edison's ability, and I have no doubt that he will succeed in his present undertaking."

Mr. Vanderbilt left this city for Paris at 10:30 this morning.

Mr. Darr, also a similar American, believed in 1850, that there would be a time when gas would be driven out of the houses by electric light. Mr. Darr's invention was the first step in this direction, and, although he died before the invention was perfected, he succeeded in securing the services of Mr. Starr, the original inventor of the incandescent burner, who, when a young man, was known as a very ingenious mechanic, and would have been almost entirely forgotten in connection with the history of electric lighting, were it not for the fact that he lived, would know about other experimental electricians. He worked for a number of years with two associates, William Starr and Moses G. Farmer, in conducting experiments in electric lighting, and succeeded in obtaining a light, I am told, equivalent to 75 gas burners, but it was not considered practical for general use, as the cost of working was too great. Starr, however, was not satisfied with this result, and continued his experiments for a number of years, and finally succeeded in producing a light which was considered practical for general use, and which could be produced at a cost of working much less than that of gas. Starr's invention consisted of a carbon burner, which he placed in a glass globe, from which the air was exhausted, thus filling the globe with a vacuum. The carbon burner was in the form of a horseshoe, and was connected with a platinum wire by means of which the electric current was conducted to the burner. Starr's invention was exhibited at the Centennial Exhibition in Philadelphia, and was awarded a medal. Starr's invention was sealed into the upper part of the globe. One terminal of the electric current was connected with the platinum wire, and passed through it, the other terminal was connected with the carbon burner, and thus the connection in the circuit was easily effected. The carbon burner was placed in the globe, and the globe was filled with nitrogen with a battery of 20 cells, each element about 4 × 2 inches. The light was very brilliant, about half an inch long, and the carbon stick (made of gas-retort coke) stood firmly, but the glass was dimmed with a carbon deposit.

Mr. Starr's invention was exhibited in Europe, and was highly spoken of by the press, as unusually successful. He obtained out by his death, and it was left for Edison, by expanding the upper part of a large globe, and by using a carbon burner, to make the invention commercially successful. Edison's invention consists in using a platinum wire in connection with the carbon burner, and in using in cup of mercury, through which the current passes to the carbon burner. The platinum wire is sealed into the upper part of the globe, and passed through it, the other end of the wire being connected with the carbon burner, and thus the connection in the circuit is made. The carbon burner was placed in the globe, and the globe was filled with nitrogen with a battery of 20 cells, each element about 4 × 2 inches. The light was very brilliant, about half an inch long, and the carbon

800 giri per minuto. Malgrado che la corrente dell'armatura possa essere utilizzata per eccitare l'elettro-calamita, il signor Edison, per ottenere più economia, preferisce caricare l'elettro-calamita con una macchina separata, difatti egli intende caricare una batteria di questi generatori, con una macchina Faraday semplice di questa forma.

Un fatto importante è stato scoverto durante gli esperimenti fatti con questo generatore. Edison ha trovato che, rimanendo la estremità dell'elettro-calamita con un filo di ottone, quando la macchina è in movimento, l'elettro-calamita raggiunge prestissimo il suo *maximum* di carica che conserva per tutto il tempo che il generatore resta in attività continua.

Il peso dell'elettro-calamita sola è di circa 500 kil. e vi bisogna quasi un minuto per caricarlo sino a tale tensione.

La resistenza interna dell'armatura è solamente d'un 1/2 Ohm. ed Edison pretende di realizzare 90 0/0 della forza trasmessa a questa macchina, in corrente esterna effettiva.

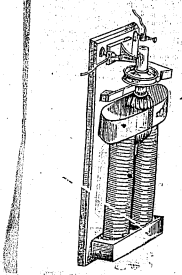
Per ricavare dalla sua macchina tutto l'effetto, di cui essa è capace, è necessaria una forza di 5 cavalli; con tale forza, la macchina può generare una corrente sufficiente, a mantenere 40 lampade, producendo eguale una luce equivalente a 16 bogie.

L'economia della macchina, è provata dal fatto, che un sol unico grandioso può generare abbastanza corrente per mantenere l'arco elettrico d'una Cabina di Jablochkoff.

Questo generatore rassomiglia in prima vista a tutti gli altri del suo genere come il Brush-Wallace-Weston e si avvicina più particolarmente alla macchina Siemens; somiglia, ma non ne differisce intanto grandemente. Questa differenza consiste in ciò che essa genera una corrente doppia, paragonata a tutte le macchine della sua specie.

La macchina Siemens produce dalla corrente di circuito 92 0/0 dell'energia ricevuta, mentre che pravee meglio stabilite hanno dato 83 per cento; e dicesi, questi dati la più parte dei nostri scienziati sono d'avviso che non vi sia ormai più poco o punto margine per miglioramenti. Ora l'energia così portata vien distribuita sull'intera resistenza, di modo che, se la resistenza della macchina è rappresentata da 1 nel circuito esterno da 9, noi avremo 9/10 dell'energia totale effettivamente risultante, giacchè essa è tale al di fuori della macchina; 1/10 è perduta nella resistenza della macchina. La macchina Siemens, come quasi tutte le altre, ha la resistenza esteriore eguale a quella del circuito; per questione ecc. di eguagliare a zero, utilizzare questi risultati; quelle la molte ricerche Edison nei suoi lavori sono state le principale scientifiche la maggior parte ecc. ma egli non ha perduto il coraggio ed ha ritatto questo formolo come esso dovevano essere per raggiungere lo scopo.

Nel generatore di Edison 5 cavalli vapore sono trasferiti senza ecc. residenza di 5 cavalli del quali 1/2 Ohm. nella macchina; essa libera quindi 1/10 di cavallo, totale sul circuito esterno della macchina, ottenendo in questa condizione del *maximum*. Il economia, mentre, studi, condizioni le altre macchine non ne produrrebbero quasi come una lampada non bastava ad una illuminazione elettrica: bisognava anche, anzi innanzi tutto, un generatore economico, ed Edison, come s'è veduto, deve averlo trovato.



Questo figura rappresenta il nuovo motore elettrico di Edison; esso è stato ideato allo scopo di essere situato dappertutto, ove una forza molto importante sia necessaria, come quella per muovere una macchina da cucire, un tornio, un elevatore ecc. ecc.; basta per ciò di staccare il filo della lampada e di comunicarlo al piccolo motore: avuto così la scelta sia d'illuminare, sia di far lavorare il vostro motore. Il disegno rappresenta la macchina a meno di 1/8 della grandezza reale.

La sua costruzione non differisce in niente per così dire dal generatore. L'armatura è actuata parallelamente all'elettro-calamita, invece di essere trasversale, e l'elettro-calamita è fissa in un sol pezzo invece di essere in diverse sezioni, come nel generatore (figura A). Tutto il resto è assolutamente simile al generatore avendo la stessa armatura e lo stesso commutatore con spazzoli di rame.

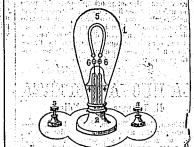


Figura B. Questo disegno rappresenta la nuova lampada di Edison, la quale, come si vede, è molto semplice, ed è approssimativamente 1/4 della grandezza reale.

(1) È il globo di vetro che ricopre tutto e nel quale si produce il vuoto.

(2) Base della lampada, per la quale base s'introducono i fili conduttori della corrente.

(3) Piccolo filamento di carta carbonizzata.

(4) (5) Fili di platino che conducono alle viti (6) (7) o di là al generatore.

Uno dei grandi vantaggi della luce elettrica è di non dare calore: e di più l'incandescenza nella nuova lampada prodotta nel vuoto, nella non ha consumazione vizziata.

La qualità de del costo comparato al gas sarà di circa 60 a 70 per cento a migliore mercato per la nuova lampada; ciò che in gas costava 2.50 a 3 franchi per ora, ora al massimo a costare 1 franco, colla superiorità incontestabile sulla qualità dell'illuminazione.

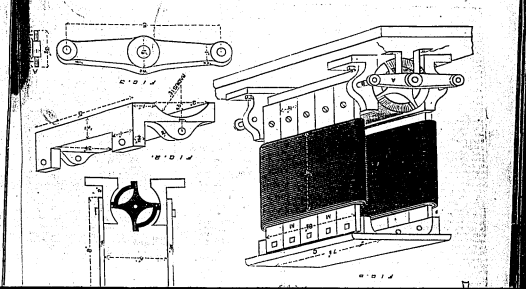
La maneyra della lampada è molto è delle più semplici; essa può essere regolata da un fanciullo. La luce può essere a volontà, portata istantaneamente ad una grande intensità ed essere ridotta ad una luce impercettibile.

È una fortuna che Edison abbia trovato il nuovo elemento di carbone fatto colla carta; senza questo la questione sarebbe rimasta allo stato di arco elettrico, perchè per farsi un'idea del costo attuale che si produce colla dinamo, basterà dire che nel momento dell'accendere si può mantenere l'arco elettrico per circa 3000 e qualche volta più d'ora per quelli grandi.

Edison dopo molte ricerche ha adottato il carbone che ora egli impiega e che è fatto con carta tagliata in forma di ferro di cavallo; forto e poi esposto ad una temperatura molto elevata; ciò per ottenere carbone fatto puro per quanto è possibile e depurato da tutte le materie volatili. Ciò fatto e fatto il vuoto quasi perfetto nella campana della lampada, i risultati sono stati soddisfacentissimi, poichè il carbone, visto l'assenza, dell'ossigeno non deteriora punto.

Se tutto va di questo passo avviamo a luogo andare alla stato d'assenza in formola: — = — è che essa può senza alcuna spesa nè alterazione essere impiegata nei luoghi ordinari, invece del gas; invece dei becco di gas s'introduce la piccola lampada: i semplici fili conduttori fanno il resto.

Per stabilire la luce in una città basta di avere un poste dove lavalore una macchina a vapore, secondo la forza necessaria, o per questa macchina fa muovere la quantità necessaria di macchine del tipo della figura A. Basta che ci sia la comunicazione fra questo ultimo e la lampada per fili di rame, e tutto è fatto. Le lampade per fili di rame, e tutto nell'interno dei possono essere situate farvi alcuna le fanali a gas esistenti senza si otterrebbe alla vendita di tutti i materiali inutili che servirono al gas pagherebbe il nuovo sarebbe ecc. decuplato? La nuova speculazione che abbe essere intrapresa da questa scoperta



currents induced in them which pass out to the lamps.

Four types of the machine are at present manufactured, viz.:

No. 1 Type.

	4 millimetre candles.			3 millimetre candles.
Number of Candles ...	4	6	8	12
Horse-power consumed ...	1·75	1·5	1·6	...
Speed of Machine in revolutions per minute ...	1250	1300	1450	1460 to 1500
Light per candle produced, in Candlelamps ...	72	60	50	30

No. 1a Type.

The No. 1a machine is specially adapted for lighting 12 3-millimetre candles, which, with 4 horse-power consumed, will each give a light equal to 30 Carcel lamps.

No. 2 Type.

This type of machine will light 8, 12, or 16 4-millimetre candles, or 24 3-millimetre candles.

No. 2a Type.

This machine is specially constructed for burning 24 3-millimetre candles with a consumption of 8 horse-power.

The cost of the candles with 3-millimetre carbons is 2d. The circuits of No. 1 machine, when it is required for burning 4, 6, or 8 lights, are grouped for quantity, as this gives the best effect. If the 12 lights are used then the circuits are joined up in series. In the case of 8 large or 12 small lights a resistance is introduced between the two parts of the machine.

EDISON'S ELECTRIC LAMP.

Details of this invention are now to hand, the *New York Herald* having published an illustrated description of the apparatus. The following extracts from that paper will show the nature of the new lamp. Commencing with a description of Mr. Edison's first experiments, the *Herald*, quoting Mr. Edison's words, writes as follows:—"When wires or sheets of platinum, iridium or other metallic conductors of electricity that fuse at a high temperature are exposed to a high temperature near their melting-point in air for several hours by passing a current of electricity through them and then are allowed to cool, the metal is found to be rarefied, and under the microscope there are revealed myriads of cracks in various directions, many of which reach nearly to the centre of the wire. I have also discovered, continues Mr. Edison, that, contrary to the received notion, platinum or platinum and iridium alloy loses weight when exposed to the heat of a candle; that even heated air causes it to lose weight; that the loss is so great that a hydrogen flame is tinged green. After a time the metal falls to pieces; hence wire or sheets of platinum or platinum and iridium alloy are now known in commerce are useless for giving light by incandescence.—

"1st. Because the loss of weight makes it expensive and unreliable, and causes the burner to be rapidly destroyed.

"2nd. Because its electrical resistance changes by loss in weight, and its light-giving power for the total surface is greatly reduced by the cracks or ruptures.

"The melting-point also is determined by the weakest spot of the metal. By my invention or discovery I am able to prevent the deterioration of the platinum or its alloys by cutting off or intercepting the atmospheric action. A spiral wire, or other form of platinum, is placed in a glass tube or bulb, with the wire near its ends passing through and sealed in the glass, and the air is exhausted from the globe. The platinum wires of the spiral are then connected to a magneto-electric machine or battery, the current of which can be controlled by the addition of resistance. Sufficient current is allowed to pass through the wire to bring it to about 150 degrees Fahrenheit. It is then allowed to remain at this temperature for ten or fifteen minutes. While thus heated both the air and gases confined in the metal are expelled by the heat or withdrawn by the vacuum action.

"While this air or the gases are passing out of the metal the mercury pump is kept continually working.

"After the expiration of about fifteen minutes the current passing through the metal is augmented so that its temperature will be about 300 degrees Fahrenheit, and it is allowed to remain at this temperature for another ten or fifteen minutes.

"The mercury pump is to be worked continuously and the temperature of the spiral raised at intervals of ten or fifteen minutes until it attains vivid incandescence and the glass is contracted where it has passed to the pump and melted together.

"The wire is now in a perfect vacuum and in a state heretofore unknown, for it may have its temperature raised to a most dazzling incandescence, emitting a light of twenty-five standard candles, whereas before treatment the same radiating surface gave a light of only about three standard candles. The wires after being thus free from gases are found to have a polish exceeding that of silver and obtainable by no other means. No cracks can be seen even after the spiral has been raised suddenly to incandescence many times by the current, and the most delicate balance fails to show any loss of weight in the wire, even after it is burning for many hours continuously. I have further discovered that if an alloy of platinum and iridium is coated with the oxide of magnesia and subjected to the vacuum process described, a combination takes place between the metal and the oxide, giving the former remarkable properties. With a spiral having a radiating surface of 3-16 of an inch light equal to that given by forty standard candles may be obtained, whereas the same spiral, not coated by my process, would melt before giving a light of four candles. The effect of the oxide of magnesia is to harden the wire to a surprising extent and render it more refractory. A spiral made of this wire is elastic and springy when at high incandescence. I have found that chemically pure iron and nickel drawn in wires and subjected to the vacuum process may be made to give a light equalling that of platinum in the open air. Carbon sticks also may be freed from air in this manner, and be brought to a temperature where the carbon becomes pasty, and on cooling it is homogeneous and hard."

Notes.

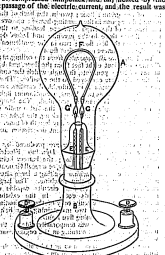
Edison's New Electric Lamp.—A strip of cardboard bent into a horse-shoe form and converted into carbon by baking in an iron mould, is the basis of the new lamp; the strip is placed in an exhausted globe, and a current of electricity being sent through the strip renders the latter incandescent. As regards durability, &c., the *Times* correspondent says:—"About 60 lights were burning. On Saturday night I saw them burn seven hours. Two have been burning continuously for ten days without injury to the carbon. One in the little globe gives a fine light. Cardboard seems sufficiently durable, successfully resisting quite rough usage, such as dropping, shaking, &c. Thousands of times, and to that of 200 candles. Epps, Mr. Edison will put up 25 lights in the Inventions Exhibition in New York. He has also a number of small machines by the Siemens and Gramme gauge. By successively Mr. Edison gets individual inch lamps having 100 ohms on or off and the current ran gas is, while the current was small at No. 36. The an even current, while the to supply furnished to each a that the best generators ever, each one here spoken

Each lamp costs about while a supply equivalent educed for tenpence or less. ut of furnishing light thus— tool in a steam engine will e one hour. Mr. Edison's power for small industries, since, Mr. Edison's light ably does away flickering ptic gas, and consequently Mr. Edison lights at block a street lamps, also laborer. It available for every ts is used."

ceed Mr. Edison's invenn, and we think it a matter ental journal as the *Times* ral announcements, which, for what they are worth by ridical the general public is

About this time another truth dawned upon the inventor, namely, that economy in the production of light from incandescence demanded that the incandescent substance should offer a very great resistance to the passage of the electric current. Concerning this the inventor writes—"It is essential to reverse the present practice of having lamps of but one or two ohms (electrical units) resistance, and to construct lamps which when giving their proper light shall have at least two hundred ohms resistance."

Having perfected the platinum lamp apparently, Mr. Edison was led to try, "by accident," a filament of compressed lampblack and tar, heated by the passage of the electric current, and the result was



satisfactory. A piece of carbonised cotton was next tried, with better results still; a light equal to several gas-jets being obtained. Several other experiments with various carbonised substances were then tried, and finally the carbonised strip of cardboard was found to give the best results.

"With a suitable punch there is cut from a piece of 'Bristol' cardboard a strip of; the same in the form of a miniature horse-shoe, about two inches in length and one-eighth of an inch in width. A number of these strips are laid flatwise in a wrought iron mould about the size of the hand, and separated from each other by tissue paper. The mould is then covered and placed in an oven, where it is gradually raised to a temperature of about six hundred degrees Fahrenheit. This allows the volatile portions of the paper to pass away. The mould is then placed in a furnace and heated almost to a white heat, and then removed and allowed to cool gradually. On opening the mould the charred remains of the little horse-shoe cardboard are found. It must be taken out with the greatest care, else it will fall to pieces. After being removed from the mould it is placed in a little globe and attached to the wires leading to the generating machine. The globe is then connected with an air pump, and the latter is at once set to work extracting the air. After the air has been abstracted, resting on a stand, n, n is the little carbon filament connected by fine platinum wires, c c, to the wires, g g, leading to the screw posts, a a, and thence to the generating machine. The current, entering at a, passes up the wire g to the platinum clamp, c; thence through the carbon filament n to c', down the wire g' to the screw post a', thence to the generating machine. It will be noticed, that the lamp has no complex regulating apparatus, such as characterised the inventor's earlier labours. All the work he did in regulators was practically wasted, for he has lately realised that they were not at all necessary—no more so than a fly wheel is to a coach.

"He finds that the electricity can be regulated with entire reliability at the central station, just as the pressure of gas is now regulated. By his system of connecting the wires the extinguishment of certain of the burners affects the others no more than the extinguishment of the same number of gas burners affects those leaving the supply from the same mains. The simplicity of the completed lamp seems certainly to have arrived at the highest point, and Edison asserts that it is scarcely possible to simplify it more. The entire cost of constructing them is not more than twenty-five cents.

"The lamp shown in the fig. is a table lamp. For chandeliers it would consist of only the vacuum globe and the carbon filament attached to the chandelier, and connected to the wires leading to the generating machine in a central station perhaps a half-mile away, the wires being run through the gas pipes, so that in reality the only change necessary to turn a gas-jet into an electric lamp is to run the wires through the gas pipe, take off the jet, and screw the electric lamp in the latter's place. Although the plans have been fully contemplated for general illumination, the outline of the probable system to be adopted is the heating of a central station in large cities in such a manner that each station will supply an area of about one-third of a mile. In each station there will be, it is contemplated, one or two engines of immense power, which will drive several generating machines, each generating machine supplying about fifty lamps.

"The apparatus for measuring the amount of electricity used by each householder is a simple contrivance consisting of an electrolytic cell and a small coil of wire, appropriately arranged in a box, the latter being of about half the size of an ordinary gas meter, and like a gas meter it can be placed in any part of the house. The measurement is obtained by the deposit of copper particles on a little plate in the electrolytic cell, such deposit being caused by the electric current passing through the cell. At the end of any period, say one month, the plate is

taken by the inspector to the central office, where the copper deposit is weighed, and the amount of electricity consumed determined by a simple calculation.

The Comte du Moncel has addressed a letter on the subject of Mr. Edison's invention to Dr. Cornelius Herz which was published in *Le Temps*. The Comte expresses astonishment at the excitement caused in the money market by the praises bestowed on the lamp, which is called, "A great discovery." "Edison," says the writer, "is an ingenious and fertile inventor, but is not acquainted with the discoveries made before his time. Neither the idea of the telephone nor the realisation of the phonograph belongs to Edison. His first lamp was a modification of the one invented by Changy in 1858. The one now announced is the modification of those of several inventors. In 1875 much noise was made about the incandescent carbon lamp of Korloff, the pretension being that one Alliance machine could feed fifteen lamps, and yet no more than two have ever been seen working. Regnier and Werdermann, by adding the cellulo are to that combination, obtained better results. The new Edison lamp revives the Lodiguyne lamp in a different shape. The small carbon needles are replaced by laminated carbon, or carbonised bristol, paper separated by metallic tissues carved into the form of a horse-shoe, and joined to the circuit by platinum wires, the whole being in a vacuum, as in Lodiguyne's system. That arrangement may be better than anything previously devised, but it is not an invention of the importance assigned to it by the American papers. The idea of intercalating metallic bodies in the carbonised mass is not new, for it had been realised by Jablochkoff and Reimer. It is difficult for the carbon horse-shoe, so loose and delicate, not to be deteriorated by pumping and disintegrating the carbonic particles and by the mechanical action of the current which carries them away and deposits them on the sides of the recipient, as in Geissler's tubes. The metallic tissues separating the layers of carbon would be damaged. Experience alone will be able to decide, and it is prudent to wait, in spite of the announcement of fifty or sixty feet fed from a single machine. The same may be said of the dynamo-electric machine which offers nothing new about which the theories put forth would upset the laws of Ohm and Joule, theories which are at variance with the experiments made with every other machine. Edison has given no account of the maximum effects." The writer finally protests against the *sans façon* of the Americans with regard to European inventions. "For them electrical science, which sprang up yesterday, was discovered in America. Many examples might be cited, to which the name of Mr. Prescott is not foreign, but we prefer to say no more. Let the public be on their guard against the pompous announcements which reach us from the New World."

ERRATUM.—At the end of the article on the "Brush" Electric Light system, which appeared in our last issue, "2,000" candles were, by a printer's error, given as "20,000."

THE ELECTRIC LIGHT AT LUDGATE HILL.

THE premises of Messrs. Samuel Brothers, Merchant Tailors, of Ludgate Hill, London, have been fitted up with the electric light, and the inauguration of the lighting took place on Wednesday evening, the 14th inst., in the presence of a large number of gentlemen interested in the question of electric lighting, representatives of the press, &c., &c.

They are lighted by means of thirteen electric lamps of the Jablochkoff system, and which are distributed as follows :—

One in each of the two windows on each side of the principal entrance in Ludgate Hill; two in the front of the ground floor; two in the back of the ground floor; one in the counting-house; one over the landing of the large staircase leading to the upper floor; three in the juvenile and ladies' department on the first floor; two in the gentlemen's bespoke department on the first floor.

The lamps are all suspended from the ceiling, at a distance of about eight feet from the floor, and by means of lamp pendants, through which the conducting wires are conveyed to the candles. They are made to contain four Jablochkoff candles, and as each candle lasts two hours, a continuous light for eight hours is therefore provided. The lamps can easily be replenished when the last candle is burning, so that, practically speaking, the light can be made to be continuous for any length of time.

The globes are of the opalescent description and are 20 inches in diameter.

The currents of electricity are produced by a battery of Gramme Patent Dynamo Electric Machines of the 20-light size; the battery being composed, as is well known now, of a small Gramme continuous current machine exciting a large alternating current distributing machine. The large machine is divided into four circuits, capable of maintaining five lights each. In the existing arrangement three circuits only of the distributing machine are utilised, two maintaining four lights each, and one maintaining five lights.

An additional lamp was temporarily added to that number, and was kept burning in the engine-room, which it lighted admirably.

The lights are arranged so as to be all switched from a switch board placed at one of the cashier's desks on the ground floor. This arrangement is an important feature, and the switching was shown in operation.

The motive power for working the electric machines is obtained from a 12 horse-power "Otto" gas engine, made by Messrs. Crossley Brothers, of Queen Victoria Street, London.

It is within the mark to say that this form of engine is taking the place of steam at the rate of twenty-five engines a week, a fact that should go a long way to re-assure holders of gas-stock.

The Gramme machines are driven directly by means of suitable pulleys fixed on the shaft of the engine, the small one, or exciter, running at a speed of 812 revolutions, and the large one, or distributor, at a speed of 688 revolutions per minute. They are together with the gas engine erected in a room situated in the basement at the back of the building.

The whole mechanical and electric plant, which has been fitted up under the immediate supe

Notes.

EDISON'S NEW ELECTRIC LAMP.—A strip of cardboard bent into a horse-shoe form and converted into cashon by baking it in an iron mould, is the basis of the new lamp; the strip is placed in an exhausted globe, and a current of electricity being sent through the strip renders the latter incandescent. A correspondent writing to the *Times* correspondent says that the globes were burning. On Saturday night I saw them burn seven hours. Two have been burning continuously for ten days without injury to the baked cardboard horse-shoe in the little glass globe which furnishes the light. Cardboard seems sufficiently durable, successfully resisting quite rough usage, such as dropping, shaking, turning the current on and off thousands of times, and raising the intensity of light to that of gas candles. All the arrangements are simple. Mr. Edison will put about 800 lights at Menlo Park, while the inventions immediately go into practical operation in New York city. The globe containing the horse-shoe is exhausted to one-millionth of an atmosphere by the Sprengel pump, measured by the M'Leod gauge. By successfully sealing up the electric current Mr. Edison gets individual lamps of any desirable power, each lamp having one ohms resistance. Light is turned on or off and the current regulated with the same ease as gas is, while the current can be transmitted over wire as small as No. 56. The central regulator maintains an even current, while the meters accurately measure the supply furnished to each consumer. Mr. Edison finds that the best generators are of five to seven horse-power, each one horse-power maintaining eight lamps. Each lamp will require one shilling to manufacture, while a supply sufficient to 10,000 cf. gas can be produced for 8*d.* expense or less. Mr. Edison calculates the cost of lighting that 1000 to the consumption of 3lb. of coal in a steam engine will maintain eight to ten lamps one hour. Mr. Edison's system also furnishes electric power for small industries, such as running sewing machines, &c. Edison's light is bright, clear, mellow, regular, free from flickering or pulsations, while the observer gets more satisfaction from it than from gas. Mr. Edison lights at Menlo Park, dwellings, offices, docks, street lamps, also laboratory and workshop, making it available for every lighting purpose for which gas is used."

THE telegram which announced Mr. Edison's invention created great excitement, and we think it a matter for regret that such an influential journal as the *Times* should publish such sensational announcements, which, although they will be taken for what they are worth by all scientific men, yet tend to mislead the general public.

Ce dernier fonctionne dans d'excellentes conditions sur

par oui-dire. Or, comme nous avons toujours dans notre pays le triste courage de ne trouver bien que ce qui vient de l'étranger, nous n'avons nullement encouragé les constructeurs habiles qui, comme MM. Ratier et Monier, auraient parfaitement pu construire nos grands câbles. Il est résulté de cet abandon de nos ressources, que l'Angleterre s'est trouvée avoir sans contestes le monopole de la construction des câbles sous-marins, et c'est elle, en effet, qui a fourni les câbles à tous les pays du monde qui en font usage. Cette industrie nouvelle ayant naturellement créé un débouché pour les électriciens, il s'en est formé un grand nombre en Angleterre, et ce sont eux qui, en faisant progresser la science de la télégraphie sous-marine, l'ont conduite au point

à Paris; il a été aussi employé pour les lampes installées par

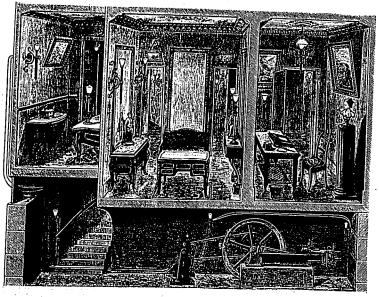
où nous la voyons aujourd'hui. Certainement il devient alors facile pour des compagnies anglaises de trouver des directeurs techniques pour leurs opérations; on n'a que l'embarras du choix; mais il n'en est pas de même pour les autres pays, et c'est ce qui fait que nous sommes obligés d'avoir recours à nos voisins, même pour le personnel, lorsqu'il s'agit d'une entreprise un peu importante. Dans tous les cas nous ne voyons pas de raisons pour qu'on indique sur des programmes, comme électriciens français, des noms complètement inconnus dans la science électrique.

TH. DU MONCEL.

(A suivre.)

1 Dec 1879

LA LUMIÈRE WERDERMANN

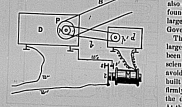


Les expériences remarquables qui ont eu lieu dernièrement à l'Opéra nous engagent à donner quelques détails sur les importants perfectionnements qui ont été apportés à la lampe Werdermann dans ces derniers temps et qui ont permis de résoudre d'une manière très-satisfaisante le grand problème de la division de la lumière électrique.

Les figures 1 et 2 représentent une vue et une coupe du dispositif que Richard Werdermann a installé pour l'éclairage

ZANNI'S IMPROVED MAGNETIC CUT-OFF FOR DYNAMO-ELECTRIC MACHINES.

The object of this invention is to prevent a reversal of the polarity of the electricity employed in the process of the electro-deposition of metals and generated by means of dynamo-electric machines. It is a well known fact that in the process of depositing metals by means of an electric current generated by a dynamo machine, that whenever the machine ceases to work a current generated by the action of the electricity on the depositing bath returns through the dynamo machine and reverses its polarity, consequently when the machine is again started the metal deposited on the article being plated leaves, by a reversal of the required process, denuded of its metallic coating, instead of having the thickness of the same increased. Several devices have been suggested and tried for overcoming this defect, but most of them, for some cause or other, have been unsatisfactory and uncertain in their action. The invention of Mr. Zanni



for effecting the object in view has been tested and proved to be thoroughly reliable in its action, and is therefore a very valuable addition to the electro-plater's plant.

The principle of the invention is shown by the fig.

It is the dynamo machine driven by the hand in, which is connected with the source of power. On the same axle to which the driving pulley, *p*, of the machine is fixed, is also attached another pulley, *f*, which drives by means of a band, *h*, and pulley, *f'*, a small magneto machine, *d*, the circuit of this machine is closed through the electro-magnet, *w*, press against the insulated stop, *i*; but when the magnet is excited it is attracted against the stop, *i'*, thus completing the circuit of the wires *n* or *n'*, which lead to the depositing bath through the connection, *x*.

The action of the apparatus is almost self-evident: when the machine is at rest the circuit of *n*, or *n'* is open, but when the dynamo machine, *b*, is rotated and with it the magneto machine, *d*, the current from the latter is sent through the electro-magnet, *w*, and attracts the tongue, *i*, against the stop, *i'*, thus closing the circuit of *n*, or *n'*; the moment the machine stops, the tongue, *i*, falls back against the stop, *i*, thus opening the circuit and preventing the return of the current from the depositing bath through the machine, *b*.

In the number of the *Journal* for December 13th, 1879, in a notice of Mr. Urquhart's book on electroplating, we expressed our surprise that a simple form of reostat had not been adopted in electro-plating operations for the purpose of regulating the strength of the current; on reference to a patent of Mr. Zanni's we find that this has been suggested and practised by him together with the use of a galvanometer in the circuit, by which the current strength could be seen.

Although fully recognizing the efficiency of Mr. Zanni's magnetic "cut-off," we should have thought that the same end could be effected in a simpler manner by working the electro-magnet, *w*, by a "derived" circuit from the machine, *b*, the resistance of the electro-magnet being sufficiently high to avoid drawing off more of the current than is actually required to excite the electro-magnet. The amount of current required to excite it is evident, would be but an infinitesimally small portion of the total current, and would therefore in no way diminish the efficiency of the machine.

An Electric Tramway.—According to the *Neue Frankfurter Presse*, Messrs. Siemens & Halske, of Berlin, are reported to be in a position to make public in every short time a new plan which they have devised to propel tramways by electric currents. The inventors claim for their system, amongst other advantages, that of greater economy than can be obtained in the steam or horse drawn tramways. It is said that there are yet some technical difficulties to overcome, the principal one being to find out an efficient manner of insulating the axles of the wheels, which, it seems, must not come in direct contact with any metallic part of the carriage. Other special features of this system are that the line will have to be laid on a plan similar to the American aerial railways, and that one carriage only will be set in motion at the time. The engine, it is said, will be of a very light and inexpensive pattern.

AMERICAN INDUSTRIES.—No. 67.

THE MANUFACTURE OF DYNAMO-ELECTRIC MACHINES AND ELECTRIC LAMPS.

The Weston machine for electro-deposition of copper, silver, nickel, and gold is too well known to need any description here. Nearly all the large electroplating and electrotyping establishments in this country use them. They are also extensively used in England, France, Belgium, and are found in nearly all parts of the civilized world. A large machine of this kind was recently built for the Italian Government for the deposition of copper.

The light machine shown in our engraving, although largely used in this country, is not so well known. It has been designed and constructed strictly in accordance with scientific principles, the utmost care having been taken to avoid loss of energy in the machine itself. The armature is built up of a set of thin perforated iron disks, which are firmly secured to the shaft by means of two nuts. Between the disks there are spaces of about one-eighth of an inch. At the end of the armature there is a tube surrounding the shaft, but larger in diameter than the shaft, and terminating at one end in a flange nearly equal in diameter to the armature disks. Each end of the armature consists of a large iron disk, having ribs on its periphery extending from one side of and parallel with the shaft. In the end of this thick disk a deep circular groove is cut, and a number of holes are bored through it parallel with the shaft. When the flanged tube is passed over the shaft and fixed to the end of this thick disk the deep groove forms a chamber.

Quite an important feature in this machine is the means adopted to keep the coils and other parts of the machine as cool as possible. This is accomplished in the armature by making the armature perform the function of an ordinary blower. The flanged tubes which envelope the shaft extend beyond the ends of the coils, and thus leave an opening at the ends near the center of the armature through which air may enter and pass into the chamber between the thick iron disks forming the ends and the flange of the tubes, and from these through the holes in the end disks into the perforated sheet iron disks, and thus pass between them and escape through the spaces between the disks on the periphery of the armature. In order to increase the circulation, air-vanes extend through these iron disks from end to end of the armature. The ends and poles of the magnets are also perforated in order to allow the air to circulate through them and cool them.

The report of Professor Morton to the American Institute Board shows the remarkable performance of this machine. The machines entered at this competitive test were the Siemens, Brush, Maxim, Wallace, Hochhausen, and Weston. The Weston machine greatly excelled all others, and now, in claiming the Electrical Exhibition, says:—"Our attention has been specially directed to the Weston machine, which is both compact and efficient, and which, in addition, is made to run very steadily. The machine is a small locomotive, and can be run on a single circuit by the current from one machine; and Mr. Weston hopes soon to be able to double this number. Mr. Weston has spent much time and devised many ingenious plans for working a large number of lamps on one circuit. Several hundred of these lamps are now in constant use in factories, hotels, stores, steamboats, etc.

The Weston Electric Light Company are also building machines for the transmission of power by electricity, machines for telegraphy, etc. The works are run night and day, and use the electric light exclusively for lighting the factory.

The engraving shows several of the departments of the above works.

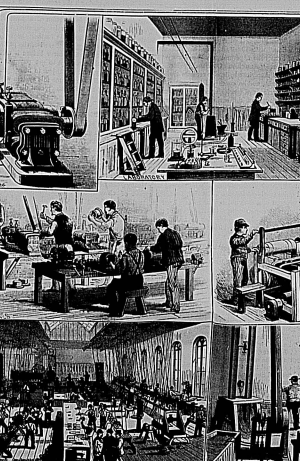
[*Continued on page 405.*]

AMERICAN INDUSTRIES.

[*Continued from first page.*]

establishment, and conveys a good idea of the activity prevalent here. The experimental work is carried on in the laboratory, which is fitted with all of the modern appliances for making electrical tests, and with a full line of chemical and physical apparatus. The machine work is all done in a machine shop covering an area of 80 × 100 feet, well stocked with machinery from the shops of the best makers in this country.

The wire used in winding the armatures and magnets is insulated by a simple, machine shown in one of the views



THE MANUFACTURE OF DYNAMO-ELECTRIC MACHINES AND ELECTRIC LAMPS.—THE WESTON ELECTRIC LIGHT CO., NEWARK, N.J.

Mr. Kinnon, an American electrician, has turned his attention to electricity as a motive power for railways. He has not seen, however, the Siemens & Halske electric railway, but is under more than one form of application of the same principle to a tramway trunk line, which he has laid down in Melle Park for electric locomotives. The line laid out consists of a single Melle Park built over natural ground, with little or no cutting. The present rolling stock consists of one single locomotive and one open car. The current is conveyed to the track by two insulated rails, worked by means of a Gramme machine. The armature of the machine is driven by a belt from the engine driving wheels. A separate rail is provided for the return current. At present a speed of ten miles an hour is maintained, but greater speeds are to be attained. The locomotive is designed to test the application of the current to develope a railway system on a large scale, and for mining districts.

I. RAILWAY DRIVEN THIRTY-THREE YEARS

Electrical Power.

Mr. Colton, of Pittsburg, Pa., have invented a system of electric railway, which is both economical and efficient. The machine is a small locomotive, upon a circular railway, around which it is driven, and from which it receives its motive power. The current is applied not to the locomotive, but to the track, and is of a very curious manner. Two carbon pencils, negative and positive, are applied to the rail by them commercially to the engine. The use is facteries, hotels, stores, steamboats, etc.

The Weston Electric Light Company are also building machines for the transmission of power by electricity, machines for telegraphy, etc. The works are run night and day, and use the electric light exclusively for lighting the factory.

The engraving shows several of the departments of the above works.

[*Continued on page 405.*]

d in this country more than thirty years before motor was introduced to the public." To which that, at the period mentioned, for want of a tro-motor, such an invention was altogether le.

A Mr. Lemuel W. Gaylor, of Castle Rock, Colorado, recently, on visiting Denver, bought a pair of Edison electric lights, and after having them in operation for a few days, he wrote to the Edison Electric Light Co. stating that he was highly pleased with the lights, and that he intended to have the Edison system with which to do away with the use of lamps and oil in his house. Mr. Gaylor is a same circuit, and can be used or extinguished separately.

old down an electric railway, be an inspector now of that ractical work, by Dr. Werner and which is on view at the tion. Mr. Edison has already ermile length of electric rail- and is about to add to it many miles. The public has done nothing practical which the Edison system is responsible. In the electric system in the I, where the available water ial experiment.

ZANNI'S PATENT MAGNETIC CUT OFF FOR DYNAMO-ELECTRIC MACHINES.

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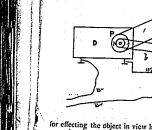

for effecting the object in view has been tested and proved to be thoroughly reliable in its action, and is therefore a very useful addition to the electroplater's plant.

The principle of the invention is shown by the accompanying fig.

It is the dynamo machine driven by the band, *b*, which is connected with the source of power, so that the same acts to which the driving pulley, *p*, of the machine is fixed, is also attached another pulley, *p'*, which drives by means of a band, *b*, and pulley, *p*, a small magneto machine, *d*, the circuit of which is established as a controlling circuit and counterbalance, the armature, *i*, of the electro-magnet, *e*, resting against the insulated stop, *s*; but when the magnet is excited it is attracted against the stop, *t*, thus completing the circuit of the wires, *w*, *w'*, which lead to the depositing bath through the contact section, *x*.

The action of the apparatus is almost self-evident: when the machine is at rest the circuit of *w*, *w'*, is open, but when the dynamo machine, *a*, is rotated and with it the magneto machine, *d*, the current from the latter at once excites the electro-magnet, *e*, and draws the tongue, *i*, against the stop, *t*, thus closing the circuit of *w*, *w'*; the moment the machine stops, the tongue, *i*, falls back against the stop, *s*, thus opening the circuit and preventing the return of the current from the depositing bath through the machine, *a*.

In the number of the *Journal* for December 15th, 1879, a review of Mr. Urquhart's book on electroplating, we expressed our surprise that a simple form of rheostat had not been adopted in electroplating operations for the purpose of regulating the strength of the current; on reference to a patent of Mr. Zanni's we find that this has been suggested

An Electric Tramway.—According to the *New Freie-fonter Presse* Messrs. Siemens & Halske, of Berlin, are reported to be in a position to make public in a very short time a new plan which they have devised to propel tramways by electric currents. The inventors claim for their system, amongst other advantages, that of greater economy than can be obtained in the steam or horse driven tramways. It is said that there are yet some technical difficulties to overcome, the principal one being to find out an efficient manner of insulating the axles of the wheels, which, it seems, must not come in direct contact with any metallic part of the carriages. Other special features of this system are that the line will have to be laid in the middle of the road, as in American axial railways, and that one carriage only can be set in motion at the time. The engine, it is said, will be of [illegible] horse-power.

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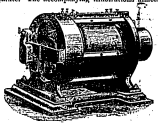
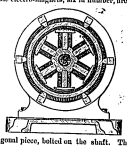
A NEW GRAMME MACHINE.

M. Hippolyte *Fontaine* describes in the *Nuova Industrielle* a new Gramme machine, diagrams of which we believe were exhibited by the British Electric Light Company at the recent conversazione of the Physical Society at King's College. In his old machine, M. Gramme used a small continuous machine (the exciter) to send a current through a larger machine, which has been termed the distributor. The inventor has now combined the two machines, and obtains better results than when they were separate. The accompanying illustrations almost explain

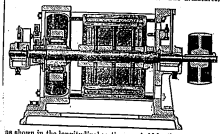


themselves. The arrangement is thus made :—On a low cast-iron bed are bolted two almost circular cast-iron plates, connected together by six square bolts, and provided with bearings for the main shaft. One of these plates is furnished on the inner side with an annular rib on which the electro-magnets of the exciting apparatus are fixed. As in the earlier machines the coils for the alternating currents rest on three square bolts, connected to the end plates by means of packing pieces of hard wood.

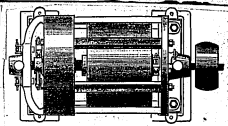
The movable electro-magnets, six in number, are fixed radially



round a hexagonal piece, bolted on the shaft. The armatures,

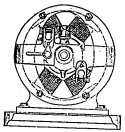


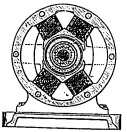
as shown in the longitudinal section, are held by the same screw. On one side the shaft carries the small exciting coil, on the other



an induction coil. The bearings are large, and in the larger machines are automatically lubricated.

A small handle serves to put the movable electro-magnets in





communication with the current of the exciting coil. This current is collected and transmitted by brushes of silvered copper wire. The brushes work by means of an endless screw, furnished with a counter screw placed outside the frame. To regulate the magnetisation of the inductors, and, consequently, the power of the machine, M. Gramme has fixed between the exciting coil and the electro-magnets a copper wire, the length and section of which can easily be varied. The winding of the wires upon the coil differs somewhat from that of ordinary machines, which consist of two parts, the exciter and distributor. Instead of winding one single wire at a time he winds two, in order to have, as required, currents of tension for small candles, or currents of quantity for larger candles.

Two types of these machines are now made :—First, one weighing 250 kilos, and supporting 12 candles of from 20 to 30 bees each, or eight candles of from 40 to 50 bees each; second, one weighing 470 kilos, and supporting either 24 of 20 to 30 bees, or 16 of 40 to 50 bees each.

The following experiments have been made with these machines :—

Order	No. of Revolutions per minute.	Motive Power in kilogrammètres.	No. Fasi.	Intensity of each fasci in Carcel bees.
1	1,140	185	4	45
2	1,200	204	4	49
3	1,330	230	4	57
4	1,400	260	4	62
5	1,450	292	12	52
6	1,250	340	8	58
7	1,300	360	8	61
8	1,360	397	8	57·5
9	1,460	440	8	60·2
10	1,000	270	8	47
11	1,200	—	16	61
12	1,300	—	20	61
13	1,200	—	22	31·5

The first four experiments were made with a small machine, worked by an Otto gas engine. The coils were made to form successively two, three, and four distinct circuits. The expenditure of motive power was measured by a Prony break. The candles used had carbons 4mm. diam., and lasted two hours. Experiments 5, 6, and 7 were made on the same machine, coupled in tension. The candles had carbons of 5mm. diam., and lasted 1·5 hours.

The division of the light weight has been pushed further; but it was observed that, when reduced to an intensity of 20 bees, the candles lost much of their regularity. Only one experiment was made in this direction. With a machine specially arranged for small lights, there were obtained, with a velocity of 1,250 revolutions, 14 foci of 20 Carcel bees, with an expenditure of motive force of 350 kilogrammètres. The candles used had carbons of 3 mm in diameter.

Experiments 8 and 9 were made with a small machine, with the help of a steam motor, the speed of which varied considerably. Several candles went out during the working, but, when the speed was slightly accelerated, this accident no longer occurred.

Experiments 10, 11, and 12 were made at the works of the Société Jablochkoff, at Paris, on two of the larger machines. They are shortly to be repeated on the Place de l'Opéra.

In all the experiments a greater fixity of light was observed than in machines possessing independent exciting coils. It is stated, moreover, that the price of the new apparatus is about 20 per cent. less than that of the old. Two years ago the Gramme machines cost 1,000f. for 16 lights, and half that amount for six lights; whilst the *bougies* cost 75 centimes, and lasted for one hour and 20 minutes. At the present time the machines are sold at 4,500f. for 20 lights, and 2,800f. for eight lights; whilst the *bougies* cost only 50 centimes, and last for two hours and 30 minutes. Great progress has, therefore, been effected from an economical as well as from other points of view; nor is there any reason to think that the maximum reduction in cost has yet been effected.

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present purpose to enter upon the complete study of electrolysis, interesting and important as that study is. The changes are usually considered to consist of two orders—1. Direct actions of the current upon a single constituent. 2. Secondary or chemical actions of the separated elements upon other substances present. I have endeavoured to trace a law which supersedes this distinction, and connects all the actions together as due to energy, and have formulated this as p. 256 of my "Electricity as a "Physical Law of Electrolysis." At the electrodes these substances are set free which absorb, in becoming free, the lowest specific energy. This is, in fact, the converse of the law recently formulated by Berthelot(also long known as a general fact) as the principle of maximum work, viz., every chemical change accomplished without the intervention of a foreign energy (heat, electricity, light) tends to the production of the body, or system of bodies, which liberates most heat. But when we seek to study causes or operations, we should look for them in their very simplest form, where they are least disturbed by other agencies, and their action most easily to be found out. The simplest form of electrolysis is that of fused chloride of silver, where there is nothing else present, and the substance breaks up into chlorine and silver. The chlorine goes to the positive conductor, or anode, and all the silver to the negative, or cathode. Now let us conceive Fig. 4

FIG. 4

as representing a line of molecules of Ag Cl, chloride of silver arranged in its order order by the electric action as shown in outline 1. It is evident that there cannot be an action at each electrode which breaks up or pulls a molecule apart; such an action is shown in line 2, and it would result in both the chlorine and the silver appearing at each end of the chain. We are driven to the conclusion that such an action takes place as is shown in line 3, namely, in a complete interchange of the arrangement of all the molecules, forming the line of transmission; one element of the terminal molecules separates and becomes free, the other element, unburdened with the energy it is transmitting, breaks up the adjoining molecule, to which it is in fact the electrode, and forms a fresh molecule thus—

$$\overset{\ominus}{Ag\,Cl}\;Ag\,Cl\;Ag\,Cl\;Ag\,Cl\;\overset{\oplus}{Ag\,Cl}$$

the upper brackets showing the original order and the lower ones the new arrangement of molecules. I must defer the following out this subject to another time, and will now make a few remarks upon such criticisms as have so far appeared upon the first paper on this subject. As to Mr. FitzGerald, p. 153, I feel sure that it will be found that the difference between us, fundamental as it looks, will prove to be but very slight in reality, and of no consequences as to its results. He says, "it is almost certain that the modus operandi of electrical conduction is a rotation of molecules," and I hold that this rotation of molecules is what we measure as quantity and call electricity. I am interested in the addition he has made to my diagram, but it does not satisfy me; it seems to me that what he measures by it is the tension, or pressure in the pipes, not the inductive effect upon all surrounding matter, which is the distinction between the hydraulic and electric currents, when the tension is common to both.

"Ignorimus," p. 175, must allow me to defend my own position. I do not accept his statement that "Mr. Sprague agrees with Mr. Preece in choosing the latter horn of the dilemma," viz., that electricity must be either a "form of matter or a form of force, and that there is no other category in which to class it." I say there is another category. Electricity is simply a word, and like other words it has a variety of meanings; it practically embodies, links together, and confuses those two things, actions, or properties embodied in E and W, which both Mr. FitzGerald and myself seek to distinguish. Therefore, I cannot even accept altogether the modification of a form of energy instead of a form of force, although I have myself often used it. That which we call electricity and measure quantitively cannot be either force or energy, Mr. FitzGerald says it is matter—a special matter, I say it is a function or action of the molecules of all matter. I am hereticenough to doubt if it can be expressed by any combination of M L and T, but think it involves the introduction of a considerations (that is a fundamental quantity) belonging to the field of chemistry. The accepted mathematical formula I consider a mere artificial contrivance, having its uses in calculation, but representing no natural truth. But electricity is a word commonly employed to mean what is really energy, that which is embodied by W. This use of the word, general as it is, is a misconception and confusion which exist. Hence, in fact, Mr. Preece falls in the quotation referred to. When he was speaking of wire really electric-potential or energy, either force or energy? but he, like many others, has confused the two in the one word electricity. The result is not merely a dilemma, but a dilemma both of whose alternatives result in a *reductio ad absurdum*. But then the dilemma itself is a myth, we have to deal with phenomena, their cause, and the mode of action and production. If we call them by one name, what of it? There are conveniences enough in theological disputes where a word commonly accepted often serves to hide very different meanings, but science must be exact and define exactly what is meant by words. My friend Mr. Phillips, p. 184, seems to be meant by what he calls "my strange duality," a motion convertible and inconvertible into work. I thought my suggestion was clear enough, but I think a familiar illustration may be given, which will carry the idea into every mind, whether it carries my intention along with it not. Take a wheel or winch with a rope wound upon it connected to work to be done; we shall now have two distinct forms of motion—1. That of the winch or its axle; 2. That of the rope. The first of these may be called, and, if each term represents a given work, such as raising one article from one floor to another, these terms will represent "quantity," that is to say, so many articles lifted; but it is evident that this number or motion as the axle (which is the thing represented in my diagram 2) is to do some convertible work. It will be the same whether each single article raised be light or heavy, just as the one "quantity" of electricity sets upon one grain of hydrogen, or 108 of silver. I hence also it does and represent either force or energy, nor is it matter. But the other motion (linked though it be to the first) is converted into work; it, in fact, transmits the energy applied to the winch. Its velocity depends upon the relations of the diameters, and the energy represented by time continued by force of motion and tension on the rope will be as the square of the motion, or, what is the same thing, as the square of the first motion, which is the analogue of C or current in electricity, while the conditions of the second motion are analogous to the E × C or W or C², which measure the energy connected to the electric current, itself measured as C or as $\frac{E}{R}$. But does not Mr. Phillips rather beg the question when he says, "current is actually *my current*, in the sense that something analogous to a grain of water is actually transmitted?" That is just what is being debated, and I contend and hope to prove that *no thing* is actually transmitted, but only energy, causing motion. When he says "the binary action is such that metal is projected on one side, and the unknown E on the other," surely this is stating a mere hypothesis as though it were experimental fact. We know that metal or bases are projected on one side, and we know that an equivalent "action" is set free on the other side—*that is fact*. That the unknown E is acid, from is pure hypothesis. Of course, there can be no objection to any hypothesis on the mere ground that it is one; in fact, we are all at work upon hypotheses, and must needs be so in the field of atoms and molecules and their motions, seeing that their very existence is a matter of hypothesis; but let us clearly distinguish between a proved fact and a hypothesis, however probable.

The Electromagnet.

ON MAGNETIC CIRCUITS IN DYNAMO AND MAGNETO ELECTRIC MACHINES.—No. 2.

BY LORD ELPHINSTONE AND CHARLES W. VINCENT, F.R.S.E., F.C.S., F.I.C.

[Communicated by Professor G. G. Stokes, Sec. R.S. Received March 10, 1880.]

A large amount of magnetism is retained by the soft iron cores of electro-magnets, when arranged so as to form a complete magnetic circuit; and sparks and other indications of the passage of an electric current can be obtained at the end of the bells when surrounding these soft iron cores each time the masses of iron are separated and the closed magnetic circuit opened. In order to procure a spark, the breaking of the circuit

* Abstract of a Paper presented to the Royal Society, corrected by the Authors.

SCIENTIFIC AMERICAN SUPPLEMENT
MANUFACTURER AND BUILDER

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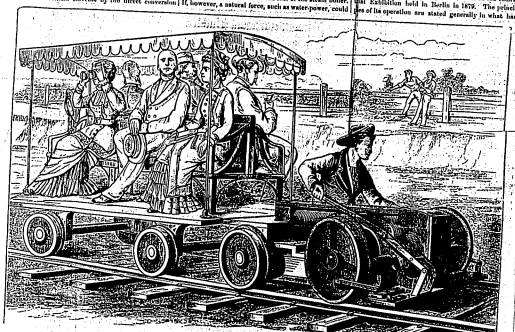
Electrical Railways.

The suggestion that electricity might be made to serve as a motive power for railways is not entirely a new one. The idea has been entertained for years, but until lately has remained an idea, or at best has found expression only in some scientific toy, which, like a baby, might or might not amount to something in time. The development and recent rapid perfection of dynamo-electric machines, however, which have given us what before was lacking—that is, a comparatively cheap means of generating and maintaining powerful electrical currents by the direct conversion of mechanical force into electricity, has supplied the long-sought-for means of supplying this agent to us in such variety of practical uses, for which its cost and ubiquity have no insuperable obstacle. For, as most of our readers will be aware, these machines have practically solved the problem of the cheap production of electricity, enabling us to convert mechanical energy—no matter how generated, whether from steam engine, wind, or waterfall—directly into electricity, and have opened up a wide field of speculation as to the possible extensive introduction of electric engines to do the work of steam, over which it possesses a number of advantages, the most obvious of which resides in the fact, that it may be transmitted with very little loss over great distances by metallic conductors, and made to drive electrical engines located at distant points, or to furnish light for towns, cities, etc. The practicability of the use of electricity was tersely presented before the British Iron and Steel Institute in the following terms: The president of that association declared that, so long as the source of electrical power depended upon the galvanic (chemical) battery, it must, in the present state of things, remain far more expensive than steam power, for the obvious reason that zinc, which is the fuel of the galvanic battery, is vastly more expensive than coal—the fuel of the steam boiler. If, however, a natural force, such as water-power, could be utilized to generate electricity economically, the case would be very different. A dynamo-electric machine, driven by water power, could be made to generate powerful electrical currents, which could be transmitted through insulated metallic conductors to a great distance with but little loss, comparatively speaking, and could then be made to run magneto-electric engines to do the work of steam in our factories and workshops, to ignite electric lamps, etc.

We have cited the foregoing simply in verification of our statement of the possible future substitution of electricity for steam power on an extensive scale. It will be apparent also to our mechanical readers that there may be numerous cases where it will be advantageous on the score of convenience, if not of economy, to employ steam-driven dynamo-electrical machines, not only for the production of light, for which use they have already been very largely introduced, but also for the production of mechanical effect. It is on this principle that the latest novelty in the application of electricity—the electrical railway—is based.

The credit of having first practically demonstrated the possibility of success in this direction must be accorded to Dr. Siemens, who constructed and operated a electrical railway as a practical aids at the Industrial Exhibition held in Berlin in 1879. The principles of its operation are stated generally in what has preceded—that is, the conversion of motive force into electricity, and the conversion of the current back again into motive force. The details will be sufficiently clear from the following explanations: If we have two dynamo-electric machines, designated as A and B, which we connect by metallic conductors, they form a complete system for the transmission of power. Motion imparted to the machine A will generate an electrical current, which the machine B will convert back again into motive power. "In the electric railway of Dr. Siemens, the machine A is driven by a stationary engine located at one end of the road; the rails are used as conductor, the current generated by the machine A being taken from an insulated



EDISON'S ELECTRICAL RAILWAY.

roll by a metallic brush, actuates zanzibar B, its motion being communicated by suitable gearing to wheels on which it is mounted, and the current is returned to the electric generator by the ordinary unisolated rails.

Mr. Edison, it appears, has been turning his attention to this same interesting problem, and has lately constructed an electrical railway at Menlo Park, with, which some practical experiments have been made with very promising results. The railway in question is a circle about half a mile long. The motive is substantially one of Mr. Edison's electrical generators, the motive power being supplied by a stationary engine, and this power converted into electricity by a similar generator. The general principles of this arrangement are, therefore, identical with those employed by Siemens. The details, so far as they have been given, however, appear to be somewhat different. In Mr. Edison's arrangement, the electrical current from the stationary generator is conveyed to the track by two copper wires, one wire being connected with each rail at the proper time full details of the motor and of its operation are promised. The design of the experiment is said to be to test the applicability of this system for the use of mining districts, large farms, plantations, etc. What its future development may be no one can affirm. Dr. Siemens has already progressed so far with his system as to have applied to the municipal authorities of Berlin for permission to erect an elevated electric railway across that city, so that no question exists as to the score of practicability. It is not at all unlikely that in the not very remote future we may have electrical tramways and elevated railways in common use in our cities.

Mr. Edison's motor, on a recent trial trip, developed a speed estimated at about 25 to 30 miles per hour, and he claims to realize 70 per cent of the power supplied to the generator. The engraving on the preceding page shows the general appearance of this novel railway and its equipments.

such a system is provided, namely, the kerosene works of the Downer Company at South Boston, and the workshops of Morris, Tasker & Company of Philadelphia; in the first named, the effectiveness of this safeguard has repeatedly demonstrated itself; in the second, the opportunity of testing its utility has happily not yet been afforded.

The arrangement is extremely simple. A series of independent steam pipes lead from the boiler-room to the several departments of the works, while one of the most open and easily accessible positions on the ground floor is chosen as the place where the steam service may be controlled. At this place (in the case of Morris, Tasker's & Co's. works), the pipes leading to the different quarters of the works, are painted, each of a different color, and for additional security against mistakes in the excitement of the moment, the name of the department to which it leads is printed in distinct letters on each of these, and the threatened apartment can be instantly deluged with steam by the simple turning of the appropriate valve, so soon as warning of the danger is given.

A similar plan could be readily adapted to large buildings like churches, public halls, theaters, etc., wherever steam is used for heating purposes, and would doubtless amply prove its efficiency should occasion call for its use.

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A Nuisance that should be Abated.

One of our contemporaries, in referring lately to the immense increase in telegraphic communication, and the rapid improvement of telegraphic methods, and extending to the visible evidences of these facts, in the net-work of wires stretching from building to building and from chimney to pole, which everywhere meet the eye in our cities and towns, designates the age we live in, as the "wire-age." The term is not inappropriate, but it would be, we submit, in better keeping with the eternal fitness of things, if the wonderful progress in telegraphy that we refer to above, had been accompanied with similar progress in telegraphic service. America has played a distinguished part in the tele-

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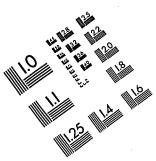

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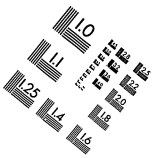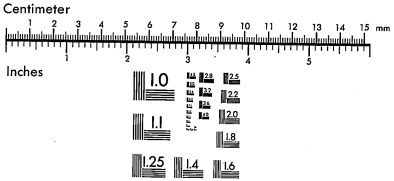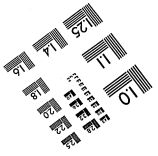
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